Y6

R: Shapes

C: Reflection (in a line/point). Line and rotational symmetry

E: What is the rule? Different geometric transformations

Lesson Plan 81

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>81</u> = $3 \times 3 \times 3 \times 3 = 3^4$ (= $9 \times 9 = 9^2$, so a <u>square</u> number)
  Factors: 1, 3, 9, 27, 81
- <u>256</u> = $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^8$
  (= $16 \times 16 = 16^2$, so it is a <u>square</u> number)
  Factors: 1, 2, 4, 8, 16, 32, 64, 128, 256
- <u>431</u> is a <u>prime</u> number Factors: 1, 431
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, 23 and $29 \times 29 > 431$)
- <u>1081</u> = 23×47 Factors: 1, 23, 47, 1081

Notes:

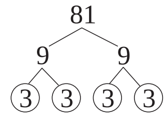
Individual work, monitored (or whole class activity)

BB: 81, 256, 431, 1081

Calculators allowed.

Reasoning, agreement, self-correction, praising

e.g.



256	2
128	2
64	2
32	2
16	2
8	2
4	2
2	2
1	

1081	23
47	47
1	

7 min

2

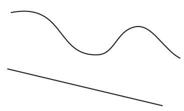
Lines and angles

Ps have rulers (and set squares if possible), or allow freehand drawing.

T gives instructions on what Ps should draw and label. After each instruction, T quickly monitors all pupils and asks a P to show an example on the BB. Class agrees/disagrees. Mistakes corrected.

a) i) Draw a curved line. BB: e.g.

ii) Draw a straight line.

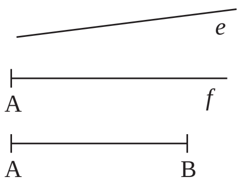


b) Draw and label appropriately:

i) a straight line

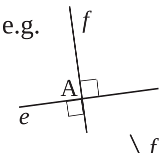
ii) a <u>half line</u> or <u>ray</u>.

iii) a <u>line segment</u>

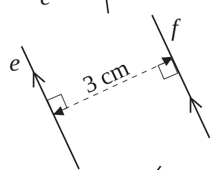


c) Draw a line, *e*, and mark a point, A, on it.
Draw a line <u>perpendicular</u> to line *e* at point A.
How can we show that they are perpendicular?
(Mark the angle with a square.)

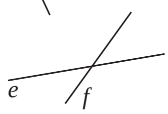
e.g.



d) Draw and label 2 parallel lines 3 cm apart.
How can we show that they are parallel?
(Mark with single arrows.)

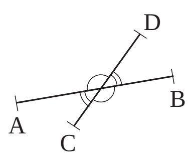


e) i) Draw two lines, *e* and *f*, which <u>intersect</u> one another.



ii) Draw two line segments, AB and CD, which <u>intersect</u> one another.

What do you notice about the angles formed?
(The <u>opposite</u> angles are equal.)



Notes:

Quick individual activities but the whole class kept together

T monitors, helps, corrects.

After each drawing, Ps say what they know, or T elicits:

- straight lines extend in both directions to infinity and the ends never meet.
- lines are usually labelled with small letters and points with capital letters.
- a ray extends from a point to infinity in one direction.
- line *f* extends beyond A
- each of the 4 angles formed is 90°.
- the distance between two lines is the <u>perpendicular</u> distance between them; parallel lines never meet, however far they are extended.
- <u>intersect</u> means 'cut or 'cross'.

Ps mark the equal angles on BB and on own drawings.
(1 arc for 1st pair, 2 arcs for 2nd pair)

Y6

Lesson Plan 81

Activity		*Notes*

2

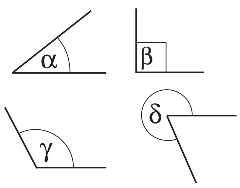
(Continued)

f) Draw: i) an <u>acute</u> angle BB: e.g.

ii) a <u>right</u> angle,

iii) an <u>obtuse</u> angle

iv) a <u>reflex</u> angle.



T asks Ps for examples of sizes of angles for each type, then elicits their limits.

BB: $0° < \text{acute angle} < 90°$, right angle $= 90°$,
$90° < \text{obtuse angle} < 180°$,
$180° < \text{reflex angle} < 360°$

15 min

Notes: Elicit that angles are usually labelled with Greek letters.

α (alpha), β (beta),
γ (gamma), δ (delta)

Which types of angles are missing?

(null angle $= 0°$,
straight angle $= 180°$,
whole angle $= 360°$)

3

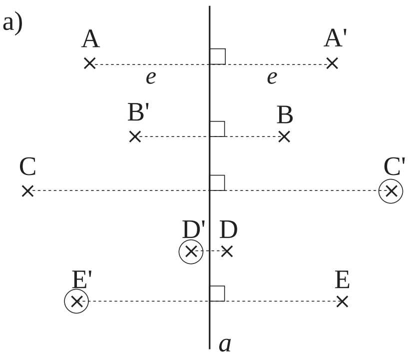
Reflection

In a PE lesson, Ps were put in pairs and told how to stand in a certain relationship with one another. What could the relationship be? Where should the missing pupil from each pair stand?

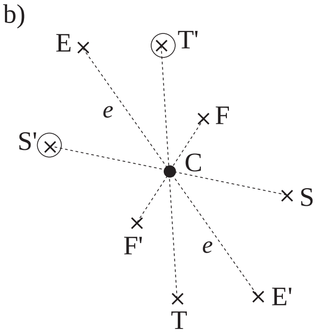
Ps study the diagram to find the 'rule' then come to BB to mark the missing points. Class agrees/disagrees. Elicit what the rule is and the main points about it. (T draws the dotted lines and squares on diagram.)

BB:

a)



b)



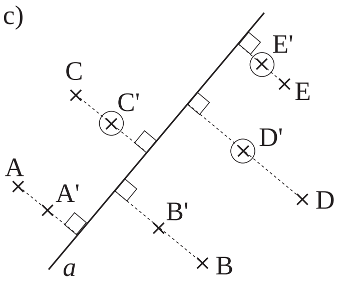
<u>Reflection</u> in the line *a*.

A and its *mirror image* A' are the <u>same</u> perpendicular distance on line *e* , from line *a*.

<u>Reflection</u> in the point C.

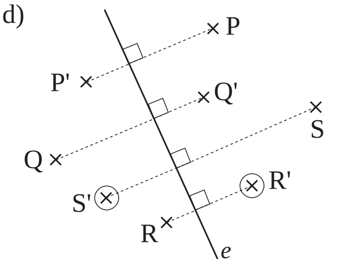
E and its mirror image, E', are an <u>equal</u> distance from point C on line *e*.

c)



A' is half as far from line *a* as A on the same perpendicular line as A and on the same side of line *a* as A.

d)



P' is half as far from line *e* as P on the same perpendicular line as P but on the opposite side of line *e* .

24 min

Notes: Whole class activity

Drawn (stuck) on BB or use enlarged copy master or OHP

(or use real Ps and a line or point in the classroom to form the patterns)

Note: The points circled are <u>not</u> given but added by Ps.

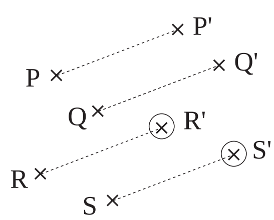
T helps with the drawing (or placing if using real Ps) if necessary, with the aid of a BB ruler or metre rule.

In good humour, at a quick pace

Discussion, agreement, praising

Feedback for T

e)



<u>Translation</u> by the same distance to the right and up (or by the same angle) each time.

The lines PP', QQ', RR' and SS' are all parallel.

Y6

Lesson Plan 81

Activity | **Notes**

4

PbY6b page 81*, *Q.1

Read: *What has been done to Triangle 1 to form the other shapes? Describe each transformation in your exercise book*

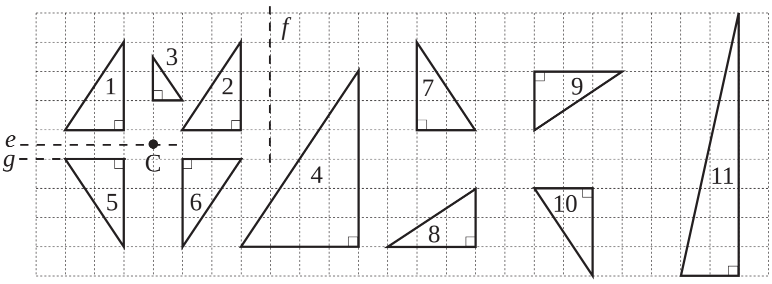
Ps come to BB to point out the relevant pairs of triangles and explain the transformations. Class agrees/disagrees. Ask Ps to draw the *mirror lines* or points of reflection, to say the scale of enlargement or reduction and to give the angle of rotation where relevant.

Agree on a good way to list the transformations in *Ex. Bks*.
T suggests the form below if no P has an idea. After agreement, Ps write the transformation in *Ex. Bks*.

Extension

Ask Ps to point out other relationships too (e.g. 7, 8, 9 and 10) and to show congruent and similar triangles.

Solution:



1 $\rightarrow$ 2: translation (4, 0)

1 $\rightarrow$ 3: reduction, reflection, translation

1 $\rightarrow$ 4: enlargement (2:1), translation

1 $\rightarrow$ 5: reflection in line *e*

1 $\rightarrow$ 6: reflection in point C

1 $\rightarrow$ 7: reflection in line *f*

1 $\rightarrow$ 8: reflection in horizontal axis, rotation by $90°$, translation

1 $\rightarrow$ 9: reflection in vertical axis and rotation by $-\ 90°$ (i.e. clockwise)

1 $\rightarrow$ 10: reflection in line *g* , then translation by (16, 0)

1 $\rightarrow$ 11: stretch vertically (same width but 3 times as high)

Notes:

Whole class activity

Drawn on BB or use enlarged copy master or OHP

If possible, T has *Triangle 1* cut out to show the actual movements to the class.

At a good pace.

Discussion, reasoning, agreement, demonstration with model where possible

Elicit that in a reflection, the corresponding points on the original shape and its mirror image are the same perpendicular distance from the *mirror line* or axis.

Praising, encouragement only

Expect only the name of each transformation from less able Ps, but some details from the more able Ps. e.g.

1 $\rightarrow$ 3: we say that the ratio of reduction is 1 : 2 (the value of the image is given first);
or we say that it is a reduction by scale factor 1 half,
i.e. *triangle 3* is half the size of *triangle 1*;

1 $\rightarrow$ 4: we say that the ratio of enlargement is 2: 1, or it is enlargement by scale factor 2.

30 min

5

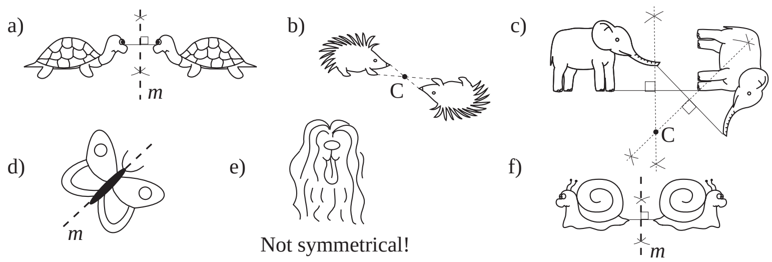
PbY6b page 81*, *Q.2

Read: *Draw the lines of symmetry and mark the centres of rotation.*

Set a time limit of 3 minutes. Expect only rough freehand drawing first and then discuss afterwards with the whole class how to draw the lines of symmetry and mark the centres of rotation accurately.

Review with whole classs. Ps come to BB to draw, mark and label. Class agrees/disagrees. If no P shows the accurate method, demonstrate with BB compasses and ruler, involving Ps where possible.

Solution:



Notes:

Individual work, monitored, helped

Use enlarged copy master or OHP

Discussion, agreement, self-correction, praising

Extra praise for Ps who remember how to construct the lines/points accurately.

(Instructions given on following page.)

e) The dog looks symmetrical at first sight but on closer inspection, the RHS of the dog is not exactly a *mirror image* of the LHS.

34 min

Y6

Lesson Plan 81

Activity ***Notes***

To Ts:

To draw a line of symmetry

Choose a point on the shape and its corresponding *mirror image*.

Set compasses to the distance between them. Put the compasses on one chosen point and draw arcs above and below it. Repeat with the other chosen point. Draw a straight line through the points where the arcs cross. This is the line of symmetry.

It is the perpendicular bisector of the line between the two chosen points (i.e. it is at right angles to it and cuts it in half).

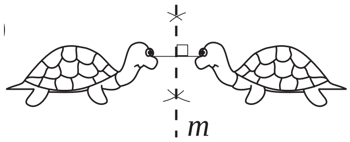
To mark a centre of rotation

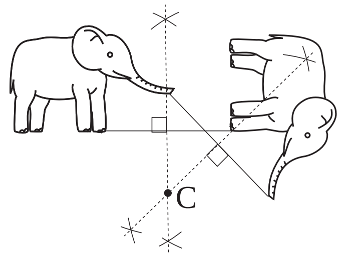
Choose a point on the shape and its corresponding *mirror image*. Construct the perpendicular bisector of the line between them.

Repeat with another pair of corresponding points. (If necessary, extend the perpendicular bisectors so that they intersect.) The point of intersection is the centre of rotation.

It is an equal distance from both points in any corresponding pair.

Notes: e.g.





6

PbY6b, page 81

Q.3 a) Read: *On a coordinate grid, draw a* ***pentagon*** *with vertices at these points.*

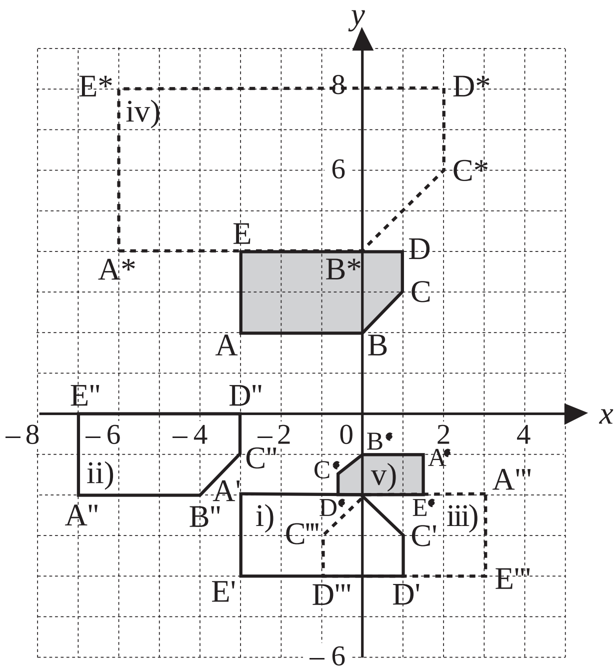
A (– 3, 2), B (0, 2), C (1, 3), D (1, 4), E (– 3, 4)

Elicit that the first number in the brackets is the *x* coordinate (horizontal axis) and the 2nd number is the *y* coordinate (vertical axis).

Set a time limit of 1 minute. Ps draw on grid sheets or in squared *Ex. Bks*. P finished first draws shape on BB or OHT. Class agrees/disagrees. Ps correct any mistakes.

What can you say about the pentagon? (irregular, convex)

Solution: (shapes in part b) are also shown in this diagram)



Notes:

Individual work, monitored, helped

Grid drawn on BB or use enlarged copy master or OHP

Ps could have copies of copy master grid too.

(Or T could have shape already prepared on OHT)

Discussion, agreement, self-correction, praising

Images of the original shape are labelled appropriately.

e.g.

ABCDE

A'B'C'D'E'

A"B"C"D"E"

A'''B'''C'''D'''E'''

A*B*C*D*E*

A•B•C•D•E•

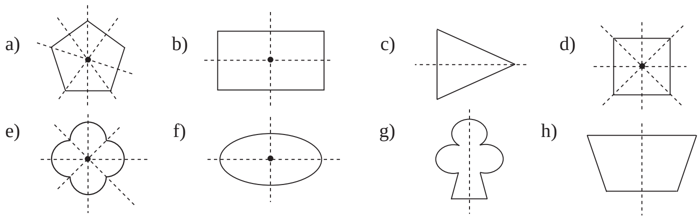
If preferred, in part b) Ps could use a different grid for each new image, so that the labelling is clearer.

Y6		*Lesson Plan 81*
Activity		***Notes***
6	(Continued) b) Read: *Change the coordinates of the points according to the instructions and draw the new shapes.* *Describe how the original pentagon's shape and size changes.* Deal with one part at a time. Set a short time limit. Ps first write the coordinates of the new points in *Ex. Bks* then draw the new shape and label its vertices appropriately. T chooses Ps to work on grid on BB or OHT. Ps compare their drawing with the one on BB and any mistakes are discussed and corrected. Elicit the type of transformation used. *Solution:* (Diagrams shown on previous page) i) *Keep the x coordinate the same and multiply the y coordinate by (– 1).* A' (– 3, – 2), B' (0, – 2), C' (1, – 3), D' (1, – 4), E' (– 3, – 4) Transformation: <u>Reflection</u> in the *x* axis. ii) *Subtract 4 from both coordinates.* A'' (– 7, – 2), B'' (– 4, – 2), C'' (– 3, – 1), D'' (– 3, 0), E'' (– 7, 0) Transformation: Translation by (– 4, – 4). iii) *Multiply both coordinates by (– 1).* A''' (3, – 2), B''' (0, – 2), C''' (– 1, – 3), D''' (– 1, – 4), E''' (3, – 4) Transformation: Reflection in the origin, i.e. the point (0, 0). iv) *Multiply both coordinates by 2.* A* (– 6, 4), B* (0, 4), C* (2, 6), D* (2, 8), E* (– 6, 8) Transformation: Enlargement (2 : 1, or by scale factor 2) v) *Divide both coordinates by (– 2).* A• (1.5, – 1), B• (0, – 1), C• (– 0.5, – 1.5), D• (– 0.5, – 2), E• (1.5, – 2) Transformation: Reduction (1 : 2, or by scale factor 1 half) c) Read: *List the **similar** shapes.* What are similar shapes? (They are the same shape but not necessarily the same size.) Elicit the symbol for 'similar to' (~) and agree that <u>all</u> the 6 shapes are similar to one another. d) Read: *List the **congruent** shapes.* What are congruent shapes? (The same shape and size.) Elicit the symbol for 'congruent to' (≅). Ps come to BB or dictate to T. Class agrees/disagrees. *42 min*	(or T has images already prepared on OHT.) When writing the ratio of enlargement/reduction, the value of the image is usually written first. or rotation by 180° around the point (0, 0) BB: ABCDE ~ A'B'C'D'E' . . . ~ A•B•C•D•E• BB: ABCDE ≅ A'B'C'D'E' ≅ A''B''C''D''E'' ≅ A'''B'''C'''D'''E'''

Y6

Lesson Plan 81

Activity		*Notes*
7	***PbY6b, page 81***	
	Q.4 Read: *Draw the lines of symmetry and mark the centres of rotation.*	Individual work, monitored (or whole class activity if time is short)
	Set a time limit of 2 minutes. Ps can draw freehand or use rulers.	
	Review quickly with whole class. Ps come to BB to draw lines and mark dots. Class agrees/disagrees. T could have the shapes cut out for demonstration by folding or turning in case there is disagreement.	Drawn (stuck on BB) or use enlarged copy master or OHP Discussion, agreement, self-correction, praising
	Which of the shapes are polygons? (a, b, c, d and h)	Elicit that the centre of rotation within a shape is the point where the lines of symmetry intersect.
	Solution:	



45 min

Y6

R: Shapes with line and rotational symmetry

C: Review: translation, rotation, similarity and congruence

E: Recognising where a shape will be after two translations

Lesson Plan *82*

Activity | *Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 82 = 2×41 Factors: 1, 2, 41, 82
- 257 s a prime number Factors: 1, 257
  (as not exactly divisible by 2, 3, 5, 7, 11, 13 and $17 \times 17 > 257$)
- $432 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 = 2^4 \times 3^3$
  Factors: 1, 2, 3, 4, 6, 8, 9, 12, 16, 18
  432, 216, 144, 108, 72, 54, 48, 36, 27, 24
- 1082 = 2×541 Factors: 1, 2, 541, 1082
  (and 541 is a prime number, as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 23, and $29^2 > 541$)

Notes: Individual work, monitored (or whole class activity)

BB: 82, 257, 432, 1082

Calculators allowed.

Reasoning, agreement, self-correction, praising

e.g.

432	2
216	2
108	2
54	2
27	3
9	3
3	3
1	

1082	2
541	541
1	

6 min

2

Translation and rotation

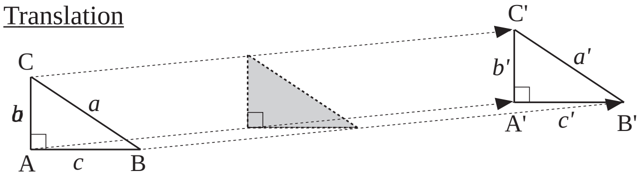
a) Translation

1. Draw around the triangular shape on the left-hand side of one of the white sheets of paper and also on the tracing paper.
2. Place the tracing paper over the white sheet so that the two shapes line up exactly.
3. Slide the tracing paper to the right and up (about 8cm) over the white sheet but without turning it.
4. Pierce the vertices of the shifted triangle through the tracing paper, then draw its new position on the white sheet.
5. Very lightly draw the path of each vertex by joining up the corresponding vertices using a ruler.
6. Using the original card shape, show the movement again. What kind of movement is it? (Translation)

What can you say about a translation? (e.g. the shape moves in the same plane; it moves in a staight line, it does not turn.)

Let's label the vertices and sides of the two triangles on the white sheet. Ps dictate the labels to T and also label their own shapes. (e.g. A' is the image of A, B' is the image of B, etc.)

BB: Translation



Who can tell me true statements about the translations?
How could we write it using mathematical notation?

(e.g. a = a', a || a', $\angle$A = $\angle$A', AB is not in the same line as A'B', AA' = BB' = CC', ABC $\cong$ A'B'C', etc,)

Extension

T: We say that AA', BB' and CC' are vectors because they show a movement by a certain distance in a certain direction.

Notes: Whole class activity but individual drawing and manipulating shapes

On desks, Ps have a right-angled triangle cut from thick coloured card, 2 sheets of plain white paper, a sheet of tracing paper, a ruler and a pair of compasses.

T gives instructions and monitors, helps, corrects.

Demonstrate on BB too.

Extra praise if a P can write it on BB.

Praising

Praising, encouragement only

Involve several Ps.

BB: Vectors

$\overrightarrow{AA'} = \overrightarrow{BB'} = \overrightarrow{CC'}$

Y6		*Lesson Plan 82*
Activity		***Notes***

2

(Continued)

b) Rotation

1. Draw around the coloured triangle on the other white sheet.
2. Place the tracing paper over the white sheet so that the shapes line up exactly.
3. Pierce the two sheets of paper with the pointed arm of your compasses at a point below the shapes and without letting go of your compasses, label the point O.
4. Turn just the tracing paper around point O by about $60°$.
5. Pierce the vertices of the triangle on the tracing paper so that its new position is marked, then draw the triangle on the white sheet.
6. Check that you are correct by repeating the turn with the tracing paper.
7. Very lightly, using your compasses, draw the path of each vertex on the white sheet.
8. Using the original card shape, show the movement again. What kind of movement is it? (Rotation)

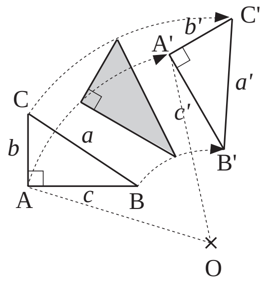
Notes: T gives instructions and monitors, helps, corrects. Demonstrate on BB too using BB compasses and BB ruler. Praising, encouragement only

What can you say about a rotation? (e.g. the shape turns around a certain point in a plane; corresponding vertices stay an equal distance from that point)

Notes: BB: Rotation
motion in an arc
around a central point

Let's label the vertices and sides of the two triangles on the white sheet. Ps dictate the labels to T and also label their own shapes. (e.g. $A \rightarrow A'$, $B \rightarrow B'$, etc.)

BB: Rotation



Who can tell me true statements about the rotation? T writes them on BB using mathematical notation.
(e.g. $a = a'$, $\angle A = \angle A'$, $OA = OA'$, $ABC \cong A'B'C'$, etc,)

Notes: Involve several Ps. Praising only

T shows translations and rotations with other shapes on BB or OHT and Ps say which type of transformation it is.

Notes: Class shouts out in unison.

20 min

Y6

Lesson Plan 82

Activity		*Notes*

3

PbY6b, page 82

Q.1 Read: *A boat sailed fron one bank of the river to the opposite **parallel** bank, staying **perpendicular** to both banks during the crossing.*

This drawing shows the positions of the boat seen from above at equal intervals of time. The arrow shows the direction in which the river was flowing.

Complete the drawing.

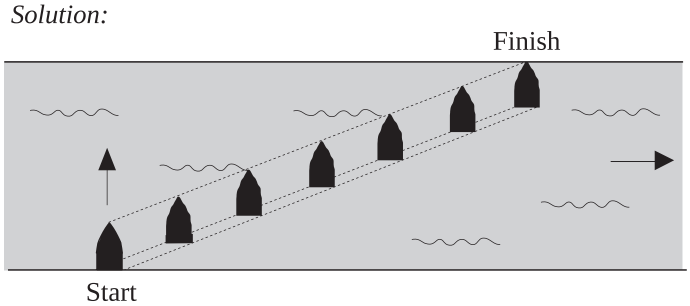
Think about what we have been doing and what you could do first to help you draw the boats. I will give you 2 minutes.

Review with whole class. P comes to BB to complete the drawing, explaining what he or she is doing. Who did the same? Who did it another way? Come and show us. Which method do you think is best? Why?

Agree that it is easier and more accurate to draw the paths of the 3 vertices lightly in pencil first, then to draw the boats.

What kind of transformation is it? (Translation)

Solution:



24 min

Notes:

Individual work, monitored closely, less able Ps helped

Drawn on BB or use enlarged copy master or OHP

Elicit what parallel and perpendicular mean.

Differentiation by time limit.

Demonstration, agreement, self-correction, praising

(If no P drew the paths of the vertices, T shows this method and asks what Ps think of it.)

Ps who did not do it, draw the translation lines now to check that their boats are accurate.

4

PbY6b, page 82

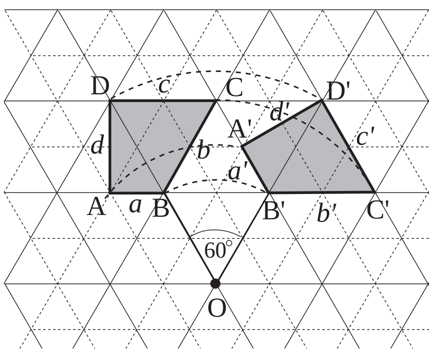
Q.2 a) Read: ***Rotate t**rapezium ABCD by* $60°$ *around the point O in a clockwise direction and show its route on the triangular grid.*

First elicit that the grid lines form angles of $60°$ and in a rotation, the corresponding points on the shape and its image are the same distance from the centre of rotation.

Set at time limit. Ps use protractors to measure the angle of turn and compasses to draw the rotation arcs. Ps label the image appropriately.

Review with whole class. Ps come to BB or draw the rotation and label it. Class agrees./disagrees. Mistakes discussed and corrected.

Solution:



Notes:

Individual work, monitored, less able Ps helped

Drawn on BB or use enlarged copy master or OHP

Make sure that Ps have the correct rotation before they complete the statements.

Agreement, self-correction, praising

T could have a cut out trapezium to demonstrate the motion.

T draws 2 radii to (e.g. OB and OB') to show the $60°$ turn clockwise.

Ps do the same in *Pbs* and use protractors to check the angle.

Y6

Lesson Plan 82

Activity ***Notes***

4

(Continued)

b) Read: *Complete the statements.*

Set a time limit of 1 minute. Review with whole class. Ps come to BB or dictate to T. Class agrees/disagrees. Mistakes discussed and corrected.

Agreement, self-correction, praising

Agree that in a rotation, the shape does not change – it moves in an arc in the plane around a centre point O.

Ps point out the relevant components on the diagram on BB.

Solution:

A'B' = AB $a' = a$

B'C' = BC $b' = b$

C'D' = CD $c' = c$

D'A' = DA $d' = d$

$\angle$ B' = $\angle$ B $\angle$C' = $\angle$ C

B'D' = BD A'C' = AC (diagonals)

A'B'C'D' $\boxed{\cong}$ ABCD (congruent)

Ps might point out that the two shapes are also <u>similar</u>.

A'B'C'D' ~ ABCD

30 min

5

PbY6b, page 82

Q.3 Read: *a) Draw these rectangles in your exercise book.*

*b) List the **similar** rectangles.*

*c) List the **congruent** rectangles.*

Individual work, monitored, helped

Ps use squared *Ex. Bks* or squared 1 cm or 5 mm grid sheets.

Set a time limit. Ps should use rulers to draw the rectangles.

Ask quicker Ps to calculate the perimeter and area of each rectangle

Differentiation by time limit.

Review with whole class. T has rectangles already prepared or Ps finished early could have drawn them on squared BB or grid on OHT. Ps compare them with their own drawings and correct any mistakes.

Discussion, agreement, self-correction, praising

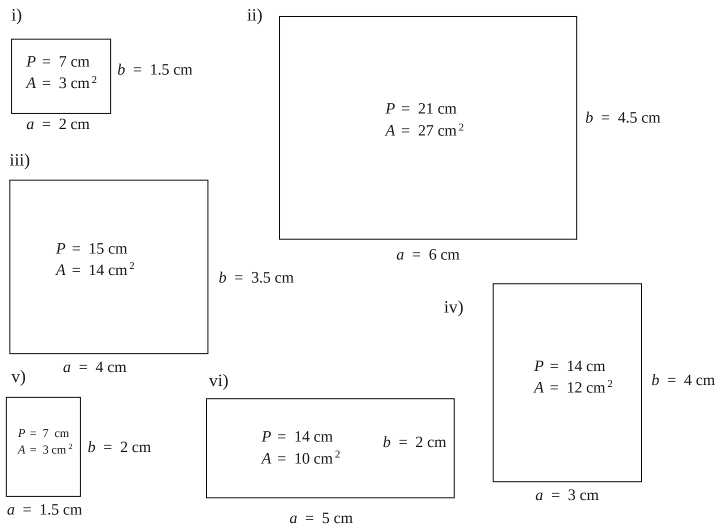
Elicit the general formulae for perimeter and area then Ps come to BB or dictate to T. Class agrees/disagrees. Mistakes corrected.

BB: $P = 2 \times (a + b)$

$A = a \times b$

Ps dictate the similar and congruent rectangles.

Solution: (actual size has been reduced)



<u>Similar rectangles</u>:

i) ~ ii) ~ iv) ~ v)

Ask Ps for the <u>ratio</u> of the sides in pairs of similar shapes. e.g.

i) : ii) = 1 : 3

iv) : v) = 2 : 1

[Note that ii) and v) are similar even though the sides are not named respectively.]

<u>Congruent rectangles</u>:

i) $\cong$ v)

[in v) the values of *a* and *b* have been exchanged, but the shape is still congruent to i)]

38 min

Y6

Lesson Plan 82

Activity		*Notes*
6	***PbY6b, page 82***	Individual work, monitored

Q.4 Read: *A sprinkler was moved 60 m E from its 1st position to its 2nd position, then 30 m SW from its 2nd position to its 3rd position.*

a) On the sketch, draw the direct route between its 1st and 3rd positions.

b) Measure this distance on the sketch and calculate its real length in metres.

(or whole class activity if time is short)

Drawn on BB or use enlarged copy master or OHP

(for demonstration only)

T asks a P to come to BB to explain what has been done and what is required to be done in his or her own words, referring to the diagram as necessary.

Extra praise if a P explains clearly without help

What kind of transformation will the direct route be? (translation)

BB: <u>Translation</u>

Set a time limit of 4 minutes. Ps use rulers, or rulers and compasses, to draw and measure.

Remind Ps to draw an arrow-head to show the direction of motion.

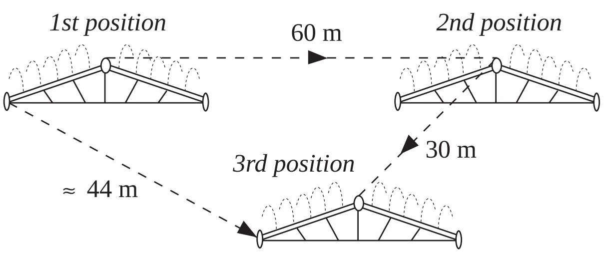
Review with whole class. Ps show solutions on scrap paper or slates on command. Ps with different answers explain reasoning at BB. Class decides who is correct. Mistakes discussed and corrected. Agree on the scale for the drawing, then Ps write it beside the diagram in *Pbs*.

Answers shown in unison.

Reasoning, agreement, self-correction, praising

Solution:

$\boxed{\textit{Scale: } 1 \text{ cm} \rightarrow 10 \text{ m}}$



Length of direct route on diagram ≈ 4.4 cm

Length of direct route in real life ≈ <u>44 m</u>

Or

length on diagram: 6 cm

length in real life: 60 m

= 6000 cm, so

Scale: 6 : 6000

or 1 : 1000

45 min

Y6

R: Polygons: labels and names

C: Reflection in a mirror line (axis)

E: Mirror images which touch or cross the original shape

Lesson Plan 83

Activity | ***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 83 is a prime number   Factors: 1, 83

  (as not exactly divisible by 2, 3, 5, 7 and $11 \times 11 > 83$)
- 258 = $2 \times 3 \times 43$ Factors: 1, 2, 3, 6, 43, 86, 129, 258
- 433 is a prime number   Factors: 1, 433

  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19 and $23^2 > 433$)
- 1083 = $3 \times 19 \times 19 = 3 \times 19^2$

  Factors: 1, 3, 19, 57, 361, 1083

Notes:

Individual work, monitored (or whole class activity)

BB: 83, 258, 433, 1083

Calculators allowed.

Reasoning, agreement, self-correction, praising

e.g.

$$\begin{array}{r|l} 258 & 2 \\ 129 & 3 \\ 43 & 43 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1083 & 3 \\ 361 & 19 \\ 19 & 19 \\ 1 & \end{array}$$

7 min

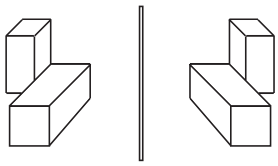
2

Reflection 1

T shows the class two solids (each the *mirror image* of the other). Are these solids the same? (Some Ps might think so, but others might notice that the vertical cuboid is to the left of the horizontal cuboid on one solid and to to the right on the other, so the solids are not congruent.

T stands the solids in symmetrical positions on either side of a line on T's desk or on a table in front of class.

e.g.



mirror

a) T holds a mirror vertically on the line so that it faces the LH solid and asks a few Ps to come look in the mirror one after the other and tell the class what they see. e.g.
   - The horizontal cuboid in the LH solid is nearest the mirror and so is the horizontal cuboid in the *mirror image*.
   - The vertical cuboid in the LH solid is furthest from the mirror and so is the vertical cuboid in the *mirror image*.
   - The *mirror image* of the LH solid is as far from the mirror as the LH solid but on the opposite side of the mirror.
   - The *mirror image* of the LH solid looks like the RH solid.

b) T reverses the mirror and again holds it on the line but this time facing the RH solid. What can you see now?

   Other Ps come to look in the mirror and tell the class what they see. (Similar comments to a) but reversed.)

c) T asks a P to look in the mirror and concentrate on the mirror *mirror image* of the RH solid , then T quickly replaces the mirror with a transparent glass. Is the *mirror image* in exactly the same position as the LH solid? (P will probably agree that it is but if not, ask other Ps what they think.)

Notes:

Whole class activity,

Initial discussion about the two shapes. Praising only

Mark positions beforehand.

Each solid is made from two cuboids stuck together (card, wood or multilink cubes).

Involve as many Ps as possible in the activity.

Agreement, praising

Agreement, priasing

Ps might suggest measuring the distance between each solid and the mirror to check that they are the same.

Y6

Lesson Plan 83

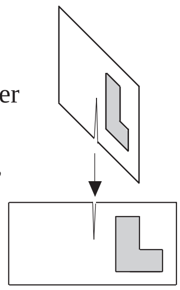
Activity		*Notes*
2	(Continued) d) T asks a P to hold his or her left hand in front of the mirror. What do you notice? (It's as if I am looking at my right hand.) How could you see a left hand in the mirror? (Hold my right hand in front of the mirror.) Could a right hand be the *mirror image* of a right hand? (No, that is impossible.) e) Ask Ps to position a pair of shoes (or other solids) so that they are *mirror images* of one other.	Agreement, praising Class agrees/disagrees before T checks with the mirror.

15 min

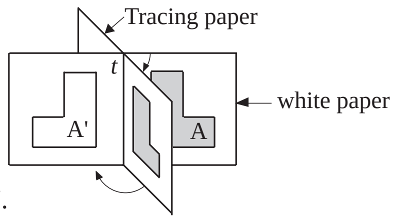
3 Reflection 2

Ps have two congruent rectangles (one of white paper and one of tracing paper) on desks. T gives instructions and demonstrates with a large model and Ps follow.

1. Fold each rectangle in half and crease the fold.
2. Draw the letter 'L' on the RH side of the white paper and colour it. Label it A.
3. Lay the tracing paper exactly over the white paper, trace the 'L' and colour it.
4. Cut halfway along the fold from the top of the white paper down and from the bottom of the tracing paper up and fit them together. Label the fold line *t*.



5. Rotate the tracing paper around the fold line *t* by 180°.
   Pierce the vertices of the shape through the tracing paper onto the LHS of the white sheet and then draw the shape. Label it A'.



What can you say about shape A and shape A'? e.g. (They are congruent shapes but facing in opposite directions. They are equal perpendicular distances from *t* but on opposite sides. The top and bottom horizontal sides are on the same line. The longest vertical sides are nearer the mirror line and the shortest further away. etc.)

T: We say that shape A' is the reflected image or the *mirror image* of shape A in the axis *t*. Let's check it with the mirror.
How did we get from A to A'? (Rotation out of the plane around line *t* by 180°.)

Elicit that shape A cannot be moved onto shape A' within the plane of the sheet of paper. It has to be moved out of that plane and turned over.

Demonstrate on BB with a cut-out shape A to prove it.

21 min

Notes:

Individual or paired work monitored, helped

T has large versions for demonstration.

(or to save time, T could have the 2 sheets already prepared then Ps will only need to fix them together.)

Encourage Ps to work carefully and accurately.

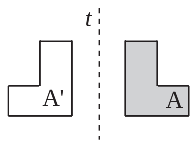
Ps use a sharp pencil or the point of a pair of compasses.

Whole class discussion

Involve several Ps

Agreement, praising only

BB:

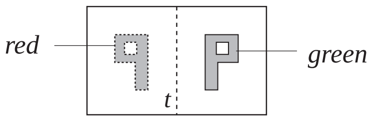
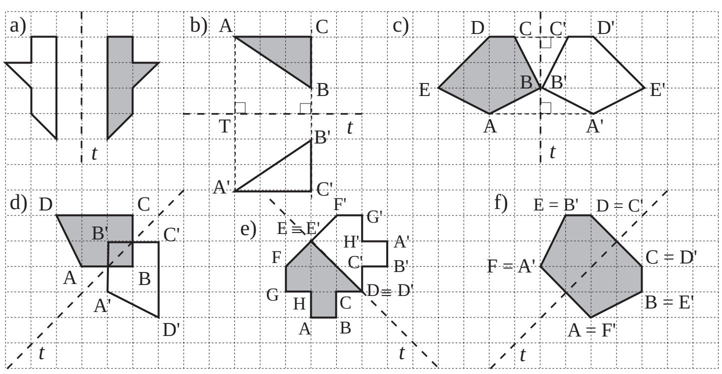


A' is the mirror image of A reflected in axis *t* .

$A' \cong A$

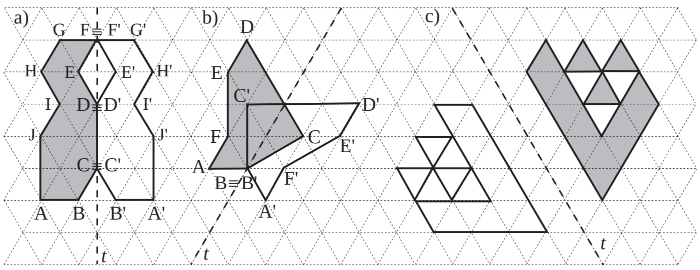
Y6

Lesson Plan 83

Activity		*Notes*
4	***PbY6b, page 83***	
	Q.1 Read: *a) Draw the letter P on a sheet of paper. Colour it green.* *b) Fold the sheet of paper along line t.* *Pierce the vertices of the shape, unfold the sheet then draw the mirror image of the shape on the other part of the sheet. Colour it red.* *c) Complete the sentences.*	*Ps have squared sheets of paper on desks.* Individual work, monitored closely, helped T has large sheet for demonstration if necessary. Do one step at a time if class is not very able.
	Ps read the instructions themselves and carry them out. Make sure that Ps' drawings are correct before they do part c).	
	Review with whole class. Ps come to BB to write the missing words. Who agrees? Who wrote something else? Is it correct? Mistakes discussed and corrected (including spelling mistakes).	(or Ps could show missing words on scrap paper or slates on command)
	Solution: a) and b) 	Discussion, reasoning, agreement, self-correction, praising
	c) i) The *red* shape is the <u>mirror</u> <u>image</u> of the *green* shape.	Accept 'reflected image' too.
	ii) The *red* shape and the *green* shape are <u>congruent</u>. iii) The *red* and *green* shapes are in **symmetrical** positions to <u>axis</u> *t*. (or <u>line</u>)	Sentences written on BB or SB or OH.
Extension	Elicit that the *red* shape is not a 'P' but a 'P' turned over. What transformation have we done to get the *red* shape from the *green* shape? (Reflection in axis *t*, or rotation out of the plane around axis *t* by 180°.) What can you tell me about the shape and its *mirror image*? (e.g. Any point and its *mirror image* are the same distance from *t*; Ps point out line segments on the shape and their *mirror images* which are perpendicular (parallel) to *t* , etc.)	Whole class discussion Involve several Ps. Agreement, praising Extra praise if a P mentions rotation. Demonstrate with a cut-out 'P'.
	27 min	
5	***PbY6b, page 83***	
	Q.2 Read: ***Reflect e****ach shape in the given mirror line or* ***axis****.* *Use different colours.*	Individual work, monitored, helped
	Set a time limit. Ps use rulers to draw the mirror images and colour each mirror image a different colour.	Drawn on BB or use enlarged copy master or OHP Differentiation by time limit
	Review with whole class. Ps come to BB or OHP to draw and label the mirror images, explaining reasoning. Class agrees/ disagrees. Mistakes discussed and corrected.	(or T has images already drawn and uncovers each one as it is dealt with) Reasoning, agreement, self-correction, praising
	Solution: 	Discuss the properties of the reflections. e.g. a) opposite orientation b) AA' $\perp$ *t*, CC' $\perp$ *t*, AT = TA', $\angle$A = $\angle$A', ABC $\cong$ A'B'C', etc. c) B $\equiv$ B' (identical to, i.e. exactly the same point)

Y6

Lesson Plan 83

Activity		*Notes*
5	(Continued) Elicit or point out the following if no P does so. • The *mirror image* of a line which is parallel to *t* is a line parallel to *t* on the opposite side of *t;* • The *mirror image* of a line which is perpendicular to *t* is the same line; • In f), the *mirror image* of the hexagon ABCDE is in the same place as ABCDE but corresponding points are on the opposite side of *t*, except for the points on the axis, which are identical. • The shapes are labelled in an anti-clockwise direction, but the *mirror images* are labelled clockwise – the opposite direction.	Show on diagram.
	35 min	
6	***PbY6b, page 83*** Q.3 Read: *Reflect each shape in the given axis. Use a different colour for each reflection.* Set a time limit or deal with one at a time. Remind Ps to make sure that the corresponding points on the image are the same perpendicular distance from the axis as the point on the shape. Review with whole class. Ps come to BB or OHP to draw and label the mirror images, explaining reasoning. Class agrees/ disagrees. Mistakes discussed and corrected. Ps say what they notice. (e.g. corresponding points, line segments and angles, lines which are parallel/perpendicular to *t*, identical points, etc.) *Solution:* 	Individual work, monitored, helped, corrected Drawn on BB or use enlarged copy master or OHP Differentiation by time limit (Ps finished early could draw the mirror images hidden from the rest of the class, or T could have them already prepared and uncover each one as it is dealt with.) Discussion, reasoning, agreement, self-correction, praising Involve many Ps in noting the properties of the reflections. T might point some out too and ask Ps if they are correct.
	41 min	

Y6

Lesson Plan 83

Activity | **Notes**

7

PbY6b, page 83

Q.4 Read: *a) Draw an axis (mirror line) in your exercise book and label it t.*

b) Place pairs of dried peas on the page so that they are mirror images of each other.
Draw points to mark their positions and label the points. (e.g. A and A')

c) Do the same with pairs of matchsticks.
Draw line segments to mark their positions.

Individual work, monitored closely, helped, corrected

Set a time limit of 3 minutes. T chooses 3 or 4 Ps to show class what they did (by drawing on BB or OHT). Class agrees/ disagrees on whether they are reflections.

(or Ps stick magnetic dots and thin rectangular magnetic strips on BB)

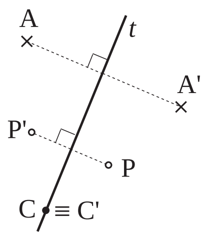
Elicit that:

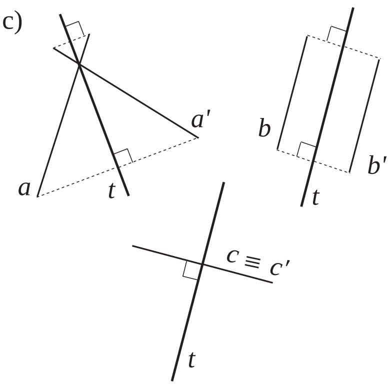
- in b), the 2 peas must be the same perpendicular distance from *t* but on opposite sides of *t*; (unless they are actually on the line *t*, when the two points are identical);
- in c), the corresponding end points of the two matchsticks must be the same perpendicular distance from *t*, and many patterns are possible. (See below) T shows any of those below which are not shown by Ps.

Discussion, reasoning, agreement, praising

If there is disagreement on a pattern, check with a BB ruler, or BB compasses.)

Solution: e.g.

b) 

c) 

Elicit that if the lines representing the 2 matchsticks are extended they can:

- meet at axis *t*, or
- be parallel to *t* and the same perpendicular distance from *t* but on opposite sides of *t*, or
- be perpendicular to *t* and therefore are on the same line.

45 min

Y6

R: Shapes

C: Line symmetry. Properties of axial reflection

E: The axis meeting the shape at a point or crossing the shape

Lesson Plan 84

Activity		*Notes*

1 Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- $\underline{84} = 2 \times 2 \times 3 \times 7 = 2^2 \times 3 \times 7$
  Factors: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84
- $\underline{259} = 7 \times 37$ Factors: 1, 7, 37, 259
- $\underline{434} = 2 \times 7 \times 31$ Factors: 1, 2, 7, 14, 31, 62, 217, 434
- $\underline{1084} = 2 \times 2 \times 271 = 2^2 \times 271$ (and 271 is a prime number)
  Factors: 1, 2, 4, 271, 542, 1084

Notes:

Individual work, monitored (or whole class activity)

BB: 84, 259, 434, 1084

Calculators allowed.

Reasoning, agreement, self-correction, praising

e.g.

84	2
42	2
21	3
7	7
1	

259	7
37	37
1	

434	2
217	7
31	31
1	

1084	2
542	2
271	271
1	

7 min

2 Folding paper to find lines of symmetry

Ps have 3 sheets of plain paper on desks.

a) Mark two points, A and B on one of your sheets of paper.

How can we fold the paper to find the points which are an equal distance from A and B?

Allow Ps a couple of minutes to think about it and try it. If no P can do it, T gives hints or demonstrates and Ps copy T.

(Fold the paper so that A and B lie one on top of the other. Crease the fold. When the paper is unfolded the crease shows the line of symmetry between the two points. Every point on the line of symmetry (or mirror line) is an equal distance from A and B.)

Extension

How could we find it without folding? (Draw a straight line joining A and B, then draw its <u>perpendicular bisector</u> using compasses.)

T or P demonstrates on BB. Label the point of intersection T.

Elicit that: AB $\perp$ *t*, AT = BT

b) Draw two <u>parallel</u> straight lines, *e* and *f*, using 2 rulers (or ruler and set square). How can we fold the paper to find the points which are an equal distance from *e* and *f*?

Allow Ps a minute to think and try it out. Review with whole class.

(Fold the paper so that *e* and *f* lie exactly one on top of the other and crease the fold. Unfold the paper and the crease shows the line of symmetry of the two lines. Every point on the line of symmetry is the same <u>perpendicular</u> distance from *e* and *f*.)

Elicit that the line of symmetry is parallel to *e* and *f* and is an equal distance between them.

c) Draw 2 straight lines, *e* and *f*, which cross each other. How can we fold the paper to find the points which are an equal distance from *e* and *f*?

Allow Ps a minute to think and try it out. Review with whole class.

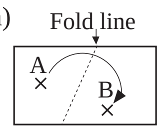
(Fold the paper so that *e* and *f* lie exactly one on top of the other and the point where they cross is on the fold line. Crease the fold. Unfold the paper and the crease shows a line of symmetry betwen *e* and *f*. Elicit that there are 2 such lines of symmetry (see digram).

Notes:

Whole class activity but individual trials of folding the paper

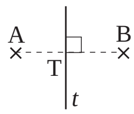
T monitors closely and notes which Ps are on the right track, helping, correcting

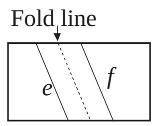
If a P does it, allow him/her to demonstrate/explain to class.

a)


Elicit that:

B = A'
A = B'

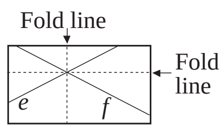
BB:


b)


Elicit that:

e' = *f*
f ' = *e*

e || *t*, *t* || *f*

c)


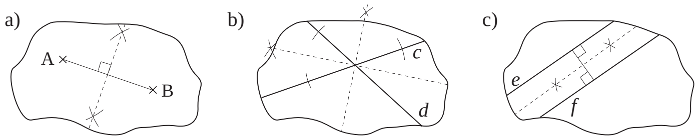
Elicit (or point out) that:

- *e* = *f*' and *f* = *e*'
- the lines of symmetry <u>bisect</u> the central angles

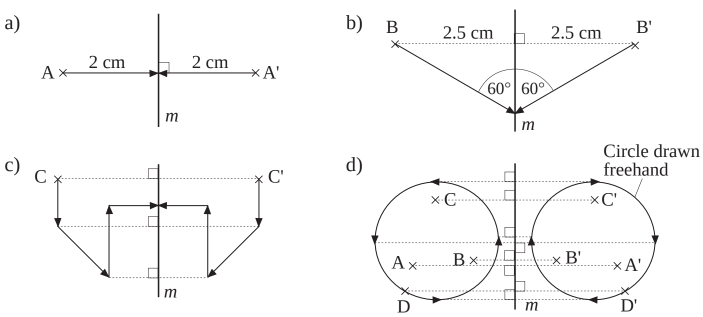
15 min

Y6

Lesson Plan 84

Activity		Notes
3	***PbY6b, page 84*** Q.1 Read: *Find points in the clearings which are an equal distance from:* *a) trees A and B b) paths c and d c) paths e and f.* Set a time limit of 3 minutes. Ps can draw freehand or accurately using rulers (measuring) or compasses (drawing arcs). Review with whole class. T chooses Ps to show and explain what they did on BB or OHT. Who did the same? Who did it a different way? etc. Mistakes discussed and corrected. If no P used compasses, T demonstrates this method to the class, with Ps' help where possible. *Solution:* 	Individual work, monitored, (helped) Drawn on BB or use enlarged copy master or OHP T notes the different methods being used by Ps. If Ps draw freehand, ask them to mark the important information on their diagram. Discussion, agreement, self-correction, praising <u>To bisect an angl</u>e: From the vertex, draw arcs to cut the two arms. From each cut point, draw an arc between the 2 arms. Join vertex to the point where the 2 arcs cross.

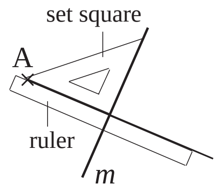
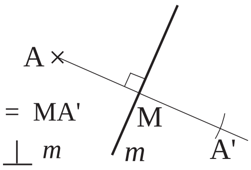
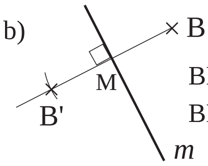
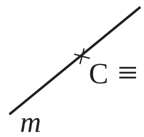
20 min

Activity		Notes
4	***PbY6b, page 84*** Q.2 Read: *Draw the mirror image of each child's route.* Elicit that each capital letter stands for a child, *m* is the mirror line and the arrows show each child's path. (Ps could come to BB to trace the routes with their fingers.) Set a time limit or deal with one part at a time. Encourage Ps to use a ruler and a pair of compasses. Review with whole class. Ps come to BB or OHT to construct the routes, marking the important information. Class agrees/ disagrees. Who did the same? Who did it another way? etc. Mistakes discussed and corrected. Who remembers the name we give to arrows which show direction and distance? (vectors) *Solution:*  Ps say what they notice. e.g. • Each line segment is the same length as its *mirror image*. • Each angle is the same size as its *mirror imag*e. • The *mirror imag*e of a turn anticlockwise is a turn clockwise (and vice versa). etc. (Also elicit information about *mirror images* of line segments which are parallel or perpendicular to the axis.)	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP Differentiation by time limit Discussion, reasoning, agreement, self-correction, praising Review reflection: • the *mirror image* of a point is the same <u>perpendicular</u> distance from the *mirror line* as the original point but on the opposite side of the *mirror line*; • the *mirror image* of a line segment has its start and end points the same <u>perpendicular</u> distances from the *mirror line* as those on the original line segment, but on the opposite side. Expect only freehand drawing of the circle in d), although the *mirror image*s of the marked points and arrows should be drawn accurately. Agreement, praising

28 min

Y6

Lesson Plan 84

Activity		***Notes***
5	***PbY6b, page 84, Q.3*** Read: ***Reflect*** *the point in the given axis. Construct and label its mirror image.* Deal with one part at a time. First elicit the main features of the *mirror image*. (e.g. in a): A' is a point which is the same perpendicular distance from *m* as A but on the opposite side of *m*) Then T leads a discussion on the steps needed to construct the *mirror image*. After agreement, carry out one step at a time, with T working on BB using BB instruments while Ps work in *Pbs*. Who can say a true statement about the diagram? Who can write it using mathematical notation? Ps dictate to T or come to BB. Class agrees/disagrees. a) Steps for construction of A'. 1) Draw a perpendicular line from point A through *m*. (Lay a set square with its vertical edge on the axis and its bottom edge exactly on A. Place a ruler against the bottom of the set square, remove the set square and draw a line along the top of the ruler from A through the axis, extending to the other side of *m*. 2) Label the intersecting point M. 3) Set a pair of compasses to the length AM, then measure this distance from M on the opposite side of M. 4) Label this point A'. b) Elicit the main features of, and the steps needed to construct, B'. Ps repeat the procedure, with a P working on BB with T's help. Then Ps write true mathematical statements about the diagram. c) Ask one or two Ps where they think C' should be. Elicit that the image of any point on the axis is that same point. Who can write it mathematically? Who agrees/? If necessary, T reminds Ps of the symbol which means 'identical to'. (≡) Agree that the point C' <u>is</u> the point C. *35 min*	Whole class activity but individual drawing, monitored, helped Drawn on BB or use enlarged copy master or OHP Discussion, demonstration, agreement, praising a)   AM = MA' AA' $\perp$ *m* b)  BM = MB' BB' $\perp$ *m* c)  C ≡ C'
6	***PbY6b, page 84*** Q.4 Read: ***Reflect*** *the line segment in the given axis. Construct and label its mirror image.* We have been constructing the mirror image of a point but how can we construct the mirror image of a line segment? (Reflect the two end points, then join up their mirror images.) Deal with one part at a time. Set a time limit. Ps use rulers, set squares and compasses. (If necessary, do part a) with the whole class first, with T (P) working on BB under Ps' direction and Ps working in *Pbs*.) Review with whole class. Ps come to BB to show and explain their construction. Class agrees/disagrees. Mistakes discussed and corrected. Ps write true mathematical statements about each diagram. T could write some too and ask Ps if they are correct.	Individual work, monitored closely, helped, corrected Drawn on BB or use enarged copy master or OHP (Less able Ps could have enlarged copies of the diagrams. to make the construction and labelling easier.) Discussion, reasoning, agreement, self-correction, praising only

Y6

Lesson Plan 84

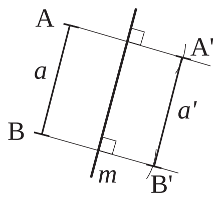
Activity

Notes

6 (Continued)

Solution:

a)



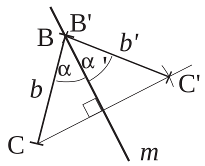
$a = a'$ or AB = A'B'

AB $\parallel$ m $\parallel$ A'B'

AA' $\parallel$ BB',

AA' $\perp$ m, BB' $\perp$ m

b)

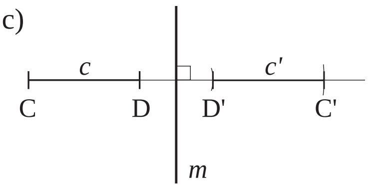


$b = b'$ or BC = B'C'

B ≡ B', $\angle\alpha = \angle\alpha\,'$

CC' $\perp$ m

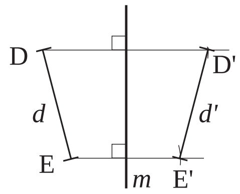
c)



$c = c'$ or CD = C'D'

$c \perp m$, $c' \perp m$

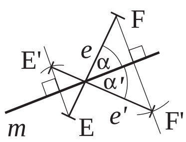
d)



$d = d'$ or DE = D'E'

DD' $\perp$ m, EE' $\perp$ m

e)



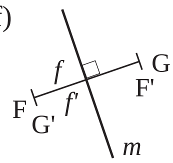
$e = e'$ or EF = E'F'

$\angle\alpha = \angle\alpha\,'$

EE' $\perp$ m, FF' $\perp$ m

EF and E'F' intersect on the axis m.

f)

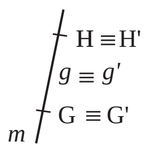


$f = f'$ or FG = F'G'

FG $\perp$ m, F'G' $\perp$ m

Line segments FG and F'G' lie on top of one another.

g)



GH ≡ G'H'

45 min

Y6

Lesson Plan 85

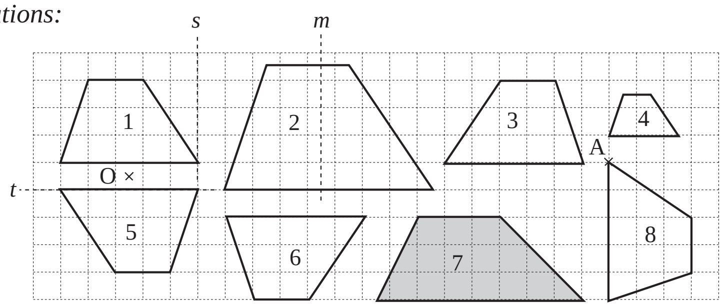
Activity

Factorising 85, 260, 435 and 1085. Revision, activities, consolidation

PbY6b, page 85

Solutions:

Q.1



Expect more able Ps to give the complete answer, but accept only the names of the transformations from less able Ps.

1 → 2: Enlargement (3 : 2), then translation (6, – 1)

1 → 3: Reflection in axis *m*

1 → 4: Reduction (1 : 2), then translation (20, 1)

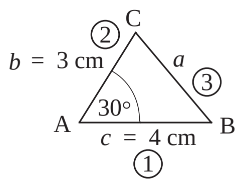
1 → 5: Rotation by 180° about point O, or reflection in point O

1 → 6: Reflection in axis *t*, then translation (6, 0)

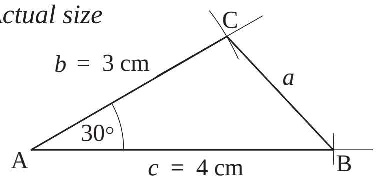
1 → 7: Stretch ($\frac{3}{2}$, 0), then translation (11.5, – 5)

1 → 8: Reflection in axis *s*, then translation (15, 0), then rotation about point A by 90° clockwise (i.e. by – 90°)

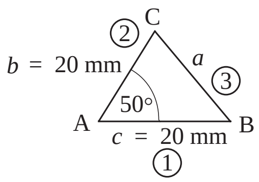
Q.2 a) i) *Sketch*



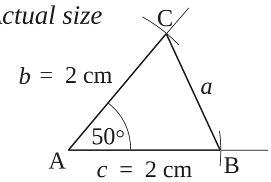
Actual size



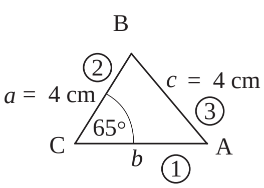
ii) *Sketch*



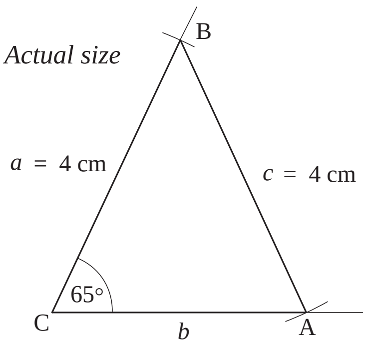
Actual size



iii) *Sketch*



Actual size



Notes

<u>85</u> = 5 × 17

Factors: 1, 5, 17, 85

<u>260</u> = 2^2 × 5 × 13

Factors: 1, 2, 4, 5, 10, 13, 20, 26, 52, 65, 130, 260

<u>435</u> = 3 × 5 × 29

Factors: 1, 3, 5, 15, 29, 87, 145, 435

<u>1085</u> = 5 × 7 × 31

Factors: 1, 5, 7, 31, 35, 155, 217, 1085

(or set factorising as homework at the end of *Lesson 84* and review at the start of *Lesson 85)*

(Translations are measured from lower left hand point of Trapezium 1. In ratio of enlargement(reduction), value of image is given first.)

N.B. Other combinations of transformations are possible, or the given transformations can be done in a different order.

(scalene triangle, obtuse-angled)

(isoscelese triangle, acute-angled)

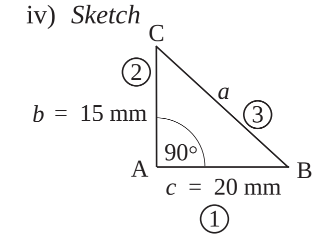
(isoscelese triangle, acute-angled)

Y6		*Lesson Plan 85*

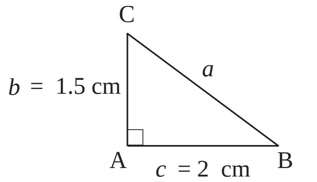
Activity ***Notes***

Q.2 a) (Continued)

iv) *Sketch*

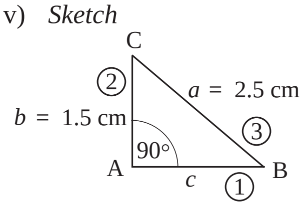


Actual size

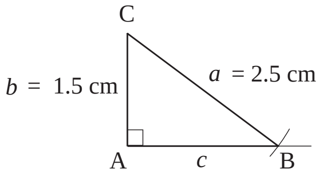


(right-angled triangle)

v) *Sketch*

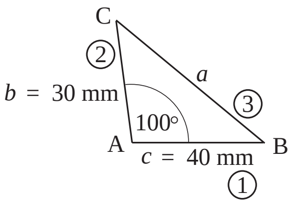


Actual size

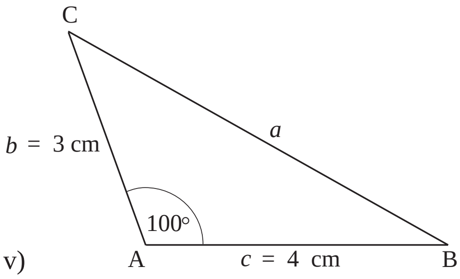


(right-angled triangle)

vi) *Sketch*



Actual size

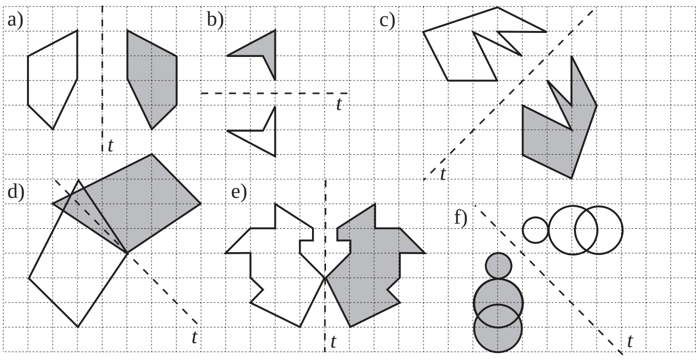


(scalene triangle, obtuse-angled)

b) ii) ~ iii), iv) ~ v)

c) iv) ≅ v)

Q.3



Q.4 Accept any shape with correct *mirror images* labelled appropriately (e.g. ABC → A'B'C' → A"B"C")

Y6

R: Shapes. Constructions

C: Reflection in a mirror line or axis

E: Reflection in two perpendicular (parallel, angled) axes

Lesson Plan 86

Activity		*Notes*

1 Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>86</u> = 2×43 Factors: 1, 2, 43, 86
- <u>261</u> = $3 \times 3 \times 29 = 3^2 \times 29$
  Factors: 1, 3, 9, 29, 87, 261
- <u>436</u> = $2 \times 2 \times 109 = 2^2 \times 109$
  Factors: 1, 2, 4, 109, 218, 436
- <u>1086</u> = $2 \times 3 \times 181$
  Factors: 1, 2, 3, 6, 181, 362, 543, 1086

Notes: Individual work, monitored (or whole class activity)

BB: 86, 261, 436, 1086

Calculators allowed.

Reasoning, agreement, self-correction, praising

e.g.

261	3
87	3
29	29
1	

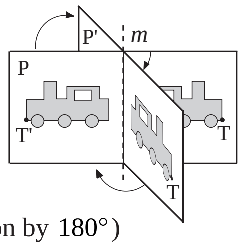
436	2
218	2
109	109
1	

1086	2
543	3
181	181
1	

7 min

2 Rotation and reflection

T has a large model for demonstration. e.g.
(If possible Ps have smaller versions to manipulate on desks too.)



T demonstrates a rotation of plane P by 180° around line *m*. (Ps copy it if possible.)

a) What transformation have we done? (rotation by 180°)
What other transformation could I have done instead?
(Reflection in line *m* within the plane P.)

b) Talk about the paths and mirror images of some points, line segments and parts of the shape (e.g. point T is shown in the diagram).

c) Elicit the properties of reflection. e.g.
- any pair of corresponding points on the shape and its mirror image are the same <u>perpendicular</u> distance from the axis;
- any pair of corresponding line segments on the shape and its mirror image are the same perpendicular distance from the axis;
- the mirror image has the opposite orientation to the shape. etc.

Notes: Whole class activity

Use any simple shape, or use two copies of enlarged copy master (one on white paper and one on a transparency) fixed together as in LP 83/3.

P could check using a mirror.

Ps come to front of class to choose the points, line segments, etc. and to show and describe their paths.

Discussion, reasoning, agreement, praising

Involve several Ps.

T reminds Ps of any they forget to mention.

12 min

3 *PbY6b, page 86*

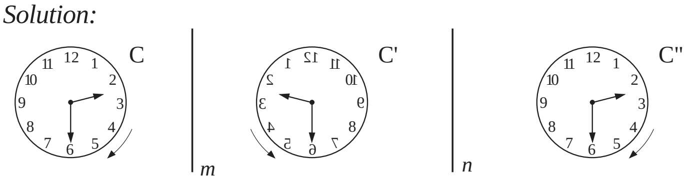
Q.1 Read: *Complete the reflection of the clock in axis m, then* ***reflect*** *its mirror image in axis n.*

Set a time limit. Ps use rulers and compasses to measure and draw.

Review with whole class. T could have mirror images already prepared (or Ps finished early could draw them, hidden from the view of the rest of the class). Ps compare their own drawings with those on BB. Mistakes discussed and corrected.

Label the clocks C, C' and C" and elicit properties of the reflections.

Solution:



Notes: Individual work, monitored, helped

Drawn (stuck) on BB or use enlarged copy master or OHP

Discussion, reasoning, agreement, self-correction, praising

How can we get from C to C" with just one transformation? (Translation)

Elicit or point out that the distance of the translation would be twice the distance between *m* and *n*. Why?

17 min

Y6

Lesson Plan 86

Activity		*Notes*
4	***PbY6b, page 86***	Individual work, monitored, helped

Q.2 Read: ***Reflect** triangle ABC in axis m, then **reflect** A'B'C' in axis n.*

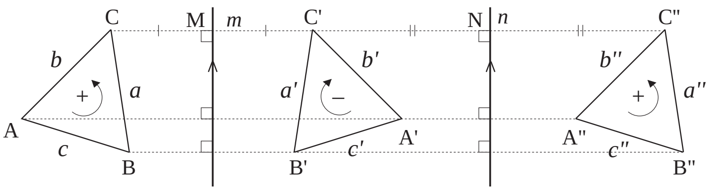
Label the vertices of the 2nd mirror image appropriately.

How can we reflect a triangle? (Reflect the 3 vertices, then join up their mirror images.)

Set a time limit. Ps use rulers, compasses and set squares to measure and draw. Ask Ps to label the sides with lower case letters too. (*a* opposite $\angle$ A, *b* opposite $\angle$ B, etc.)

Review with the whole class. Ps come to BB to demonstrate and explain their construction. Who agrees ? Who did it another way? etc. Mistakes discussed and corrected.

Solution:



Exension

Tell me some properties of the reflections. (If Ps have no ideas, T suggests some and ask Ps if they are correct.) e.g.

$m \parallel n$, ABD $\cong$ A'B'C' $\cong$ A"B"C"

$a = a' = a''$, $b = b' = b''$, $c = c' = c''$

$\angle$ A = $\angle$A' = $\angle$ A", CC' $\perp$ m, CC" $\perp$ n, etc.

The orientation changes to its opposite, then to its opposite again, so the orientation of ABC is the same as A"B"C".

What <u>single</u> transformation could we have done instead? (Translation by 10 cm to the right, or by (10, 0), keeping perpendicular to the two axes.)

Who can explain why this is so?

e.g. Lets' consider the motion of the point C:

CM = MC', C'N = NC", MC' + C'N = 5 cm (by measuring)

so CM + MC' + C'N + NC" = 2 × (MC' + C'N) = 2 × 5 cm

= <u>10 cm</u>

27 min

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

T could have a cut out triangle for demonstration.

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, praising

If necessary, revise how to reflect a point.

(Draw a perpendicular line from the point to the axis and extend it by the same distance on the other side of the axis.)

Whole class discussion

Involve several Ps.

Add extra labels (M and N) and the markings for parallel and perpendicular lines, etc. to the diagram as necessary.

Elicit or point out that the points on the original triangle and on the 2nd mirrror image are labelled in an anti-clock-wise direction (i.e. a positive turn), while the points on the 1st mirror image are labelled in a clockwise direction (i.e. a negative turn).

Feedback for T

Y6

Lesson Plan 86

Activity		*Notes*

5 ***PbY6b, page 86***

Q.3 Read: ***Reflect*** *quadrilateral ABCD in axis m, then reflect A'B'C'D' in axis n.*

Label the vertices of the 2nd mirror image appropriately. (The 2 axes are perpendicular.)

What kind of shape is the quadrilateral? (Trapezium) We know that $\angle$ A is a right angle but what else can you tell me about the shape? (DC $\parallel$ AB, $\angle D = 90°$)

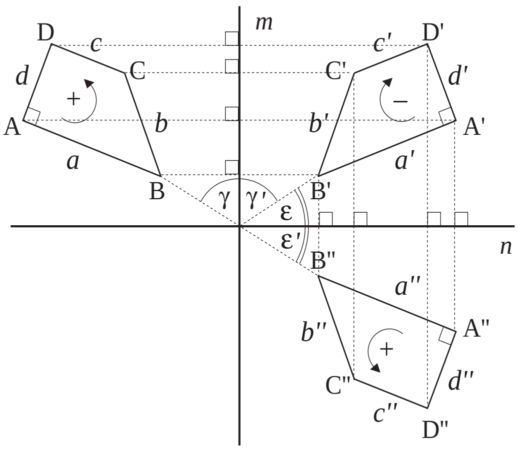
How can we reflect a quadrilateral in an axis? (Reflect each vertex, then join up the mirror images.)

Set a time limit. Ps use rulers, compasses and set squares to draw and measure, then label the vertices appropriately.

Review with whole class. (T could have mirror images already prepared and uncover each as it is dealt with, or Ps finished early could work on BB or OHT hidden from class.)

Ps compare their drawings with those on BB. Show each step if many Ps had difficulties. Mistakes discussed and corrected.

Solution:



Notes: Individual work, monitored, helped, corrected

Drawn on BB or use enlarged copy master or OHP

T has cut-out model of the trapezium for demonstration.

Initial discussion about the shape.

(If necessary, do reflection of first point on BB with whole class first.)

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, priasing

Diagram shows the lines of construction of the mirror images and the angles in the rotation (see below).

Tell me some properties of the reflections. (If necessary, T could suggest some and ask Ps if they are correct.)

e.g. ABCD $\cong$ A'B'C'D' $\cong$ A"B"C"D"

$a = a' = a''$, $b = b' = b''$, $c = c' = c''$, $d = d = d''$

$\angle$ A = $\angle$A' = $\angle$ A", etc.

AB $\parallel$ A"B", BC $\parallel$ B"C", CD $\parallel$ C"D", DA $\parallel$ D"A"

How could we get from ABCD to A"B"C"D" in just one transformation?

(Rotation by 180° around the point where *m* and *n* intersect.)

Extension How can we prove that it is a rotation of 180°?

e.g. Let's consider the rotation of point B.

BB: Angle of rotation from B to B': $\gamma + \gamma = 2\gamma$

Angle of rotation from B' to B": $\varepsilon + \varepsilon = 2\varepsilon$,

but $\gamma + \varepsilon = 90°$, (as axes are perpendicular)

so angle of rotation from B to B":

$$2 \times (\gamma + \varepsilon) = 2 \times 90° = \underline{180°}$$

Notes: Whole class discussion

Involve several Ps.

Extra praise if a P suggests labelling the sides of the trapezium *a*, *b*, *c*, *d*, otherwise T suggests it.

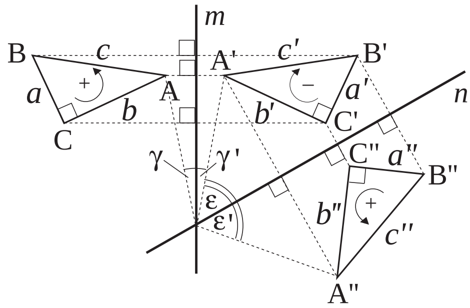
Ps might suggest 180° because BB" is a straight line. T demonstrates with cut-out shape.

Allow Ps a minute to think about it, then if no P has an idea, T leads Ps through the reasoning opposite.

Angles are usually labelled with Greek letters, e.g. γ (gamma), ε (epsilon)

37 min

Y6		*Lesson Plan 86*

Activity		*Notes*
6	***PbY6b, page 86***	
	Q.4 Read: ***Reflect** triangle ABC in axis m, then **reflect** A'B'C' in axis n.* *Label the vertices of the 2nd mirror image appropriately.*	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP
	Set a time limit. Ps use rulers, compasses and set squares to draw and measure, then label the vertices.	T has cut-out model of the triangle for demonstration. Differentiation by time limit
	Review with whole class. Ps come to BB to show and explain what they did. Class agrees/disagrees. Who did it a different way? Which way do you think is better? Mistakes discussed and corrected.	Discussion, reasoning, agreement, self-correction, praising
	Solution: 	Diagram shows the lines of construction of the mirror images and the angles in the rotation (see Extension).
	Tell me some properties of the reflections. (If necessary, T suggests some and ask Ps if they are correct.)	Whole class discussion Involve several Ps.
	e.g. ABC and A"B"C" have a positive orientation (i.e. labelled anti-clockwise) while A'B'C' has a negative orientation (i.e. labelled clockwise) ABC $\cong$ A'B'C' $\cong$ A"B"C $a = a' = a''$, $b = b' = b''$, $c = c' = c''$ $\angle$ A = $\angle$A' = $\angle$ A", $\angle$B = $\angle$ B' = $\angle$ B", $\angle$ C = $\angle$C' = $\angle$ C" = 90°	Write additional labels on diagram as required. Praising
Extension	How could we get from triangle ABC to A"B"C" in just one transformation? (Rotation around the point where *m* and *n* intersect.)	Agreement, praising Demonstrate with a cut-out triangle.
	What could we write about the angle of rotation? e.g. Let's consider the rotation of point A. BB: Angle of rotation from A to A': $\gamma + \gamma = 2\gamma$ Angle of rotation from A' to A": $\varepsilon + \varepsilon = 2\varepsilon$ Angle of rotation from A to A": $2 \times (\gamma + \varepsilon)$ (i.e. twice the angle between *m* and *n*)	T gives hints if necessary. Extra praise if Ps reason without T's help.
	45 min	

Y6

R: Properties of axial reflection (reflection in a line)

C: Constructing axial reflections

E: Problems

Lesson Plan *87*

Activity | **Notes**

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>87</u> = 3 × 29 — Factors: 1, 3, 29, 87
- <u>262</u> = 2 × 131 — Factors: 1, 2, 131, 262
- <u>437</u> = 19 × 23 — Factors: 1, 19, 23, 437
- <u>1087</u> is a prime number — Factors: 1, 1087

  (as not exactly divisble by 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and 37 × 37 > 1087)

e.g.
$$\begin{array}{r} 23 \\ 19\,\overline{)\,437} \\ -\,\underline{38} \\ 57 \\ -\,\underline{57} \\ \underline{0} \end{array}$$

Notes: Individual work, monitored (or whole class activity)

BB: 87, 262, 437, 1087

Ps could try it <u>without</u> using calculators as division practice. Revise procedure for long division.

Reasoning, agreement, self-correction, praising

e.g.
$$\begin{array}{r|l} 87 & 3 \\ 29 & 29 \\ 1 & \end{array} \qquad \begin{array}{r|l} 437 & 19 \\ 23 & 23 \\ 1 & \end{array}$$

8 min

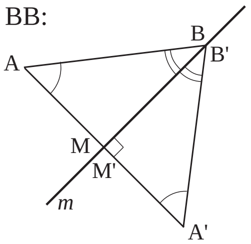
2

Properties of reflection in a mirror line

Study this diagram. What does it show? (Reflection of a triangle in a mirror line. Elict that two possible reflections are shown, Δ AMB or Δ AA'B)

Who can tell me true statements about the diagram? Ps dictate to T or come to BB to write mathematical statements. Class agrees/disagrees.

BB:



e.g. A'B' = AB, B' ≡ B, (M' ≡ M),

$A\hat{B}M = A'\hat{B'}M'$, AM = A'M'

$B\hat{A}M = B'\hat{A'}M'$, (AM' = A'M)

$A\hat{M}B = A'\hat{M'}B' = 90°$

Δ AMB ≅ Δ A'MB'

The image of Δ AA'B is itself.

T: We say that triangle AA'B is a <u>symmetrical</u> triangle and its line of symmetry is line *m*.

Notes: Whole class activity

Drawn on BB or use enlarged copy master or OHP

Discussion, reasoning, agreement, praising

T can show another way to write angles, e.g. angle ABM can be written as

$\angle$ABM or $A\hat{B}M$

(the middle letter has a <u>circumflex</u> above it to show that it is the vertex of the angle.)

13 min

3

Erratum

In *Pbs*, 2nd 'c') should be 'd)'

PbY6b, page 87

Q.1 Read: *Construct the mirror image of each triangle. Colour the mirror image red and label its vertices appropriately.*

First revise how to reflect a point (draw a perpendicular line from the point to the mirror line then extend the line by the same distance on the other side of the mirror line) and how to reflect a triangle (reflect each vertex, then join up the mirror images). Ps explain in their own words.

Set a time limit or deal with one part at a time.

Ps use rulers, set squares and compasses to draw and measure, then label the images. (Ps finished early draw mirror images on BB hidden from class, or T has images already prepared and uncovers each one as it is dealt with.)

Review with the whole class. Ps compare their drawings with those on BB and any mistakes are discussed and corrected.

Ps point out the main features of the reflections. If necessary, T suggests missed features and asks Ps if they are correct.

Notes: Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

Initial discussion on the constructions needed.

Demonstrate on BB if necessary.

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, praising

Feedback for T

Y6

Lesson Plan 87

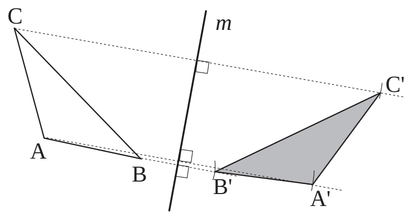
Activity		Notes

3

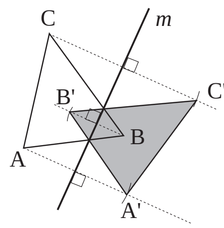
(Continued)

Solution:

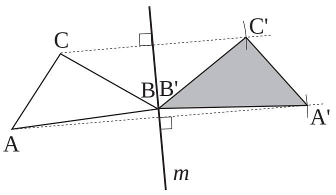
a)



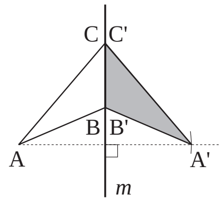
b)



c)



d)



Notes: Elicit that in d), the triangle and its mirror image form a concave deltoid.

23 min

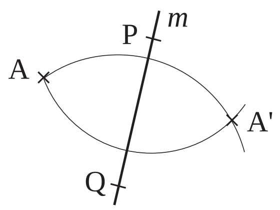
4

PbY6b, page 87, Q.2

a) Read: *Write the steps needed to reflect point A in axis m.*

Study the diagram. It shows another way to reflect a point in a mirror line using only a pair of compasses. How do you think it was done? T asks several Ps for their ideas and class agrees on the steps of the construction. T repeats each step in a clear way and Ps write the steps in their *Pbs* (or *Ex. Bks* if they need more space).

BB:



<u>To reflect a point using compasses</u>

1. Mark 2 different points, P and Q, on axis *m*.
2. Set the compasses to length PA and draw an arc around P.
3. Set the compasses to length QA and draw an arc around Q.
4. The point of intersection of the two arcs is A'.

b) Read: *Carry out the construction on this diagram.*

Set a short time limit. Ps finished quickly help slower Ps or repeat the construction in *Ex.Bks*, drawing their own points and axes.

Notes: Whole class activity

Drawn on BB or use enlarged copy master or OHP

Discussion, agreement, praising

Involve several Ps.

T writes steps on BB (or has them already prepared and uncovers each step as it is agreed on.)

Individual work, monitored closely, helped, corrected

Praising, encouragement only

30 min

5

PbY6b, page 87

Q.3 Deal with one part at a time. Allow Ps to think about it, discuss with their neighbours and try it in *Ex. Bks* first.

Review with whole class. Ps dictate the steps and demonstrate construction on BB. Class agrees/disagrees. T repeats the agreed steps in a clear way if necessary and Ps write them in *Ex. Bks.* if they have not already done so correctly.

Discuss and demonstrate different reflections for each type.

Ps say true statements about the shape and its *mirror image*.

Notes: Individual trial, monitored

(or whole class activity)

Discussion, reasoning, agreement, praising

T could have some already prepared but use Ps' diagrams where possible.

Y6

Lesson Plan 87

Activity

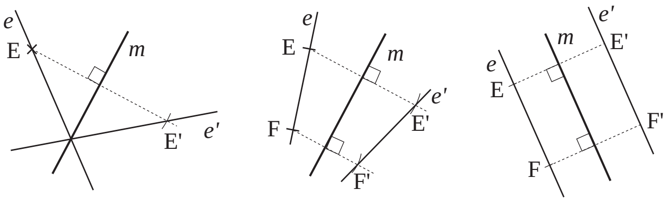
5

(Continued)

Q.3 a) Read *Write the steps needed to reflect any straight line in any axis. Draw an axis m and a straight line e.* ***Reflect*** *line e in m.*

Agree that in the diagram the line could cut the axis, or be parallel to the axis or neither cut it nor be parallel to it. Also elicit that the mirror image of a line which is perpendicular to the axis is that line.

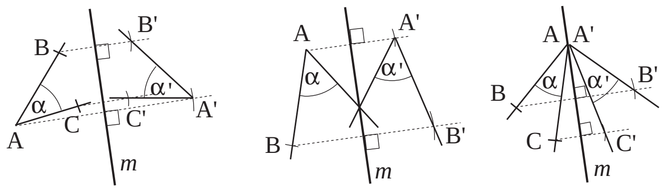
Solution: e.g.



b) Read *Write the steps needed to reflect any angle in any axis. Draw an axis m and an angle* α. ***Reflect*** *angle* α *in m.*

Three different types are possible: the angle does not touch the axis, crosses the axis, or touches the axis at its vertex.

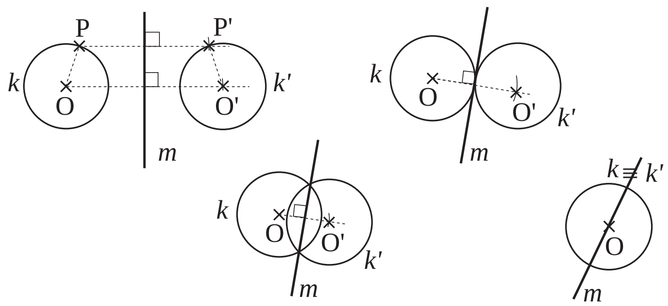
Solution: e.g.



c) Read *Write the steps needed to reflect any circle in any axis. Draw an axis m and a circle k.* ***Reflect*** *circle k in m.*

The axis does not touch the circle, or touches the circle at a point (i.e. the axis is a tangent to the circle and also to its *mirror image*), or lies on a chord of the circle, or lies on the diameter of the circle.

Solution e.g.



Elicit than when the axis lies on the diameter of the circle, the *mirror image* is the circle itself.

40 min

Notes

Extra praise if a P points out that a line which is neither parallel nor perpendicular to the axis will eventually cut the axis at some imagined point.

Steps to reflect a straight line

1. Mark any 2 points on the line (only 1 is needed if the line crosses the axis).
2. Reflect each point in the axis and label appropriately.
3. Draw a straight line through the 2 mirror images.

Steps to reflect an angle e.g.

1. Mark any point on each arm of the angle (only 1 arm is needed if the other arm crosses the axis).
2. Reflect each point and the point at the vertex in the axis. Label appropriately.
3. From the image of the point at the vertex draw rays through the images of the points on the arm(s).

Steps to reflect a circle e.g.

1. Mark the centre of the circle, O, and any point, P, on its circumference
2. Reflect the 2 points in the axis and label them.
3. Draw a circle with centre O' and radius O'P'.

or

1. Mark the centre of the circle, O.
2. Reflect O in the axis.
3. With compasses set to the radius of the original circle, draw a circle with centre O'.

Y6

Lesson Plan 87

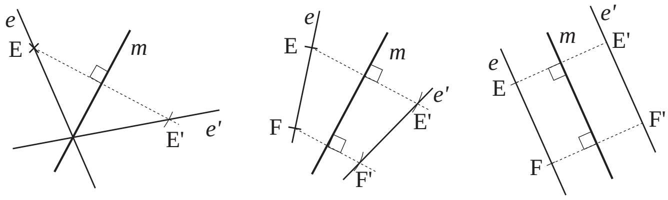
Activity

5 (Continued)

Q.3 a) Read *Write the steps needed to reflect any straight line in any axis. Draw an axis m and a straight line e.* ***Reflect*** *line e in m.*

Agree that in the diagram the line could cut the axis, or be parallel to the axis or neither cut it nor be parallel to it. Also elicit that the mirror image of a line which is perpendicular to the axis is that line.

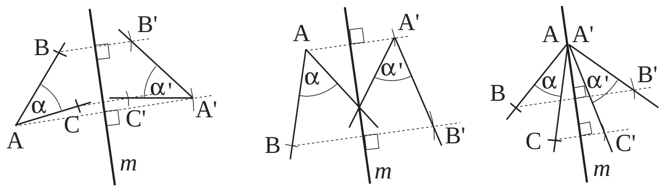
Solution: e.g.



b) Read *Write the steps needed to reflect any angle in any axis. Draw an axis m and an angle* α*.* ***Reflect*** *angle* α *in m.*

Many different types are possible, e.g. the arms do not touch the axis, or an arm crosses the axis, or vertex lies on axis, etc.

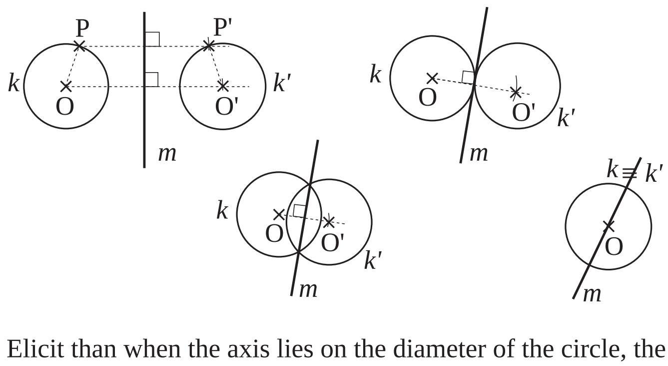
Solution: e.g.



c) Read *Write the steps needed to reflect any circle in any axis. Draw an axis m and a circle k.* ***Reflect*** *circle k in m.*

The axis does not touch the circle, or touches the circle at a point (i.e. the axis is a tangent to the circle and also to its *mirror image*), or lies on a chord of the circle, or lies on the diameter of the circle.

Solution e.g.



Elicit than when the axis lies on the diameter of the circle, the *mirror image* is the circle itself.

40 min

Notes

Extra praise if a P points out that a line which is neither parallel nor perpendicular to the axis will eventually cut the axis at some imagined point.

Steps to reflect a straight line

1. Mark any 2 points on the line (only 1 is needed if the line crosses the axis).
2. Reflect each point in the axis and label appropriately.
3. Draw a straight line through the 2 mirror images.

Steps to reflect an angle e.g.

1. Mark any point on each arm of the angle (only 1 arm is needed if the other arm crosses the axis).
2. Reflect each point and the point at the vertex in the axis. Label appropriately.
3. From the image of the point at the vertex draw rays through the images of the points on the arm(s).

Steps to reflect a circle e.g.

1. Mark the centre of the circle, O, and any point, P, on its circumference
2. Reflect the 2 points in the axis and label them.
3. Draw a circle with centre O' and radius O'P'.

or

1. Mark the centre of the circle, O.
2. Reflect O in the axis.
3. With compasses set to the radius of the original circle, draw a circle with centre O'.

Y6

R: Reflection
C: Line symmetry. Symmetrical shapes and triangles
E: Properties of symmetrical triangles

Lesson Plan 88

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 88 = $2 \times 2 \times 2 \times 11 = 2^3 \times 11$
  Factors: 1, 2, 4, 8, 11, 22, 44, 88
- 263 is a prime number Factors: 1, 263
  (as not divisible by 2, 3, 5, 7, 11, 13 and $17 \times 17 > 263$)
- 438 = $2 \times 3 \times 73$ Factors: 1, 2, 3, 6, 73, 146, 219, 438
- 1088 = $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 17 = 2^6 \times 17$
  Factors: 1, 2, 4, 8, 16, 17, 32, 34, 64, 68, 136, 272, 544, 1088

Notes: Individual work, monitored (or whole class activity)

BB: 88, 263, 438, 1088

(Ps could try it without using calculators as multiplication and division practice.)

Reasoning, agreement, self-correction, praising

e.g.

88	2
44	2
22	2
11	11
1	

438	2
219	3
73	73
1	

1088	2
544	2
272	2
136	2
68	2
34	2
17	17
1	

8 min

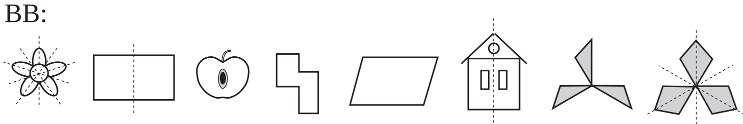
2

Line symmetry

a) Ps point out shapes in the classroom which have line symmetry. Class agrees/disagrees. Ps indicatte where the lines of symmetry are. If disagreement, check with a mirror.

b) T has a collection of different shapes drawn (stuck) on BB. e.g.

BB:



Which of these shapes have line symmetry? Ps come to BB to point to them and to draw their lines of symmetry. Class agrees/disagrees. (If the shapes are stuck on BB, Ps could check by folding them, so that one half covers the other half exactly.)

T: We say that a 2-dimensional shape has line symmetry if a line can be drawn which cuts the shape in half, so that one half can cover the other half exactly.

c) Ps have sheets of plain paper on desks and make symmetrical shapes by drawing, folding, tearing or cutting.

T chooses Ps to show their shapes to the class and to point out the lines of symmetry. Class agrees/disagrees.

Notes: Whole class activity

At a good pace

Involve several Ps.

Agreement, praising

(Ps could have collected the shapes, or T has different shapes drawn or cut out, or use enlarged copy master.)

Reasoning, agreement, checking, praising

T asks one or two Ps to repeat the definition in their own words.

Individual work, monitored, helped, corrected

Extra praise for creativity.

18 min

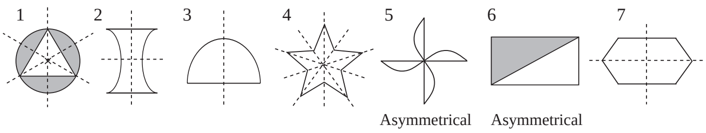
3

PbY6b, page 88

Q.1 Read: *Draw lines of symmetry on the shapes.*

Set a time limit. Review with whole class. Ps come to BB to choose a shape, draw its lines of symmetry where possible, and explain why it is (or is not) symmetrical. Class agrees/ disagrees. Mistakes discussed and corrected.

Solution: (A shape with no lines of symmetry is asymmetrical.)



Notes: Individual work, monitored

Drawn (stuck) on BB or use enlarged copy master or OHP

(T could have cut-out versions for Ps to fold if necessary.)

Discussion, reasoning, agreement, self-correction, praising

Elicit that the circle on its own would have an infinite number of lines of symmetry.

23 min

Y6

Lesson Plan 88

Activity		Notes

4

PbY6b, page 88

Q.2 Read: *Construct the lines of symmetry.*

Set a time limit. Ps use rulers, compasses and set squares to construct the lines of symmetry. Ask Ps to label them too.

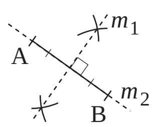
Review with whole class. Ps come to BB to explain their construction and to demonstrate on BB using BB instruments.

Class agrees/disagrees. Mistakes discussed and corrected. If no P drew 2 lines of symmetry in a) or c), T hints that there is another one and asks Ps to show where it is.

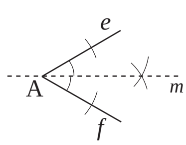
Ps point out the main features of the diagrams. (e.g. equal line segments, equal angles, perpendicular lines)

T asks one or two Ps to repeat the steps of construction for each diagram. Class points out errors or missed steps.

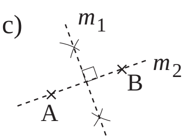
Solution:

a) 

2 lines of symmetry: m_1 is the perpendicular bisector of AB, m_2 is the line on which AB lies.

b) 

1 line of symmetry: the bisector of ∠ A.

c) 

2 lines of symmetry They cross at right angles, half way between A and B.

Notes:

Individual work, monitored, helped

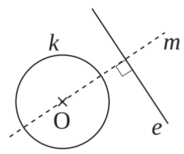
Drawn on BB or use enlarged copy master or OHP

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, praising

Involve several Ps. Praising

To bisect an angle: see *LP 84/3*

d) 

1 line of symmetry

Is line *e* a tangent to circle *k*? (No, as a tangent must touch the circle at one point.)

28 min

5

Erratum

In b): 'polyons' should be 'polygons'

PbY6b, page 88

Q.3 a) Read: *Fold a rectangular sheet of paper along one of its diagonals and cut along the fold.*

What shapes have you made? (2 triangles)
What can you tell me about them? (right-angled, scalene, concave, congruent) Ps point out the equal sides and angles.

b) Read: *Use the two pieces formed to make different polygons by placing equal sides together. Measure the sides and angles of these polygons and note the values.*

Advise Ps to label equal sides with the same letters and mark the equal angles, so that they do not mix them up.

Elicit that besides the original rectangle, we can make two different tirangles and a deltoid. Ps show them by manipulating cut-out triangles on BB.

c) Read: *In your exercise book, draw a sketch of each of the polygons you form and mark on the sketch the size of the angles and the lengths of the sides.*

Set a time limit. Review with whole class. T chooses one or two Ps to draw their sketches on BB and write their measurements. Class points out errors.

Discuss the main features of the two triangles and the deltoid.

- Triangles: 2 equal sides, 2 equal angles, perpendicular bisector of the base meets the 3rd vertex

  Elicit that they are symmetrical or <u>isosceles</u> triangles.

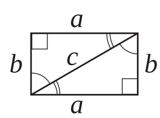
Notes:

Individual work, monitored, helped

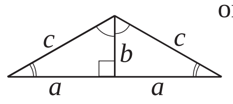
Ps have congruent rectangular sheets of paper on desks.

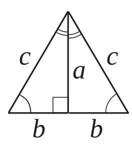
Agreement, praising

BB:

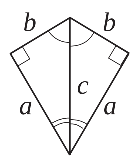


or





or



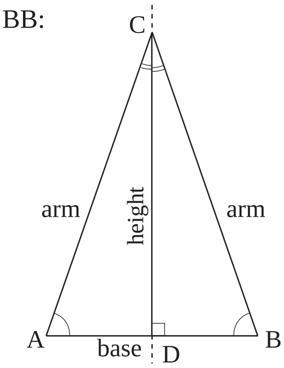
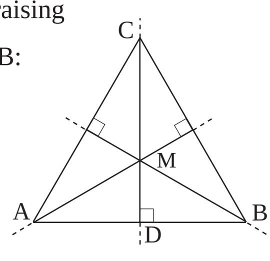
Agreement, self-correction, praising

- Deltoid: 2 pairs of adjacent equal sides, diagonals are perpendicular to each other.

36 min

Y6

Lesson Plan 88

Activity		*Notes*
6	***PbY6b, page 88*** Q.4 Read: *Fill in the missing items.* Set a time limit of 4 minutes. Ps fill in boxes in *Pbs*. Review with whole class. Ps could show missing words or values on scrap peper or slates on command. Ps with different answers explain reasoning on diagram on BB. Class decides on the correct answer. Mistakes discussed and corrected. *Solution:* a) This **symmetrical** triangle has 2 equal sides and is called an **isosceles** triangle. b) If a triangle has **2** equal sides, it is symmetrical. c) AC = BC; $\angle$ A $\boxed{=}$ $\angle$ B; $\angle$ ACD = $\angle$ BCD d) The equal sides are called the arms of the triangle. e) AB is the base of the triangle. f) The line of symmetry **bisects** the base and is perpendicular to it. g) AB $\perp$ CD; AD $\boxed{=}$ DB h) CD is the height of triangle ABC from its base.	Individual work, monitored, helped (or whole class activity) Drawn/written on BB or use enlarged copy master or OHP Responses shown in unison. Agreement, self-correction, praising BB:  isosceles triangle
Extension	What other statements could you write about about the diagram?	(e.g. ΔACD $\cong$ Δ BCD)
	41 min	
7	***PbY6b, page 88, Q.5*** Read: *If a triangle has **3** equal sides, it is called a **regular** or an **equilateral** triangle. Complete the statements.* Ps come to BB to fill in the missing items on BB. Who agrees? Who thinks it should be something else? Why? Ps explain reasoning by referring to diagram. Class agrees on correct answer and Ps write it in *Pbs*. Ps think of other statements to make about the diagram. *Solution:* a) $\angle$ A = $\angle$ B = $\angle$ C; AB $\perp$ CD; AD $\boxed{=}$ DB b) Any equilateral triangle is an isosceles triangle. c) An equilateral triangle has 3 lines of symmetry. d) DC is the height of the equilateral triangle.	Whole class activity (or individual trial first if there is time) Drawn (written) on BB or use enlarged copy master or OHP or Ps show missing items on slates or scrap paper in unison Reasoning, agreeemnt, praising BB: 
Extension	What other statements could you write about the diagram? (e.g. AM = BM = CM, $\angle$ ACD = $\angle$ BCD, etc.)	
	45 min	

Y6

R: Line symmetry

C: Construction of symmetrical triangles

E: Areas of isosceles triangles

Lesson Plan 89

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 89 is a prime number Factors: 1, 89
  (as not exactly divisible by 2, 3, 5, 7 and $11 \times 11 > 89$)
- $264 = 2 \times 2 \times 2 \times 3 \times 11 = 2^3 \times 3 \times 11$
  Factors: 1, 2, 3, 4, 6, 8, 11, 12,
  264, 132, 88, 66, 44, 33, 24, 22
- 439 is a prime number Factors: 1, 439
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19 and $23^2 > 439$)
- $1089 = 3 \times 3 \times 11 \times 11 = 3^2 \times 11^2 = (3 \times 11)^2$ (square no.)
  Factors: 1, 3, 9, 11, 33, 99, 121, 363, 1089

Notes: Individual work, monitored (or whole class activity)

BB: 89, 264, 439, 1089

(Ps could try it without using calculators as multiplication and division practice.)

Reasoning, agreement, self-correction, praising

e.g.

264	2
132	2
66	2
33	3
11	11
1	

1089	3
363	3
121	11
11	11
1	

8 min

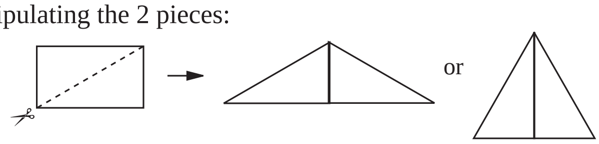
2

Isosceles triangles

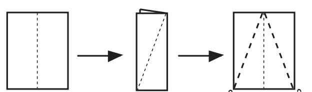
What is an isosceles triangle? (A triangle which has at least 2 equal sides) How could we create an isosceles triangle? Ps tell class what they already know or think of new ideas. T gives hints if necessary.

Ps demonstrate their different methods in front of class or on BB. e.g.

a) Folding and cutting a rectangle along one of its diagonals and manipulating the 2 pieces:

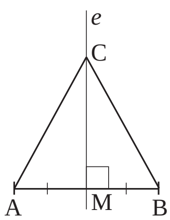


b) Fold a rectangle in half, fold the resulting rectangle diagonally, then open out the paper and cut along the diagonal folds.



c) Construction using a ruler and set square:

1) Draw line segment AB as the base.
2) Measure and mark a point, M, halfway between A and B.
3) Place the set square so that its bottom edge lies along AB and its vertical edge is on M.
4) Draw a line, *e*, through M. (It is the perpendicular bisector of AB.)
5) Mark any point C (which is not on AB) on line *e*. Join C to A and B. Triangle ABC is an isosceles triangle.



d) Construction using a ruler and compasses:

1) Draw a base AB.
2) Set compasses to more than half the distance between A and B.
3) Draw arcs around A and B. Label their point of intersection C.
4) Join A and B to C. C is the 3rd vertex of the isosceles triangle.

Notes: Whole class activity

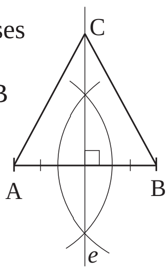
T has large rectangles of paper and BB ruler, compasses and set square at hand (or use OHP for Ps to demonstrate with own instruments)

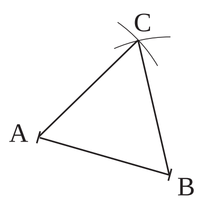
T helps Ps to explain their ideas.

Discussion, demonstration, agreement, praising

Or set compasses and draw arcs around A and B

Join up the points of intersection to draw the perpendicular bisector of AB, line *e*.





16 min

Y6

Lesson Plan 89

Activity | **Notes**

3

PbY6b, page 89

Q.1 Deal with one part at a time. Set a short time limit.

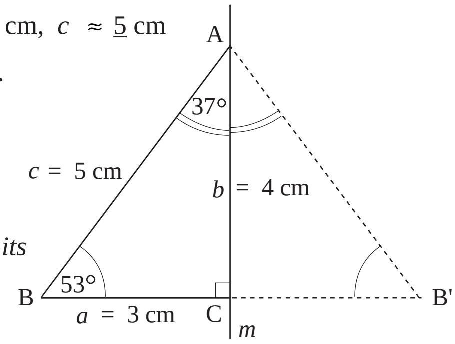
Review with whole class. Ps show results on scrap paper or slates where possible, or dictate to T, or come to BB to write missing values and explain reasoning. Mistakes discussed and corrected.

Part d) could be done with the whole class, with Ps suggesting ideas and explaining at BB. (T could have 2 cut-out triangles ready for demonstration.)

Solution:

a) *Measure the sides of this right-angled triangle.*

$a \approx \underline{3}$ cm, $b \approx \underline{4}$ cm, $c \approx \underline{5}$ cm



b) *Measure its angles.*

$\angle A \approx \underline{37°}$

$\angle B \approx \underline{53°}$

$\angle C \approx \underline{90°}$

c) *What is the sum of its three angles?*

$\angle A + \angle B + \angle C$

$\approx 37° + 53° + 90° = \underline{180°}$

(Extra praise if a P remembers that the sum of the angles in <u>any</u> triangle is 180°.)

d) ***Prove** that* $\angle A + \angle B = 90°$.

By calculation:

$\angle A + \angle B = 180° - \angle C = 180° - 90° = 90°$

By demonstration:

Show that 2 congruent right-angled triangles can be joined to form a rectangle. (Draw a diagram or use cut-out triangles.)

e) ***Reflect** triangle ABC in the line AC.*

i) *What shape is formed from the triangle and its mirror image?*

(ABB' is an <u>isosceles</u> triangle, or a <u>symmetrical</u> triangle)

ii) *What is the sum of the angles of the new shape?*

$\angle B = \angle B' = 53°$, $B\hat{A}C = B'\hat{A}C = 37°$

$\angle A = B\hat{A}C + B'\hat{A}C = 2 \times 37°$

So $\angle A + \angle B + \angle B' = 2 \times (37° + 53°)$

$= 2 \times 90° = \underline{180°}$

26 min

Notes:

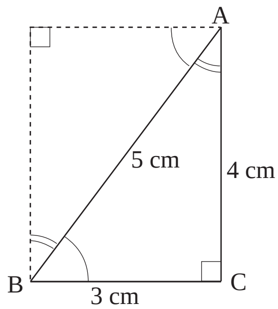
Individual work, monitored helped

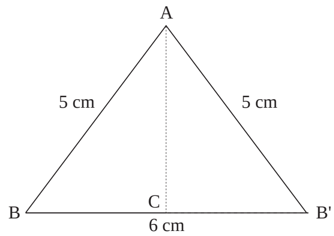
Drawn (stuck) on BB or use enlarged copy master or OHP for demonstration only

Discussion, reasoning, agreement, self-correction, praising

(Reflection required in part e) below is also shown here.)

BB:

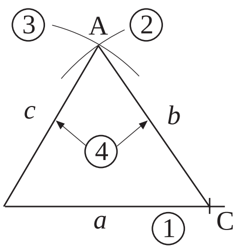
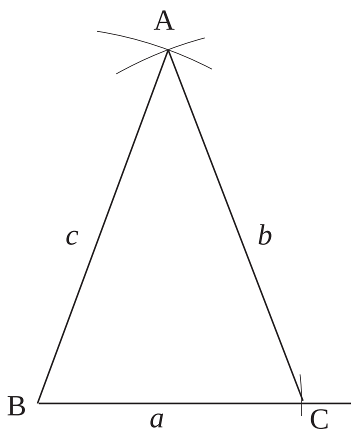
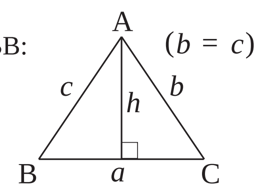




A P might say that the sum of the angles in <u>any</u> triangle is 180°.

Y6

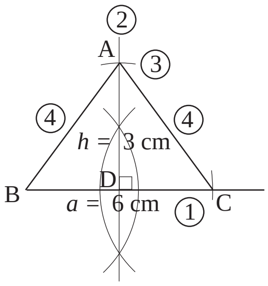
Lesson Plan 89

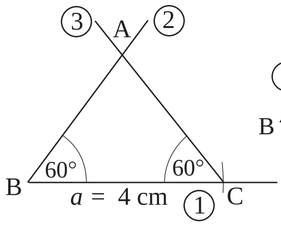
Activity		Notes
4	***PbY6b, page 89*** Q.2 a) Read: *Complete this sketch to show the construction of a triangle. (Step 1 is already given.)* What is *Step 1*? Ps come to BB to point to it on diagram and explain what it is. <u>*Step 1*</u> Draw a ray from a point B. Set the compasses to length *a* and mark the point C. What should be done next? Ps come to BB to explain each step and write its number on the diagram on BB. Class agrees/disagrees. Ps number the steps on own diagrams. <u>*Step 2*</u> Set the compasses to length *b*, then draw an arc around C. <u>*Step 3*</u> Set the compasses to length *c* and draw an arc around B. Label the intersection of the 2 arcs A. <u>*Step 4*</u> Join up AB and AC. What would be different when drawing an <u>isosceles</u> triangle? ($c = b$, so in Step 3, we keep the compasses at width *b* when drawing an arc around B.) b) Read: *In your exercise book, construct this isosceles triangle.* *Base: $a = 3.5$ cm, Arms: $b = c = 5$ cm* Set a time limit. Review with whole class. T asks Ps to tell class what they did at each step and demonstrate on BB or OHP. Who did the same? Who did it a different way? Mistakes corrected. Agree that when constructing an isosceles triangle, it does not matter if *Step 2* and *Step 3* are interchanged. What is the sum of the angles in your triangle? (180°) *32 min*	Whole class discussion on the required steps. Drawn on BB or use enlarged copy master or OHP Discussion, reasoning, agreement, praising T helps Ps to explain clearly. BB:  <u>Completed sketch</u> <u>Actual construction</u>  $\angle A + \angle B + \angle C = 180°$
5	***PbY6b, page 89*** Q.3 Read: *In your exercise book, draw a sketch to show your construction plan, then construct these* ***isosceles*** *triangles accurately. Label them appropriately.* First discuss the appropriate labelling of triangles. (Vertices labelled in an anticlockwise direction using capital letters; sides labelled with lower case letters, *a* opposite A, *b* opposite B, *c* opposite C, the perpendicular height is labelled *h*.) Deal with one triangle at a time. Ps first draw a construction plan (sketch) in *Ex. Bks*. Review the plan with the whole class and make sure that Ps correct any errors before they do the actual construction. Ps finished early could demonstrate the construction on BB or help slower neighbours.	Individual work, monitored closely, helped, corrected BB:  Discussion, agreement, self-correction, praising or T could have triangles already prepared and uncover each as it is dealt with.

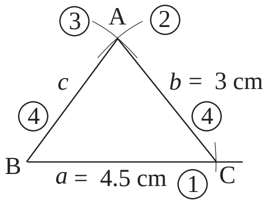
Y6

Lesson Plan 89

Activity		*Notes*
5	(Continued) *Solution*: a) $a = 6$ cm, $h = 3$ cm; b) $a = 4$ cm, $\angle B = \angle C = 60°$; c) $a = 4.5$ cm, $b = 3$ cm	In a) elicit that the perpendicular bisector of BC should be constructed, but accept construction using ruler and set square, or compasses (as shown in diagram). In b), after agreement on the plan, revise how to use a protractor accurately. In c), $b = c = 3$ cm







40 min

6 ***PbY6b, page 89***

Q.4 a) Read: *Measure the angles of the* ***isosceles*** *triangles you drew in Questions 2 and 3.*

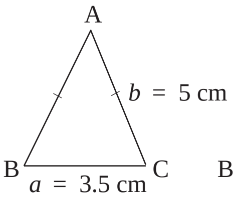
Write your results below these sketches.

Set a time limit. Ps use protractors, approximating to the nearest degreee. Ps can extend the sides of the triangles to make the task easier where necessary.

Review with whole class. Ps could show the angles on scrap paper or slates on command. Ps with inaccurate results should measure again and amend their answers in *Pbs*.

T asks Ps to describe each triangle.

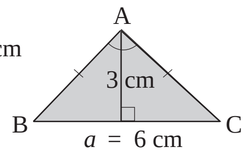
Solution:



$\angle A \approx \boxed{40°}$

$\angle B = \angle C \approx \boxed{70°}$

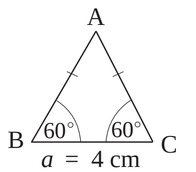
It is an acute-angled isosceles triangle.



$\angle A \approx \boxed{90°}$

$\angle B = \angle C = \boxed{45°}$

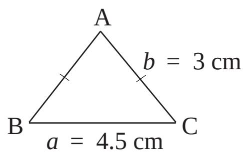
It is a right-angled isosceles triangle.



$\angle A = 60°$

$\angle B = \angle C = 60°$

It is a regular or equilateral triangle.



$\angle A \approx \boxed{97°}$

$\angle B = \angle C \approx \boxed{42°}$

It is an obtuse-angled isosceles triangle.

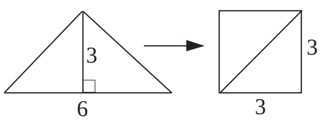
Indvidual measuring, monitored (helped). Drawn on BB or use enlarged copy master for recording only. Differentiation by time limit. Responses given in unison. Agreement, self-correction, praising.

b) Read: *Calculate the area of the shaded triangle.*

Set a time limit of 1 minute. Ps could show area on scrap paper or slates on command. Ps with different answers explain reasoning at BB. Who did the same? Who did it a different way? T makes sure that both the methods below are discussed.

Solution:

By drawing and calculation:

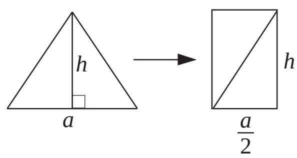


$A = 3 \text{ cm} \times 3 \text{ cm} = \underline{9 \text{ cm}^2}$

By calculation: $A = \dfrac{a \times h}{2} = \dfrac{6 \times 3}{2} \text{ cm}^2 = \underline{9 \text{ cm}^2}$

(h is the perpendicular height of the triangle from its base)

Individual work, monitored, helped (or whole class activity). Responses shown in unison. Discussion, reasoning, agreement, self-correction, praising. Agree that for any isosceles triangle:



45 min

Y6

Lesson Plan 90

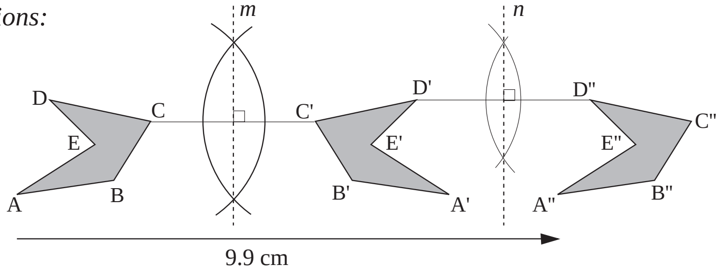
Activity

Factorising 90, 265, 440 and 1090. Revision, activities, consolidation

PbY6b, page 85

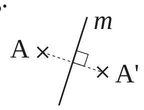
Solutions:

Q.1

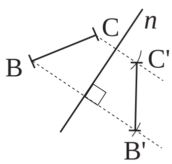


A single translation (9.9 cm, 0 cm) can replace the two reflections.

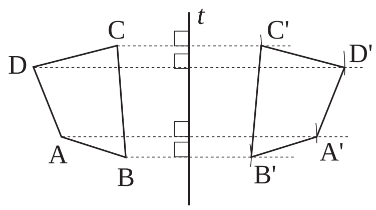
Q.2 a) e.g.



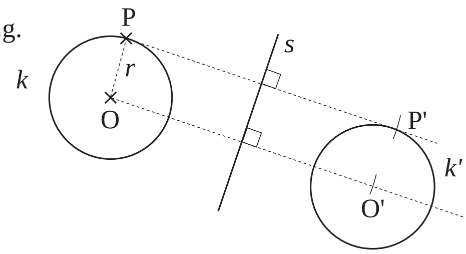
b) e.g.



c) e.g.

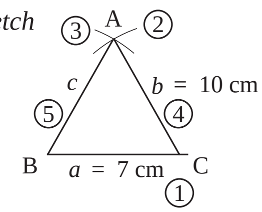


d) e.g.

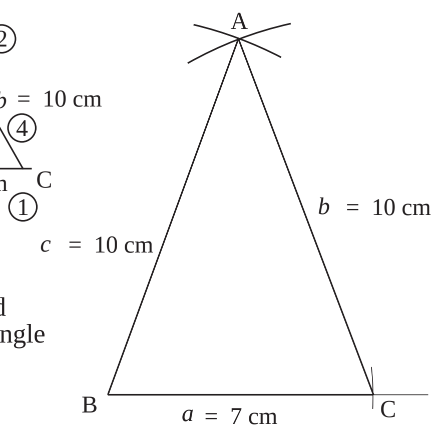


e) To reflect any polygon in any axis, reflect each of its vertices then join up their mirror images.

Q.3 a) *Sketch*



Acute-angled isosceles triangle



Notes

$\underline{90} = 2 \times 3^2 \times 5$

Factors: 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90

$\underline{265} = 5 \times 53$

Factors: 1, 5, 53, 265

$\underline{440} = 2^3 \times 5 \times 11$

Factors: 1, 2, 4, 5, 8, 10, 11, 20, 22, 40, 44, 55, 88, 110, 220, 440

$\underline{1090} = 2 \times 5 \times 109$

Factors: 1, 2, 5, 10, 109, 218, 545, 1090

(or set factorising as homework at the end of *Lesson 89* and review at the start of *Lesson 90)*

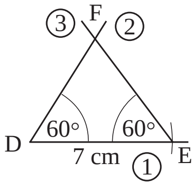
(Actual size reduced by 1 : 2 here to fit on the page.)

Y6 — *Lesson Plan 90*

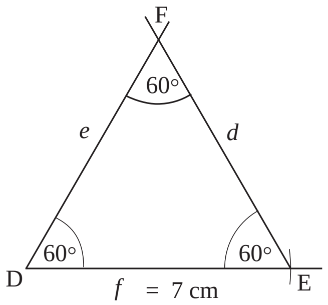
Activity		**Notes**

Soltuions (Continued)

Q.3 b) *Sketch*



Equilateral triangle

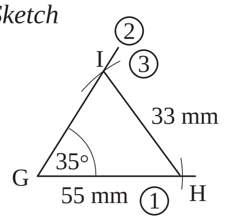


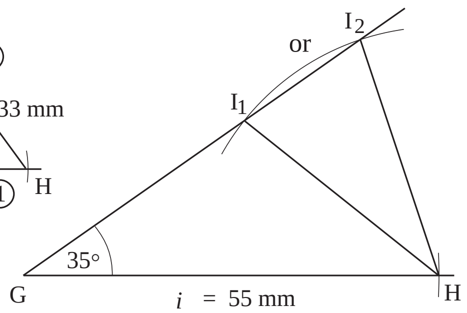
(Actual size reduced by 1 : 2 here to fit on the page.)

$d = e = f = 7$ cm

Any triangle which has all 3 angles 60° is equilateral.

c) *Sketch*





Whole class activity

Extra praise if Ps notice that two triangles are possible:

GHI_1 obtuse-angled triangle

GHI_2 acute-angled triangle

Q.4 a) An **equilateral** triangle has angles of $\boxed{60}$ ° and has three <u>equal</u> sides.

b) An **isosceles** triangle has at least 2 equal <u>sides</u>. (or angles)

c) An **equilateral** triangle is also an <u>isosceles</u> triangle.

d) A triangle which has sides in the ratio of 3 : 4 : 5 is a <u>right-angled</u> triangle.

e) A triangle with 3 different sides is called a <u>scalene</u> triangle.

f) There is no triangle which has a <u>reflex</u> angle. (or <u>straight</u>, or <u>whole</u>, or <u>null</u>)

g) The sum of the angles of any triangle is $\boxed{180}$ °.

Whole class activity

In c): accept <u>acute-angled</u>.

In d):

T has various triangles already prepared for discussion. Ps check the ratio of the sides and measure the angles.

Ps could try to draw a 3: 4 : 5 triangle which does <u>not</u> contain a right angle. (Impossible!)

Y6

R: Definitions of triangles and quadrilaterals. Reflection in an axis
C: Symmetrical quadrilaterals
E: Constructing symmetrical quadrilaterals

Lesson Plan *91*

Activity | ***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 91 = 7 × 13   Factors: 1, 7, 13, 91
- 266 = 2 × 7 × 19   Factors: 1, 2, 7, 14, 19, 38, 133, 266
- 441 = 3 × 3 × 7 × 7 = $3^2 \times 7^2$ = $(3 \times 7)^2$ (square number)
  Factors: 1, 3, 7, 9, 21, 49, 63, 147, 441
- 1091 is a prime number   Factors: 1, 1091
  (as not exactly divisble by 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and 37 × 37 > 1091)

Notes:
Individual work, monitored (or whole class activity)
BB: 91, 266, 441, 1091
(T decides whether Ps can use calculators.)
Reasoning, agreement, self-correction, praising
e.g.

91	7
13	13
1	

266	2
133	7
19	19
1	

441	3
147	3
49	7
7	7
1	

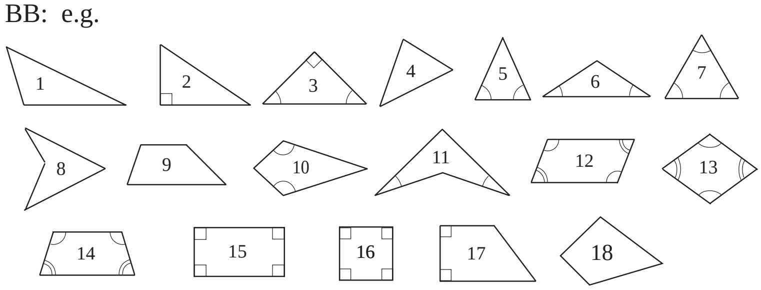
8 min

2

Triangles and quadrilaterals

T has a collection of triangles and quadrilaterals (and other polygons if T wishes) drawn or stuck on BB.

BB: e.g.



a) T points to each shape in turn. Ps say what they know about it. e.g.
1. Obtuse-angled triangle, scalene, asymmetrical, convex
2. Right-angled triangle, scalene, asymmetrical, convex
3. Right-angled isosceles triangle, 1 line of symmetry, convex angles: 90°, 45°, 45°
4. Acute-angled triangle, scalene, asymmetrical, convex
5. Acute-angled isosceles triangle, 1 line of symmetry, convex
6. Obtuse-angled isosceles triangle, 1 line of symmetry, convex
7. Equilateral triangle, 3 lines of symmetry, rotational symmetry, each angle is 60°, convex
8. Quadrilateral, asymmetrical, concave
9. Trapezium, 2 parallel sides, asymmetrical, convex
10. Deltoid, 2 pairs of adjacent equal sides, 2 equal angles, 1 line of symmetry, its 2 diagonals intersect at right angles, convex
11. Deltoid, concave, 1 line of symmetry, etc.
12. Parallelogram, opposite sides equal and parallel, opposite angles equal, rotational symmetry of 180°, no line symmetry, convex

b) Let's think of ways to group the shapes. T and Ps suggest criteria and choose Ps to list the numbers of the relevant shapes. Class agrees/ disgrees. (e.g. symmetry, sides, angles, shape)

Notes:
Whole class activity
Drawn (stuck) on BB or use enlarged copy master or OHP
Agreement, praising
If disagreement, check by measuring or using a mirror.
Ps draw lines of symmetry.
Extra praise for unexpected properties

13. Rhombus, 4 equal sides, opposite sides parallel, opposite angles equal, 2 lines of symmetry, diagonals intersect at right angles, rotational symmetry of 180°, convex
14. Trapezium, 1 pair of equal sides, convex, 1 line of symmetry, etc.
15. Rectangle, 4 right angles, 2 lines of symmetry, rotational symmetry, etc.
16. Square, 4 right angles, 4 lines of symmetry, rotational symmetry (90°), convex, etc.
17. Trapezium, 2 right angles, asymmetrical, convex
18. Quadrilateral, asymmetrical

Involve many Ps.
In good humour!
Extra praise for creativity!

20 min

Y6

Lesson Plan 91

Activity		Notes

3

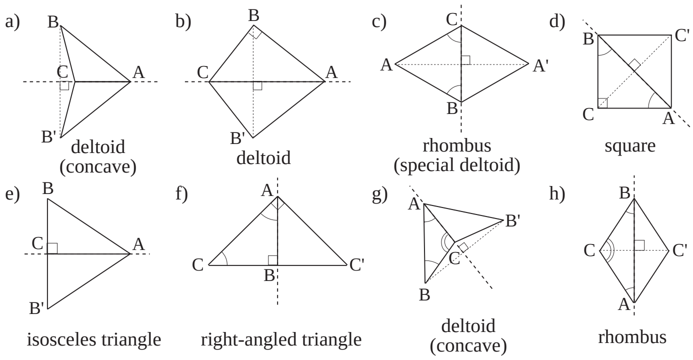
PbY6b, page 91

Q.1 Read: ***Reflect** the triangles in the side indicated. Write the name of the polygon formed by the original shape and its mirror image.*

Set a time limit. Do not expect precise construction but encourage Ps to use rulers and to be reasonably accurate.

Review with whole class. Ps come to BB to reflect the required point and complete the shape, saying what the name of the shape is and why they think so. Class agrees/disagrees. Mistakes discussed and corrected.

Solution:



Notes: Individual work, monitored, helped

Drawn on BB or use enlarged copy master or oHP

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, praising

T could have cut-out triangles for each part so that Ps can demonstrate the reflections as a check, especially if there is disagreement.

Extension

Discuss the properties of the shapes (sides, angles, diagonals, lines of symmetry, etc.).

Notes: Whole class activity

Involve several Ps. Praising

30 min

4

PbY6b, page 91

Q.2 Read: *To the left of AC construct an **isosceles** triangle which has **2 cm** arms.*

*To the right of AC construct another **isosceles** triangle which has **3 cm** arms.*

*We say that AC is the **common base** of the two triangles.*

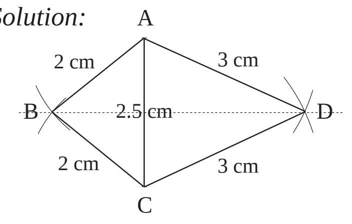
What kind of polygon have you formed?

First elicit the steps needed in the construction. (Set compasses to 2 cm, then draw arcs on LHS of AC with pointed end of compasses on A, then on C. Label B the point where the 2 arcs intersect. Join A and C to B. Repeat on RHS of AC but with compasses set to 3 cm and the point of intersection labelled D.)

Set a time limit. Ps draw the polygon and write its name.

Review with whole class. Ps show name on scrap paper or slates on command. Ps with different names explain why they chose them. T shows prepared diagram for discussion.
Class agrees on the correct name of the shape. (Deltoid)

Solution:



1 line of symmetry
(the diagonal BD)

BD $\perp$ AC

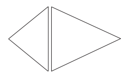
BD bisects AC

$B\hat{A}D = B\hat{C}D$, etc.

Notes: Individual work, monitored, helped

Drawn on BB or SB or OHT

(T has the 2 triangles cut out as a check for the construction.



Initial whole class discussion

T (P) could demonstrate with BB compasses if possible.

Responses shown in unison.

(Or Ps finished early could have drawn the 2 triangles on BB, hidden from view of the rest of the class)

Reasoning, agreement, self-correction, praising

Extension

Elicit some properties of the deltoid ABCD (see above)

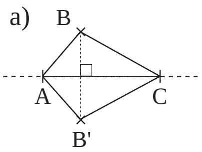
Notes: Whole class activity. Praising

34 min

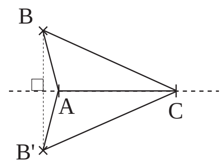
Y6

Lesson Plan 91

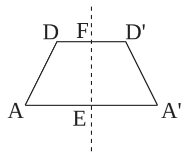
Activity		Notes
5	***PbY6b, page 91*** Q.3 Read: ***Reflect:*** *a) point B in line AC. Join B and B' to A and C. What is ABCB'?* *b) point B in line AC. Join B and B' to A and C. What is ABCB'?* *c) the linear shape in line EF. What is AA'D'D?* Set a time limit. Ps use rulers, compasses and set squares to measure and draw, then write the name of the shape in *Pbs*. Review with whole class. Ps could show names on scrap paper or slates on command. Ps with different names come to BB to complete the drawing and explain why they chose that name. Class agrees on correct answer. Mistakes discussed and corrected. Discuss the main properties of each reflection. *Solution:*	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP T could have two cut-out pieces to demonstrate the reflection in c). Deal with one at a time if class is not very able. Responses shown in unison. Discussion, reasoning, agreement, self-correction, praising Involve several Ps. Agreement, praising

a) 

deltoid (convex)

b) 

deltoid (concave)

c) 

trapezium (symmetrical)

e.g.
a) AB = AB', BC = B'C,
AC is the perpendicular bisector of BB'.
$A\hat{B}C = A\hat{B}'C$
etc.

40 min

Activity		Notes
6 **Erratum** In *Pbs*: the box in a) should be longer.	***PbY6b, page 91, Q.4*** Read: *Complete the sentences. Draw an example of each quadrilateral in your exercise book* T chooses a P to read out each sentence, saying 'something' instead of the missing word. (Ps can draw diagrams in *Ex. Bks* or on scrap paper to help them decide or to check.) Ps write missing word on scrap paper or slates and show on command. Ps with different words explain their reasoning, drawing diagrams on BB, with T's help if necessary. Class decides if they are correct. Ps write agreed word(s) in *Pbs*. *Solution:* *a) A quadrilateral is called a <u>parallelogram</u> if its diagonals **bisect** each other.* *b) A quadrilateral with equal angles is called a <u>rectangle.</u>* *c) A quadrilateral with equal sides is called a <u>rhombus</u>.* *d) A r**egular** quadrilateral is called a <u>square</u>.*	Whole class activity (or individual work if Ps wish and there is time, with extra questions set for quicker Ps) Written on BB or use enlarged copy master or OHP Responses shown in unison. Reasoning with diagram, agreement, (self-correction), praising In a), elicit that <u>additional</u> criteria are needed for the quadrilateral to be a rhombus (equal sides), a rectangle (equal angles) or a square (equal sides and angles).
Extension	e) A quadrilateral is called a <u>deltoid</u> if one of its diagonals lies on a line of symmetry. f) Every deltoid has two pairs of adjacent <u>equal</u> sides. g) Every rectangle is a <u>trapezium</u>. (or parallelogram) h) Every rhombus is a <u>deltoid</u>. (or parellogram, or trapezium)	When each quadrilateral is drawn on BB, elicit other properties too. Feedback for T

45 min

Y6

R: Properties of reflection in an axis

C: Properties of symmetrical quadrilaterals. Perimeter, area, angles

E: Sum of the angles of symmetrical quadrilaterals

Lesson Plan 92

Activity — ***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 4 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>92</u> = $2 \times 2 \times 23 = 2^2 \times 23$ Factors: 1, 2, 4, 23, 46, 92
- <u>267</u> = 3×89 Factors: 1, 3, 89, 267
- <u>442</u> = $2 \times 13 \times 17$ Factors: 1, 2, 13, 17, 26, 34, 221, 442
- <u>1092</u> = $2 \times 2 \times 3 \times 7 \times 13 = 2^2 \times 3 \times 7 \times 13$

  Factors: 1, 2, 3, 4, 6, 7, 12, 13, 14, 21, 26, 28 ↓
  1092, 546, 364, 273, 182, 156, 91, 84, 78, 52, 42, 39

Notes: Individual work, monitored (or whole class activity)

BB: 92, 267, 442, 1092

Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

92	2
46	2
23	23
1	

1092	2
546	2
273	3
91	7
13	13
1	

267	3
89	89
1	

442	2
221	13
17	17
1	

6 min

2

Symmetrical shapes (trapeziums)

a) <u>Sheet with circle</u>

On your circle draw any chord and label it AB. (Elicit that a chord is a straight line segment which has its start and end points on the circumference of the circle.)

Draw another chord, CD, which is <u>parallel</u> to AB. Join AD and BC.

What shape is ABCD? (trapezium) T shows one on BB. Who drew this type of trapezium? What do you notice about it? (symmetrical)

How many lines of symmetry does this trapezium have? (1)

Who can show us where it is? (By folding the paper so that C lies on D and B lies on A and creasing the fold; or by drawing the perpendicular bisector of the 2 parallel chords.)

Ps draw the lines of symmetry on own diagrams. Elicit that the lines of symmetry passes through the centre of the circle, point O.

T: We call such a symmetrical trapezium a <u>chord trapezium</u>, because each of its sides is a chord of the same circle.

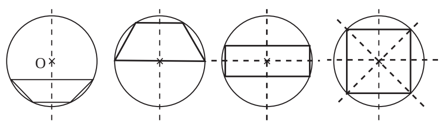
We say that the trapezium is <u>inscribed</u> in the circle (i.e. each of its 4 vertices are points on the circumference of the circle.)

Let's collect the properties of the chord trapezium on the BB. Ps suggest some, in words, or using mathematical notation on BB, adding extra labelling to diagram as necessary. Class agrees/disagrees.

e.g. AD = BC, $\angle$A = $\angle$ B, $\angle$C = $\angle$ D, AC = BD
(They are mirror images of each other.) Δ AMD $\cong$ Δ BMC, etc.

What other kinds of symmetrical trapeziums are there? Ps come to BB to draw them, with prompting from T if necessary.

BB:



rectangle square

Elicit that a trapezium can have 1 or 2 or 4 lines of symmetry.

Elicit that:

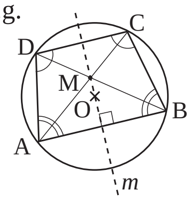
- a <u>rectangle</u> is a chord trapezium with equal angles
- a <u>square</u> is a regular chord trapezium (i.e. equal angles and equal sides)

Notes: Whole class activity

Ps have 3 sheets of paper on which are drawn a circle, an isosceles triangle and a deltoid.

T has shapes drawn on BB too (or has large cut-out models).

BB: e.g.



<u>chord trapezium</u>
(symmetrical)

Ps follow instructions individually but are involved in discussions with the whole class.

Discusison, reasoning, agreement, praising

Or T asks Ps who drew any of these types to show their diagrams on BB and explain their main features.

(e.g. 2nd from left: base side is the diameter ofthe circle)

Agree that all symmetrical (chord) trapeziums can be <u>inscribed</u> in a circle.

Y6

Lesson Plan 92

Activity		*Notes*

2

(Continued)

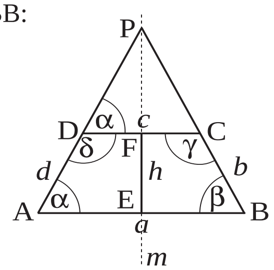
b) Sheet with isosceles triangle

On your isosceles triangle, draw any line which is parallel with the base. Label the points lke this. (T shows on BB.)

What is the quadrilateral ABCD? (a symmetrical or chord trapezium)

Ps come to BB to point out its line of symmetry and equal angles and sides. Class agrees/disagrees.

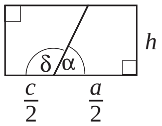
BB:



i) How could we write the perimeter of ABCD? Ps dictate to T or come to BB. Who agrees? Who thinks something else?

$P = a + b + c + d$,
but $d = b$,
so $P = \underline{a + 2b + c}$

ii) How could we write the area of ABCD? Ps make suggestions. If necessary, T directs their thinking by drawing a diagram (or by manipulating two cut-out pieces of the trapezium) and eliciting the values of the sides.

BB: 

$A = \left(\frac{a}{2} + \frac{c}{2}\right) \times h = \underline{\frac{a + c}{2} \times h}$

iii) What is the sum of the angles in ABCD? e.g.

$\angle A = \angle B = \alpha = \beta$ and $A\hat{D}C = B\hat{C}D = \gamma = \delta$

but at vertex D, we can see that $\alpha + \delta = 180°$ (straight angle)

(or show that angles $\alpha + \delta$ form a straight angle in the rectangle formed in ii).

so the sum of the angles of ABCD is:

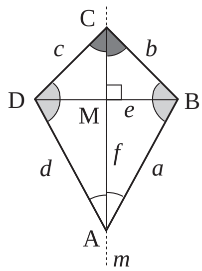
$\alpha + \beta + \gamma + \delta = 2\alpha + 2\beta = 2 \times (\alpha + \beta)$

$= 2 \times 180° = \underline{360°}$

c) Sheet with deltoid.

What do you noice about this shape? (symmetrical) How many lines of symmetry does it have? (1) Ps show it by folding the paper or by drawing. Ps label the vertices appropriately.

BB:



Who can tell me some properties of the deltoid? Ps come to BB or dictate to T, adding extra labelling as necessary. Class agrees/ disagrees. T suggests some if necessary.

(e.g. AC $\perp$ BD, DM = MB, $a = d$, $b = c$, $A\hat{D}C = A\hat{B}C$)

(mirror images of each other)

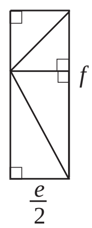
i) How can we write the perimeter of the deltoid?

BB: $P = a + b + c + d = 2a + 2b = 2 \times (a + b)$

ii) How can we write the area of the deltoid?

e.g. $A = \frac{e}{2} \times f$ (where e and f are the lengths of the diagonals)

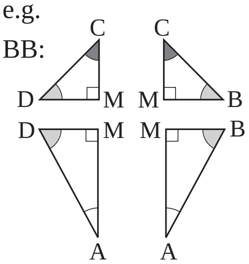
T draws a diagram or cuts the deltoid into 4 pieces and forms a rectangle.



ii) What is the sum of the angles at the vertices of the deltoid?

e.g.

BB:



$M\hat{C}D + M\hat{D}C = 90°$ [180° – 90°]

$M\hat{C}B + M\hat{B}C = 90°$

$M\hat{B}A + M\hat{A}B = 90°$

$M\hat{A}D + M\hat{D}A = 90°$

So $\angle A + \angle B + \angle C + \angle D$

$= 4 \times 90° = \underline{360°}$

(as the sum of the angles in a triangle is 180° and the 3rd angle in each triangle is 90°)

21 min

Y6

Lesson Plan 92

Activity		***Notes***

3

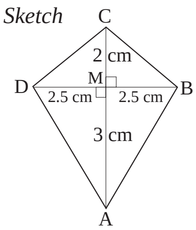
PbY6b, page 92

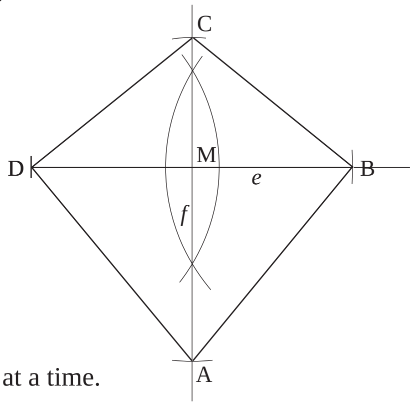
Q.1 a) Read: *Construct this* **deltoid** *accurately using the data given in the sketch*

Set a short time limit. Ask Ps to think about the order of the steps first before doing the actual construction.

Review quickly with whole class. T chooses Ps to tell the class how they drew their deltoid, referring to the diagram on BB. Who did the same? Who did it a different way? etc. Class agrees on a good method.

Solution:





Deal with b), c) and d) one at a time.

Set a time limit. Ps show results on scrap paper or slates on command. Ps with correct answers explain their reasoning at BB. Who did the same? Who did it a different way? etc. Mistakes discussed and corrected

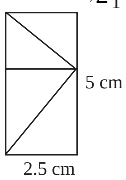
b) *Calculate the area of the deltoid. (Find right-angled triangles.)*

Solution: e.g.

$$A = \frac{2.5 \times 2}{2} + \frac{2.5 \times 2}{2} + \frac{2.5 \times 3}{2} + \frac{2.5 \times 3}{2}$$

$$= \cancel{2}^{1} \times \frac{2.5 \times 2}{\cancel{2}_1} + \cancel{2}^{1} \times \frac{2.5 \times 3}{\cancel{2}_1} = 5 + 7.5 = \underline{12.5}\ (\text{cm}^2)$$

or



A = 5 cm × 2.5 cm

= $\underline{12.5\text{ cm}^2}$

c) *Measure the angles of the deltoid and add them together.*

Ps use protractors, extending the sides of the deltoid where necessary.

Solution:

$\angle A \approx 80°$, $\angle B = \angle D \approx 89°$, $\angle C \approx 102°$

$\sum$angles $\approx$ 80° + 2 × 89° + 102° = 182° + 178° = $\underline{360°}$

d) *Measure the sides of the deltoid and add their lengths together.*

AB = AD ≈ 3.9 cm, CB = CD ≈ 3.2 cm

P = (3.9 cm + 3.2 cm) × 2 = 7.1 cm × 2 = $\underline{14.2\text{ cm}}$

26 min

Notes

Individual work, monitored, helped, corrected

(or b), c), d) done with the whole class)

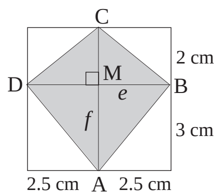
Sketch drawn on BB or use enlarged copy master or OHP

Discussion, reasoning, agreement, self-correction, praising

Method e.g.

1. Draw DB 5 cm long.
2. Draw its perpendicular bisector: use compasses to draw arcs from B and D above and below BD; draw a line through the 2 points of intersection of the arcs.
3. Mark point C at 2 cm above DB and point A at 3 cm below DB on the bisector.
4. Join D and B to A and C.
5. Label M the point of inter-section of DB and AC.

or



A = (5 cm × 5 cm) ÷ 2

= 25 cm^2 ÷ 2

= $\underline{12.5\text{ cm}^2}$

Revise how to use protractors if necessary.

Accept ± 1° but Ps with very inaccurate results should be asked to measure again, with the help of a more able P.

Elicit or remind Ps that '$\sum$' is the mathematical notation for 'sum of'.

Y6

Lesson Plan 92

Activity		*Notes*

4

PbY6b, page 92

Q.2 Read: *a) Complete the drawing of a* ***rhombus.*** *Label its vertices.*

b) Calculate the area of the rhombus.

c) Measure its angles and add them together.

d) Measure its sides and calculate its perimeter

Deal with one part at a time under a time limit and review before continuing with the next part.

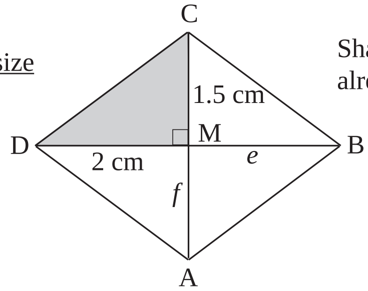
Ps come to BB to complete the shape on BB and explain their construction. Who did the same? Who did it another way? Elicit the main properties of the rhombus. (It is a special deltoid.)

Ps show area, sum of angles and perimeter on scrap paper or slates on command. Ps with correct answers explain reasoning at BB. Who did it another way? Mistakes discussed and corrected

Solution:

a)

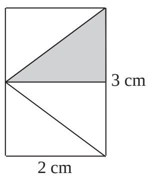
Actual size



Shaded triangle already given

b) $A = \cancel{4}^{2} \times \dfrac{2 \times 1.5}{\cancel{2}_{1}} = 2 \times 3 = \underline{6}$ (cm^2)

or



$A = 2 \text{ cm} \times 3 \text{ cm}$

$= \underline{6 \text{ cm}^2}$

c) $\angle A = \angle C \approx 106°, \quad \angle B = \angle C \approx 74°$

Σ angles $\approx 2 \times (106° + 74°) = 2 \times 180° = \underline{360°}$

d) AB = AD = CB = CD $\approx$ 2.5 cm

$P \approx 2.5 \text{ cm} \times 4 = \underline{10 \text{ cm}}$

Notes:

Individual work, monitored, helped, a) corrected

(or whole class activity for b), c) and d) if Ps are unsure)

Drawn on BB SB or OHT

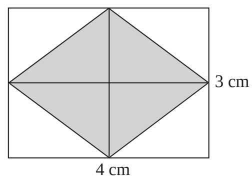
Ps can do calculations and sketch any supplementary diagrams in *Ex. Bks.*

Discussion, reasoning, agreement, self-correction, praising

T could have the 4 separate right-angled triangles cut out so that Ps can manipulate them on the BB.

Ps can label the 2 diagonals *e* and *f*.

or



$A = \dfrac{4 \times 3}{2} = \underline{6}$ (cm^2)

i.e. $A = \dfrac{e \times f}{2}$

31 min

5

PbY6b, page 92

Q.3 Read: *a) Construct a* ***square*** *which has sides 3.5 cm long.*

b) Calculate its area. *c) Calculate its perimeter.*

d) Calculate the sum of its angles.

e) Draw and measure its diagonals.

f) Measure the angles formed by the diagonals.

Set a time limit. Make sure that Ps' diagrams are correct before they do parts b) to f). Ps use rulers, set squares and compasses. Remind Ps to label their diagrams.

Review with whole class. Ps come to BB to explain reasoning. Class agree/disagrees. Mistakes discussed and corrected.

Elicit that a square is a regular deltoid and a regular rhombus.

Notes:

Individual work, monitored, helped, a) corrected

Ps work in *Ex. Bks.*

Quick discussion on how to draw a square.

Differentiation by time limit

Discussion, reasoning, agreement, self-correction, praising

Elicit the properties of a square. (sides, angles, diagonals)

Y6 — *Lesson Plan 92*

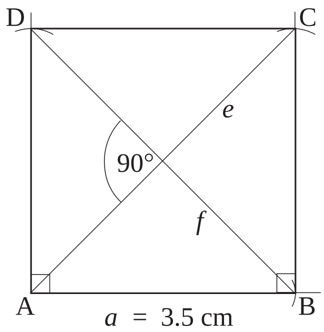
Activity		**Notes**

5

(Continued)

Solution:

a) Actual size



b) A = 3.5 cm × 3.5 cm = 12.25 cm²

c) P = 4 × 3.5 cm = 14 cm

d) Σ angles = 4 × 90° = 360°

e) $e = f \approx$ 4.9 cm (accept 5 cm)

f) The angles formed by the diagonals are 90°. $e \perp f$

Notes:

Method e.g.

1. Draw AB.
2. Use a set square to draw perpendicular rays from A and from B.
3. Set compasses to 3.5 cm and mark the points C and D on the two rays.
4. Join C to D.

		3.	5
	×	3.	5
	1	7	5
1	0	5	0
1	2.	2	5
	1		

36 min

6

PbY6b, page 92

Q.4 Read: *a) Construct a* ***rectangle*** *which has sides 4 cm and 3 cm long.*

b) Calculate its area. *c) Calculate its perimeter.*

d) Calculate the sum of its angles.

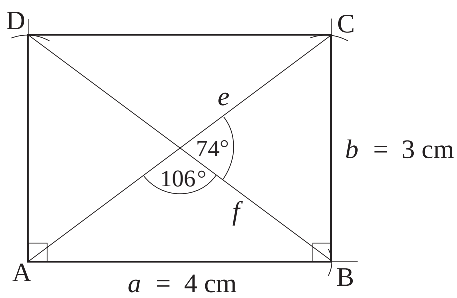
e) Draw and measure its diagonals.

f) Measure the angles formed by its diagonals.

As for Activity 5. Elicit that a rectangle is neither a deltoid nor a rhombus and that not all rectangles are squares but every square is a regular rectangle.

Solution:

a) Actual size



b) A = 4 × 3 = 12 (cm²)

c) P = 2 × (4 + 3) = 14 (cm)

d) Σ angles = 4 × 90° = 360°

e) $e = f$ = 5 cm

f) Angles at the intersection of the diagonals are approximately 74° and 106°.

(2 adjacent angles form a straight angle)

Notes:

Individual work, monitored, helped, a) corrected

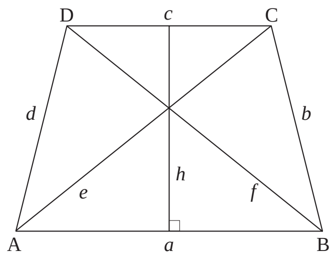
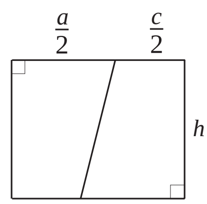
Method of construction as for a square.

Discussion, reasoning, agreement, self-correction, praising

41 min

Y6

Lesson Plan 92

Activity		*Notes*
7 **Erratum** In *Pbs*: 2nd '(d)' should be 'f)'	***PbY6b, page 92*, *Q.5*** Deal with one part at a time. Ps measure or calculate individually then dictate to T (or show results on scrap paper or slates on command). Ps explain reasoning where relevant and class agrees on correct answer. In d), T has two parts of the trapezium cut out to show how they can form a rectangle to make the calculation of the area easier. *Solution:* a) *What is the name of this shape?* (chord trapezium) b) *Measure its diagonals.* ($e = f \approx 6.4$ cm) c) *Measure its sides.* ($a = 6$ cm, $b = d \approx 4.1$ cm, $c = 4$ cm) d) *Calculate its perimeter.* ($P = 6$ cm $+ 4$ cm $+ 2 \times 4.1$ cm $= 10$ cm $+ 8.2$ cm $=$ <u>18.2 cm</u> e) *Measure its angles and add them together.* ($\angle A = \angle B \approx 76°$, $\angle C = \angle D \approx 104°$ $\angle A + \angle B + \angle C + \angle D \approx 2 \times (76° + 104°) = 2 \times 180°$ $= \underline{360°}$) e) *Calculate its area.* ($A = \dfrac{a+c}{2} \times h = \dfrac{6+4}{2} \times 4 = \dfrac{10}{2} \times 4$ $= 5 \times 4 = \underline{20}$ (cm^2))	Whole class activity (or individual work under a time limit, reviewed with whole class) Drawn on BB or use enlarged copy master or OHP BB:  

45 min

Y6

R: Geometric definitions

C: Practice : Reflection in a line. Symmetry. Construction.

E: Problems

Lesson Plan 93

Activity　　***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>93</u> $= 3 \times 31$　　Factors: 1, 3, 31, 93
- <u>268</u> $= 2 \times 2 \times 67 = 2^2 \times 67$　　Factors: 1, 2, 4, 67, 134, 268
- <u>443</u> is a prime number　　Factors: 1, 443
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, and $23^2 > 443$)
- <u>1093</u> is a prime number　　Factors: 1, 1093
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and $37 \times 37 > 1093$)

Notes:

Individual work, monitored (or whole class activity)

BB: 93, 268, 443, 1093

Ps may use calculators.

Reasoning, agreement, self-correction, praising

e.g.

268	2
134	2
67	67
1	

8 min

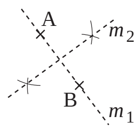
2

Lines of symmetry

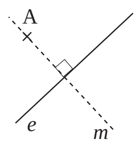
T has diagrams on BB or OHT.

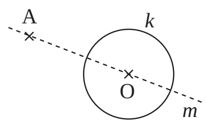
Let's draw lines of symmetry on these diagrams. Ps come to BB to use BB instruments (or to OHT using own instruments) to construct the lines of symmetry, explaining in a loud voice what they are doing. Class makes helpful suggestions or points out errors where necessary.

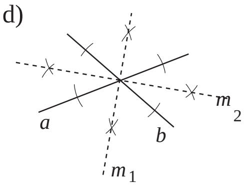
BB:

a)


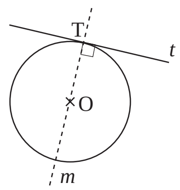
$m_1 \perp m_2$

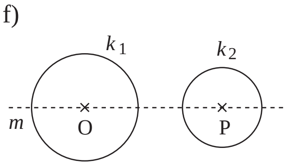
b)


c)


d)


$m_1 \perp m_2$

e)


f)


In d), elicit/point out that when two lines intersect:

- <u>opposite</u> angles are equal
- the lines of symmetry are the <u>bisectors</u> of the angles (i.e. they cut them in half).

Notes:

Whole class activity

Drawn on BB or use enlarged copy master or OHP

(If possible, Ps have own version on desks too, so that they can check the lines of symmetry by folding the paper. Otherwise T has versions on sheets of paper.)

Reasoning, agreement, checking, praising

T makes sure that the main points of each construction are stressed.

In e), elicit or remind Ps that line t is a <u>tangent</u> to the circle (i.e. the line and the circle share one common point, T).

15 min

Y6

Lesson Plan 93

Activity		*Notes*

3

Constructing angles

a) How could we construct an angle of $60°$ using a ruler and compasses?

Ps make suggestions and come to BB to show their methods. T give hints if Ps have no ideas. [e.g. What shape do you know has $60°$ angles? (equilateral triangle) What is special about an equilateral triangle? (equal sides, as well as equal angles, so can be inscribed in a circle).]

If Ps still cannot think what to do, T leads Ps through the construction, involving them where possible, while rest of class construct the angle in *Ex. Bks.* too. Ps check that the angle is $60°$ with a protractor.

Method

1. Draw a ray, *e*, from a point A.
2. Mark a point on *e* and label it B.
3. Set compasses to length AB, then draw an arc with radius AB around A.
4. Keeping compasses set to length AB, draw an arc with radius AB around B.
5. Draw a ray from A through the point where the two arcs intersect. Label it *f*.

Notes:

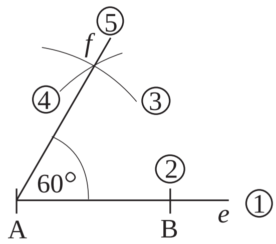
Whole class activity

Discussion, reasoning, agreement, checking, praising

Involve several Ps

Extra praise if a P thinks of the method without help from T.

BB: Constructing a $60°$ angle



b) How could we draw an angle of $30°$ using a ruler and compasses? (Draw an angle of $60°$, then halve it.) What do we need to draw to halve the angle? (Construct the bisector of the angle.)

Ps come to BB to amend the angle on BB (or draw another $60°$ angle first) explaining what they are doing. Ps copy steps in *Ex. Bks*.

Method:

1. Construct an angle of $60°$ (as previously).
2. With compasses at the same width, mark points on *e* and *f* which are equal distances from A.
3. Draw arcs with equal radii around the marked points.
4. Draw a line from A through the point where the two arcs intersect.

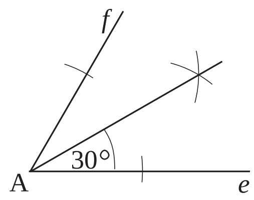
Ps check that the angle is $30°$ using a protractor.

Notes:

Ps make suggestions. T gives hints if necessary.

At a good pace

BB: Constructing a $30°$ angle



Agreement, checking, praising

20 min

4

PbY6b, page 93

Q.1 a) Read: *Construct an **equilateral** triangle with 4 cm sides. Label its vertices.*

Set a short time limit. Review with whole class. Ps come to BB or OHP to show and explain the construction. Who did the same? Who did it a different way?

(e.g. Draw AB 4 cm long. Set compasses to 4 cm and draw arcs around A and B. Label C the point of intersection of the the two arcs. Join C to A and B.)

Ps compare their own drawings with that on BB and correct any mistakes.

What is the perimeter of triangle ABC? (P = 12 cm)

What is the sum of its angles? ($3 \times 60° = \underline{180°}$)

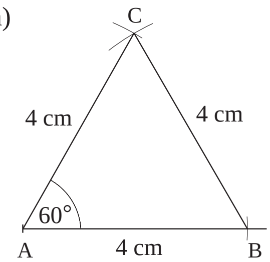
Notes:

Individual work, monitored, helped corrected

Reasoning, agreement, self-correction, praising

Feedback for T

a)



Y6

Lesson Plan 93

Activity

4 (Continued)

b) Read: ***Reflect** it in the line BC. Label the mirror image of A with D. What kind of shape is ABDC?*

Allow Ps to use any method they wish but give extra praise to Ps who use only compasses to mark point D.

Review with whole class. Ps show name of shape on scrap paper or slates on command. (ABDC is a <u>rhombus</u>.)

Elicit the main features of rhombus ABCD. (4 equal sides, opposite sides parallel, diagonals meet at right angles, $\angle A = \angle D = 60°$, $\angle B = \angle C = 2 \times 60° = 120°$)

c) Read: ***Reflect** the second triangle in line BD. Label the mirror image of C with E.*

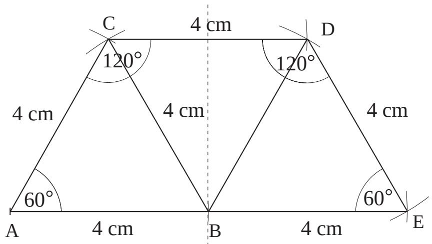
Ps can use compasses to mark point E, or Ps might realise that they can extend AB by 4 cm. Accept both methods.

d) Read: *What shape do the the three triangles form altogther? Measure or calculate its angles and add them together.*

Set a short time limit. Ps show name, then sum of angles on scrap paper or slates on command. Ps with different responses explain reasoning. Class agrees on correct answer.

Solution:

The 3 triangles form a symmetrical or chord <u>trapezium</u>.



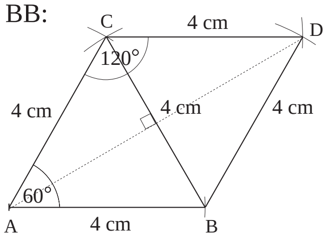
Elicit that the line of symmetry is the <u>perpendicular bisector</u> of AE and CD (passing through point B)

27 min

Notes

T could have rhombus already constructed, or choose quicker Ps to demonstrate and explain construction on BB.

BB:



T has larger version already prepared for Ps to compare with their own drawings (or manipulates cut-out triangles)

Responses shown in unison.

Reasoning, agreement, self-correction, praising

$\angle A + \angle E + \angle D + \angle C$

$= 2 \times (60° + 120°)$

$= 2 \times 180° = \underline{360°}$

What is its perimeter?

$P = 5 \times 4$ cm $=$ <u>20 cm</u>

---

5 ***PbY6b, page 93***

Q.2 Read: *Calculate the missing angles in the table if AB = AC and the given angle is:*

a) $\alpha = 40°$ *b)* $\gamma = 65°$ *c)* $\gamma^* = 120°$.

What kind of triangle is ABC? (isosceles triangle) What do you notice about angles alpha and alpha star, beta and beta star, gamma and gamma star? (Each pair forms a straight angle of 180°.)

Set a time limit or deal with one row at a time.

Review with whole class. Ps come to BB to explaining reasoning and referring to diagram. Class agrees/disagrees. Mistakes discussed and corrected.

Solution:

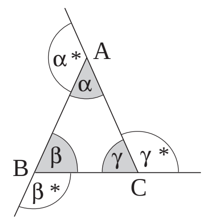
	α	β	γ	α*	β*	γ*	α + β + γ	α* + β* + γ*
a)	**40°**	70°	70°	140°	110°	110°	180°	360°
b)	50°	65°	**65°**	130°	115°	115°	180°	360°
c)	60°	60°	60°	120°	120°	**120°**	180°	360°

32 min

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

BB:



Discussion, reasoning, agreement, self-correction, praising

Bold values are given.

Y6

Lesson Plan 93

Activity | ***Notes***

6

PbY6b, page 93

Q.3 Read: *Each of the angles below is* $60°$. *Construct:*

a) *a* $45°$ *angle on this diagram*

b) *a* $120°$ *angle on this diagram*

c) *a* $90°$ *angle on this diagram.*

Individual trial, monitored, helped

(or whole class activity, with Ps dictating the steps, T or P working on BB and Ps following steps in *Pbs*)

Drawn on BB or use enlarged copy master or OHP

Deal with one at a time. T points out that the angles could be measured with a protractor, but the word 'construct' does not mean measure. Ps should try it using only compasses and ruler, then check their angles with a protractor.

Set a short time limit. Ps who think they have done it come to BB to demonstrate their methods to class. Who did the same? Who used a different method? If no P thought of labelling the marked points, T could suggest it so that the method can be explained more easily, as below. Mistakes corrected.

Discussion, reasoning, agreement, checking (self-correction), praising

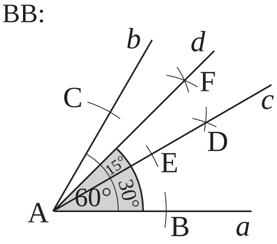
T repeats Ps' descriptions of their constructions more clearly/concisely if necessary.

Solution: e.g.

a) Method

1. Set compasses and mark points on *a* and *b* which are an equal distance from A. Label the points B and C.
2. Draw arcs with radius AB around B and around C. Label D the point where they intersect.
3. From A, draw a ray, *c*, through point D. Ray *c* is the bisector of angle A.
4. Mark point E on ray *c* so that AE = AC.
5. Draw arcs with radius AC around C and around E. Label F the point where they intersect.
6. From A, draw a ray, *d*, through point F. Ray *d* is the bisector of angle CAD.
   The angle formed by rays *a* and *d* is $45°$.

BB:



$F\hat{A}B = F\hat{A}D + D\hat{A}B$

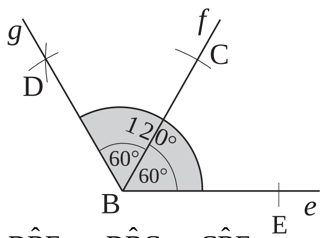
$= 15° + 30°$

$= \underline{45°}$

b) Method

1. Mark any point C on *f*.
2. Draw arcs with radius BC on the left of *f* around B and around C. Label D the point where the arcs intersect.
3. From B, draw a ray, *g*, through D. The angle formed by *f* and *g* is $60°$. The angle formed by *e* and *g* is $120°$.

(To explain the reasoning more easily, mark any point E on *e*.)



$D\hat{B}E = D\hat{B}C + C\hat{B}E$

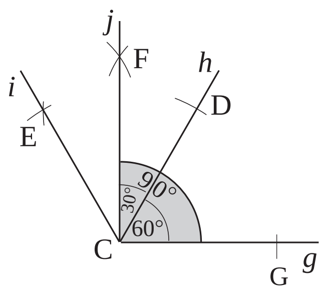
$= 60° + 60° = \underline{120°}$

c) Method

1. Mark any point D on *h*.
2. Draw arcs with radius CD on the left of *h* around C and around D. Label E the point where the arcs intersect.
3. From C, draw a ray, *i*, through E.
   The angle formed by rays *h* and *i* is $60°$.
4. Draw arcs with equal radius, between *i* and *h*, around D and around E. Label F the point where the arcs intersect.
5. From C, draw a ray through F and label it *j*. (*j* is the bisector of angle ECD.)

   The angle formed by rays *g* and *j* is $90°$.

(To explain the reasoning more easily, mark any point G on *g*.)



$F\hat{C}G = F\hat{C}D + D\hat{C}G$

$= 30° + 60° = 90°$

37 min

Y6

Lesson Plan 93

Activity | ***Notes***

7

PbY6b, page 93

Q.4 Read: *Describe the steps needed to find the centre of the circle.*

*A c**hord,** AB, and its **perpendicular bisector,** line e, have been drawn .*

Allow Ps a couple of minutes to write the steps and carry them out on the diagram as a check.

Review with whole class. T chooses Ps to read their descriptions while another P carries them out on diagram on BB or OHT. Who thought the same? Who thought of another way to do it? etc.

Class agrees on the correct form of words. Ps who were wrong or who could not write a description, copy the correct steps in *Pbs*, amending diagram appropriately.

Solution: e.g.

1. Mark another point, C, on the circumference and draw chord AC.
3. Construct the perpendicular bisector of AC. (Draw arcs of equal radius around A and around C. Draw a line through the 2 points of intersection). Label it *f*.
4. The point where *e* and *f* intersect is the centre of the circle. Label it O.

Elicit that OA = OB = OC, as they are radii of the circle.

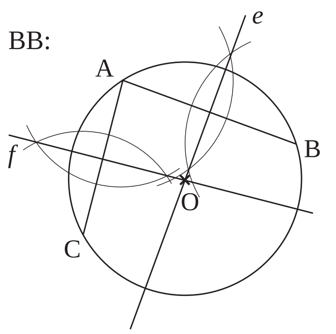
Notes: Individual trial first, monitored closely

(or whole class activity if Ps are not very able or time is short)

Drawn on BB or use enlarged copy master or OHP

Reasoning, agreement (self-correction), praising

BB:



41 min

8

PbY6b, page 93

Q.5 Read: *Construct a **trapezium** which has these dimensions.*

Base: a = 5.2 cm, Height: h = 3.4 cm, $\angle\alpha = 60°$

Allow Ps a couple of minutes to think about it and try it out in *Ex. Bks.* Extra praise if Ps notice that there is not enough information given (as side *b* could be any length ≥ 3.4 cm).

T accepts this, or suggests that Ps draw a chord (symmetrical) trapezium, so that both base angles are 60°.

Ps dictate the steps and T carrries them out on a larger scale on BB using BB instruments. Class agrees/disagrees. Mistakes discussed and corrected.

Solution: e.g.

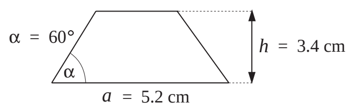
1. Draw base AB of length 5.2 cm.
2. Lay bottom edge of set square along AB and draw a line perpendicular to AB. Label it *h*.
3. Mark a point on *h* which 3.4 cm from AB.
4. Using a set square, draw a line through this marked point which is perpendicular to *h* (and also parallel to AB).
5. Construct an angle of 60° at A. (Mark a point E on AB. Draw arcs with radius AE around A and around E.

   Draw a line segment from A through the point where the arcs intersect to meet the line parallel to AB at D.)
6. Draw a line segment from B to meet the line parallel to AB at C. *(Ps choose where they want C to be.)*

Notes: Individual work, monitored, helped

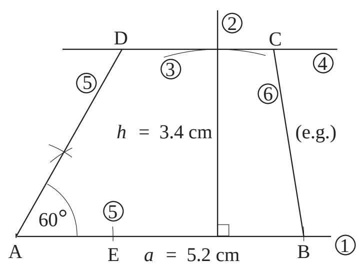
(or whole class activity if time is short)

Sketch drawn on BB or OHT:



Discussion, reasoning, agreement, (self-correction) praising

BB: e.g.



[Or if T suggests drawing a <u>chord</u> trapezium, construct an angle of 60° at B.]

45 min

Y6	R: Calculation **C: Reflection and symmetry. Regular polygons.** *E: Problems. Rotational symmetry*	*Lesson Plan* *94*

Activity

Notes

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>94</u> = 2×47 Factors: 1, 2, 47, 94
- <u>269</u> is a prime number Factors: 1, 269
  (as not exactly divisible by 2, 3, 5, 7, 11, 13 and $17^2 > 269$)
- <u>444</u> = $2 \times 2 \times 3 \times 37 = 2^2 \times 3 \times 37$
  Factors: 1, 2, 3, 4, 6, 12, 37, 74, 111, 148, 222, 444
- <u>1094</u> = 2×547 Factors: 1, 2, 547, 1094
  (547 is not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, 23, and $29 \times 29 > 547$)

Notes:

Individual work, monitored (or whole class activity)

BB: 94, 269, 444, 1094

T decides whether Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

$$\begin{array}{r|l} 94 & 2 \\ 47 & 47 \\ 1 & \end{array} \qquad \begin{array}{r|l} 444 & 2 \\ 222 & 2 \\ 111 & 3 \\ 37 & 37 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1094 & 2 \\ 547 & 547 \\ 1 & \end{array}$$

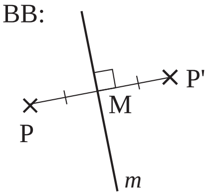
7 min

2

Reflection

a) **A**, come and mark a point on the BB and label it P.
B, come and draw a line on the BB and label it *m*.
C, come and reflect P in *m*. **C** explains in a loud, clear voice. e.g.

BB:

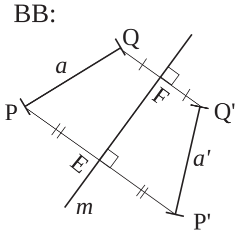


1. Draw a perpendicular line from P to *m*. Label M the point where the lines meet.
2. Extend the line by the same distance on the opposite side of *m*.
3. Label P' the mirror image of point P.

(PM = P'M, PP' $\perp$ *m*, i.e. *m* is the perpendicular bisector of PP')

b) **D**, come and draw a line segment and label it PQ.
E, come and draw an axis and label it *m*.
F, come and reflect PQ in *m*. **F** explains loudly and clearly. e.g.

BB:



1. Reflect point P in *m* and label its mirror image P'. (**F** explains method as above.)
2. Reflect point Q in *m* and label its mirror image Q'. (As above)
3. Join P' to Q'. P'Q' is the mirror image of PQ.

(PQ = P'Q', $a = a'$, PE = EP', QF = FQ', $m \perp$ PP', $m \perp$ QQ')

What shape is PP'Q'Q? (symmetrical, or chord, trapezium)

Notes:

Whole class activity

Diagrams drawn by Ps on BB or OHT

(alternatively, T has points and lines already prepared)

At a good pace.

In good humour.

Involve majority of (all) Ps.

Class points out errors or missed steps.

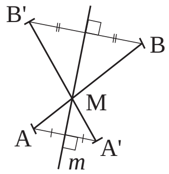
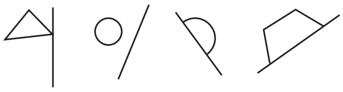
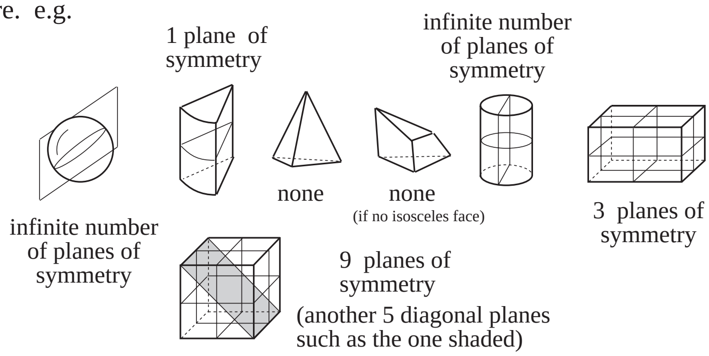
Ps need only do freehand drawings as long as they give correct explanations and note important information on the diagrams.

Reasoning, agreement, praising

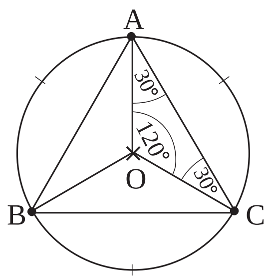
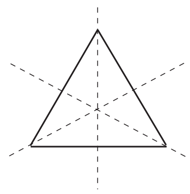
After each reflection, elicit from the class the main features (in words or using mathematical notation) with Ps adding extra labelling where needed.

Y6

Lesson Plan 94

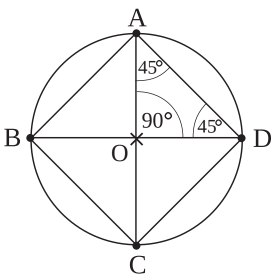
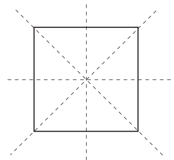
Activity		*Notes*
2	(Continued) c) **G**, come and draw a line segment and label it AB. **H**, come and draw an axis which crosses AB and label it *m*. **I**, come and reflect AB in *m*. e.g. BB:  1. Reflect point A in *m* and label its mirror image A'. 2. Reflect point B in *m* and label its mirror image B'. 3. Join A' to B'. A'B' is the mirror image of AB. (AB = A'B', AB and A'B' intersect on line *m* at point M, AM = A'M, BM = B'M, AA' $\perp$ *m*, BB' $\perp$ *m*, AA' || BB') d) One P draws an axis, a 2nd P (or T) draws a shape, a 3rd P reflects the shape in the axis and other Ps dictate the main features of the reflection. e.g.  *15 min*	Ps also give details of each reflection, as in b). Ps label the shapes and mirror images appropriately. Praising, encouragement only Feedback for T
3	**Symmetrical solids** T has various solids on desk/table in front of class. Ps come to front of class one after the other to choose a solid and say what they know about it. (Name, number of faces, edges and vertices, type of faces, etc.) Class agrees/disagrees or points out any main feature missed. Is this shape symmetrical? Stand up if you think it is. Ps standing show where the planes of symmetry are and class agrees on how many there are. e.g.  *20 min*	Whole class activity Some shapes could be made from multilink cubes, or prepared so that they can be split along the relevant planes of symmetry and the parts shown as being congruent. If possible, T has isometric diagrams of the shapes on BB too, as shown opposite. (At least one shape should <u>not</u> have planar symmetry.) At a good pace. Reasoning, demonstration, agreement, praising Agree that a sphere or cylinder has an <u>infinite</u> number of planes of symmetry.

Y6 *Lesson Plan 94*

Activity		*Notes*
4	***PbY6b, page 94***	
	Q.1 Read: *Divide the whole ($360°$) central angle of the circle into* ***3*** *equal parts.*	Whole class activiity but individual measuring and drawing (so that Ps know what to do in the following activities)
	Draw the radii and join up the ***3*** *points where the radii meet the circumference.*	Circle drawn on BB or use enlarged copy master or OHP
	What shape have you drawn?	
	What size will each angle be? ($360° \div 3 = 120°$)	
	Deal with one step at a time, with T demonstrating on BB and Ps working in *Pbs*.	Elicit each step from Ps if possible, otherwise T suggests what to do next .
	Ps use protractors to measure $120°$ angles, mark points, then lay a ruler on each marked point and the centre point and draw straight lines from the centre of the circle to the circumference. Ps join up the 3 points on the circumference and label them appropriately.	Revise how to use a protractor if necessary. T monitors, helps, corrects.
	What shape have we drawn? (equilateral triangle)	Ps shout out in unison.
	Let's collect its properties. Ps dictate to T and T writes on BB using mathematical notation where possible. T prompts where necessary (e.g. the angles at the base of the internal isosceles triangles and the number of lines of symmetry the shape has).	Whole class discussion Agreement, praising T could have the shape cut out, so that it can be folded to check the number and positions of the lines of symmetry.
	Solution: BB: Equilateral triangle  e.g. $\angle A = \angle B = \angle C = 60°$ $AB = BC = AC$ $OA = OB = OC$ (radii of circle) OA bisects $\angle A$, so $O\hat{A}B = C\hat{A}O = 30°$, etc. $\Delta OAB \cong \Delta OBC \cong \Delta OCA$ (isosceles triangles)	 (3 lines of symmetry)
	T: We can also call the shape a regular triangle.	(as its angles and sides are equal)
	If we rotate the triangle around O, after how many degrees will it line up with its original position? ($120°$, $240°$, $360°$, $480°$, $600°$, . . ., i.e. multiples of $120°$) How many times does this happen in one complete turn? (3)	T pins cut-out shape on top of the diagram to show the rotations.
	T: We say that the regular triangle has rotational symmetry of $120°$, or has rotational symmetry of order 3, around O.	
	25 min	

Y6

Lesson Plan 94

Activity		*Notes*
5	***PbY6b, page 94***	
	Q.2 Read: *Divide the whole ($360°$) central angle of the circle into **4** equal parts.*	Individual work, monitored, helped, corrected
	*Draw the radii and join up the **4** points where the radii meet the circumference.*	(or whole class activity as in Activity 4 if Ps are unsure)
	What shape have you drawn?	Circle drawn on BB or use enlarged copy master or OHP
	Set a time limit. Ps carry out construction as in Activity 4 and write the name of the shape in *Pbs*. Ps finished early write properties of the shape in *Ex. Bks*. in preparation for the discussion.	Differentiation by time limit and by extra task
	Review with whole class. Ps show name on scrap paper or slates on command. P with correct name explains to Ps who were wrong. Mistakes corrected.	Name shown in unison. Agreement, self-correction, praising
	T has shape already prepared on BB or OHT (or P finished first draws it, hidden from rest of class). Elicit its properties.	Whole class activity. Involve many Ps. Praising, encouragment only. T prompts where necessary.
	Solution: BB: <u>Square</u> e.g. $\angle A = \angle B = \angle C = \angle D = 90°$	
		
	AB = BC = CD = DA OA = OB = OC = OD (radii) OA bisects $\angle A$, so $B\hat{A}O = D\hat{A}O = 45°$, etc. $\Delta OAB \cong \Delta OBC \cong \Delta OCD \cong \Delta ODA$ (right-angled, isosceles triangles)	(4 lines of symmetry)
	T: We can also call the shape a <u>regular quadrilateral</u>.	(a quadrilateral with equal sides and angles)
	If we rotate the square around O, after how many degrees will it line up with its original position? ($90°$, $180°$, $270°$, $360°$, $450°$, . . ., i.e. multiples of $90°$) How many times does this happen in one complete turn? (4)	Demonstrate rotation with cut-out square pinned to diagram on BB.
	T: We say that the square has rotational symmetry of $90°$, or has rotational symmetry of <u>order 4</u>, around O.	
	30 min	

Y6

Lesson Plan 94

Activity		Notes

6

PbY6b, page 94

Q.3 Read: *Divide the whole (360°) central angle of the circle into **5** equal parts.*

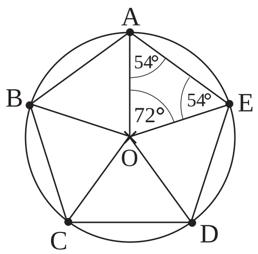
*Draw the radii and join up the **5** points where the radii meet the circumference.*

What shape have you drawn?

Deal with this activity in a similar way to *Activity 5*.

Solution:

BB: <u>Pentagon</u>



$\angle A = \angle B = \angle C = \angle D = \angle E = 108°$

AB = BC = CD = DE = EA

OA = OB = OC = OD = OE

OA bisects $\angle A$, so

$B\hat{A}O = E\hat{A}O = 54°$, etc.

$\Delta OAB \cong \Delta OBC \cong \Delta OCD \cong \Delta ODE \cong \Delta OEA$

(isosceles triangles)

T: We can also call the shape a <u>regular pentagon.</u>

If we rotate the pentagon around O, after how many degrees will it line up with its original position?

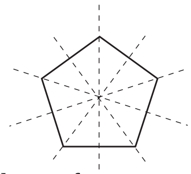
(72°, 144°, 216°, 288°, 360°, 432°, . . ., i.e. multiples of 72°)

How many times does this happen in one complete turn? (5)

T: We say that the pentagon has rotational symmetry of 72°, or has rotational symmetry of <u>order 5</u>, around O.

Notes: Individual work, monitored, helped, corrected under a time limit, then reviewed and properties discussed with the whole class, as in *Activity 5*

Ps measure $\angle A$, etc. with protractors.



(5 lines of symmetry)

(as it is a pentagon with equal angles and equal sides)

Demonstrate rotation with cut-out pentagon pinned to diagram on BB.

35 min

7

PbY6b, page 94

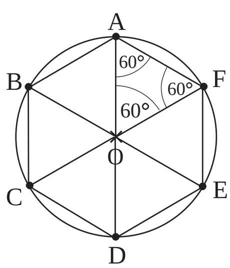
Q.4 Read: *Divide the whole (360°) central angle of the circle into **6** equal parts.*

*Draw the radii and join up the **6** points where the radii meet the circumference. What shape have you drawn?*

Deal with this activity in a similar way to *Activity 5*.

Solution:

BB: <u>Regular Hexagon</u>



$\angle A = \angle B = \ldots = \angle F = 120°$

AB = BC = CD = DE = EF = FA

OA = OB = OC = OD = OE = OF

OA bisects $\angle A$, so

$B\hat{A}O = F\hat{A}O = 60°$, etc.

$\Delta OAB \cong \Delta OBC \cong \Delta OCD \cong \Delta ODE \cong \Delta OEF \cong \Delta OFA$

(regular triangles)

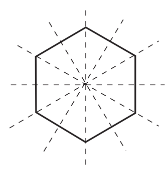
If we rotate the hexagon around O, after how many degrees will it line up with its original position?

(60°, 120°, 180°, 240°, 300°, 360°, . . ., i.e. multiples of 60°)

How many times does this happen in one complete turn? (6)

T: We say that the pentagon has rotational symmetry of 60°, or has rotational symmetry of <u>order 6</u>, around O.

Notes: Individual work, monitored, helped, corrected under a time limit, then reviewed and properties discussed with the whole class, as in *Activity 5*



(6 lines of symmetry)

Demonstrate rotation with cut-out hexagon pinned to diagram on BB.

40 min

Y6

Lesson Plan 94

Activity		*Notes*

8

PbY6b, page 94

Q.5 Read: *Divide the whole (360°) central angle of the circle into **8** equal parts.*

*Draw the radii and join up the **8** points where the radii meet the circumference.*

What shape have you drawn?

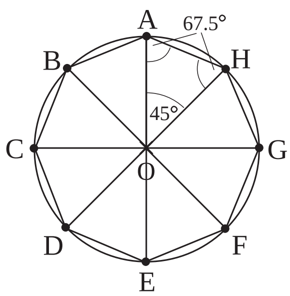
Individual work, monitored, helped, corrected under a time limit, then reviewed and properties discussed with the whole class, as in *Activity 5*

Deal with this activity in a similar way to *Activity 5*.

Solution:

BB: Regular Octagon

BB: $360° \div 8 = \underline{45°}$



$\angle A = \angle B = \ldots = \angle H = 135°$

$AB = BC = CD = DE = \ldots = HA$

$OA = OB = OC = OD \ldots = OH$

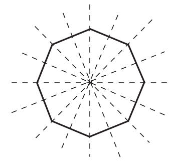
OA bisects $\angle A$, so

$B\hat{A}O = H\hat{A}O = 67.5°$, etc.

$\Delta OAB \cong \Delta OBC \cong \Delta OCD$
$\cong \Delta ODE \cong \Delta OEF \cong \Delta OFG$
$\cong \Delta OGH \cong \Delta OHA$

(isosceles triangles)

BB: $135° \div 2 = 67.5°$



(8 lines of symmetry)

If we rotate the octagon around O, after how many degrees will it line up with its original position?

(45°, 90°, 135°, 180°, 225°, 270°, 315°, 360° . . ., i.e. multiples of 45°)

How many times does this happen in one complete turn? (8)

T: We say that the octagon has rotational symmetry of 45°, or has rotational symmetry of <u>order 8</u>, around O.

Demonstrate rotation with cut-out octagon pinned to diagram on BB.

45 min

Y6

Lesson Plan 95

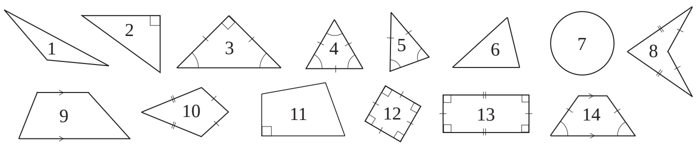
Activity

Factorising 95, 270, 445 and 1095. Revision, activities, consolidation

PbY6b, page 95

Solutions:

Q.1



a) Line symmetry: 3, 4, 5, 7, 8, 10, 12, 13, 14

b) Rotational symmetry: 4, 7, 12, 13

c) Regular: 4, 7, 12

d) At least 1 obtuse angle: 1, 9, 10, 11, 14

e) Only acute angles: 4, 5, 6,

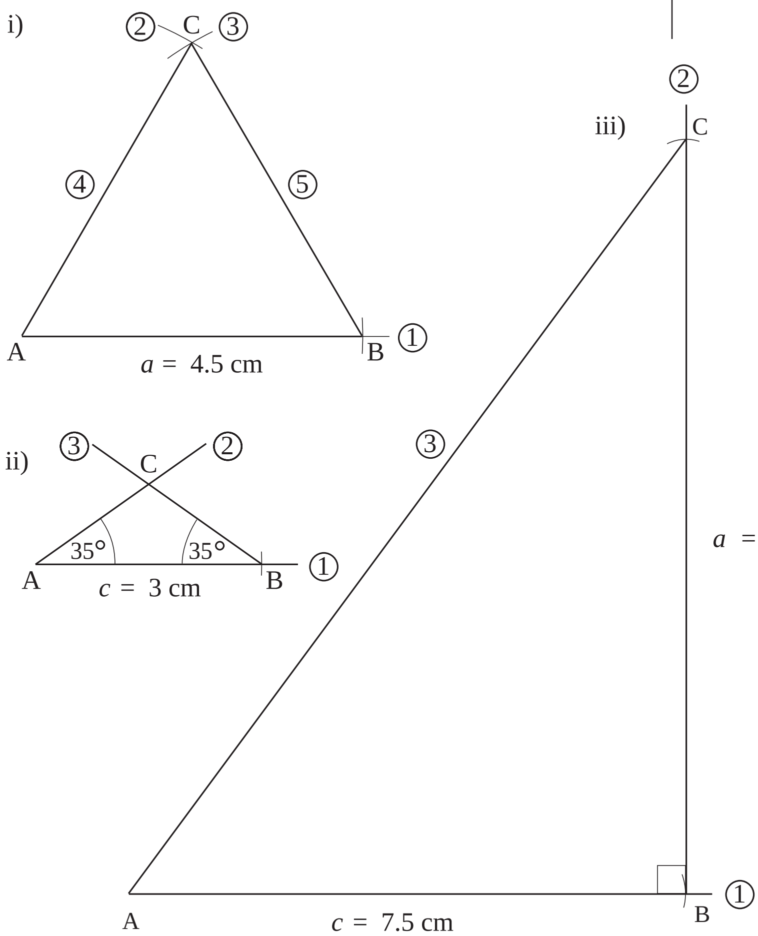
f) Trapezium: 9, 12, 13, 14

g) Deltoid: 8, 10, 12,

h) Rhombus: 12

i) Not a polygon: 7

Q.2 a) i)



Erratum

In *Pbs*: last three questions should be labelled g), h) and i)

Notes

$\underline{95} = 5 \times 19$

Factors: 1, 5, 19, 95

$\underline{270} = 2 \times 3^3 \times 5$

Factors: 1, 2, 3, 5, 6, 9, 10, 15, 18, 27, 30, 45, 54, 90, 135, 270

$\underline{445} = 5 \times 89$

Factors: 1, 5, 89, 445

$\underline{1095} = 3 \times 5 \times 73$

Factors: 1, 3, 5, 15, 73, 219, 365, 1090

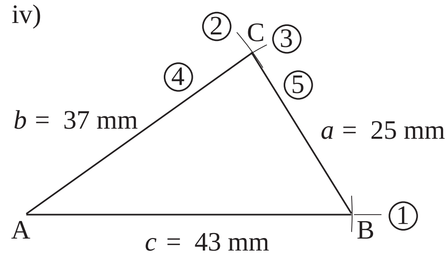
(or set factorising as homework at the end of *Lesson 94* and review at the start of *Lesson 95)*

Y6		*Lesson Plan 95*

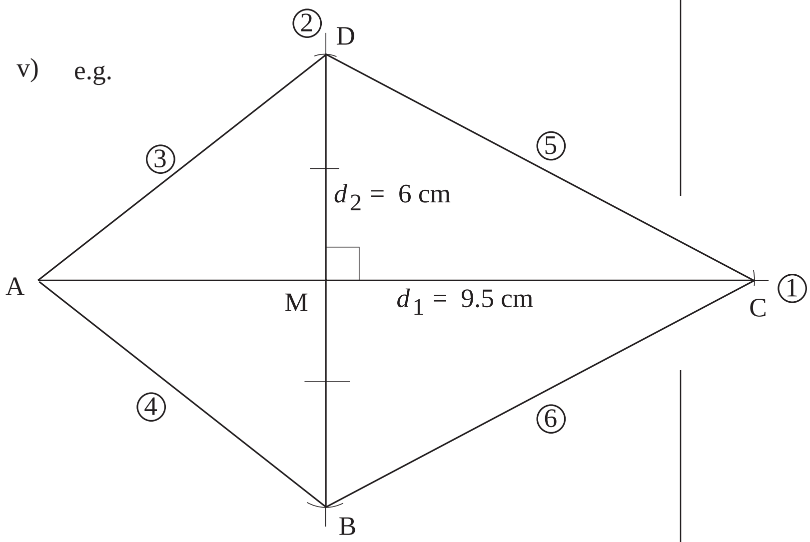
Activity ***Notes***

Solutions (Continued)

Q.2 a) iv)



v) e.g.

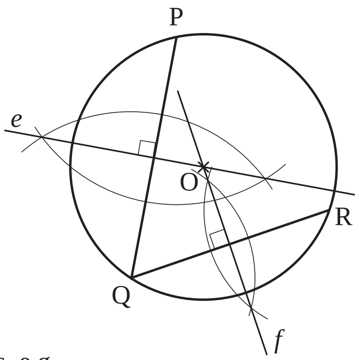


(BD could intersect AC at any point.)

vi) Such a trapezium is impossible!

b) Accept any valid statement.

Q.3 a) e.g.



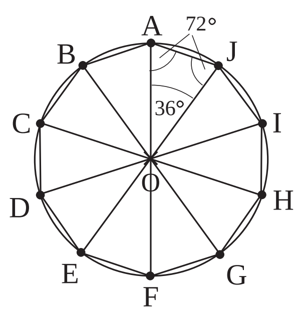
c) OP = OQ = OR
= r = <u>17.5 mm</u>

d) $d = 2 \times r$
= <u>35 mm</u>

b) <u>Steps</u> e.g.

1. Construct the perpendicular bisector of PQ. Label it *e*.
2. Choose a point R on the circumference and draw the chord QR.
3. Construct the perpendicular bisector of QR. Label it *f*.
4. Label 'O' the point where *e* and *f* intersect.
   O is the centre of the circle.

Q.4 360° ÷ 10 = <u>36°</u>



∠A = 144°

144° ÷ 2 = 72°

Y6

R: Calculations. Angles

C: Order of rotational symmetry

E: Problem solving

Lesson Plan 96

Activity | *Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>96</u> = $2 \times 2 \times 2 \times 2 \times 2 \times 3 = 2^5 \times 3$
  Factors: 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96
- <u>271</u> is a prime number Factors: 1, 271
  (as not exactly divisible by 2, 3, 5, 7, 11, 13 and $17^2 > 271$)
- <u>446</u> = 2×223 Factors: 1, 2, 223, 446
- <u>1096</u> = $2 \times 2 \times 2 \times 137 = 2^3 \times 137$
  Factors: 1, 2, 4, 8, 137, 274, 548, 1096

7 min

Individual work, monitored (or whole class activity)

BB: 96, 271, 446, 1096

T decides whether Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

$$\begin{array}{r|l} 96 & 2 \\ 48 & 2 \\ 24 & 2 \\ 12 & 2 \\ 6 & 2 \\ 3 & 3 \\ 1 & \end{array} \qquad \begin{array}{r|l} 446 & 2 \\ 223 & 223 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1096 & 2 \\ 548 & 2 \\ 274 & 2 \\ 137 & 137 \\ 1 & \end{array}$$

2

Properties of regular polyhedra

T has various models on desk at front of class.

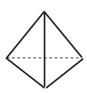
What do all these shapes have in common? (3-D solids, they have only plane faces) Who remembers the name of a 3–D shape which has many plane faces? (a <u>polyhedron</u>) T writes it on BB.

These solids are special kinds of <u>polyhedra</u> (plural of polyhedron).

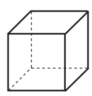
T holds up each solid in turn. Elicit or tell Ps the name of each solid [Ps might guess the <u>hex</u>ahedron (<u>6</u> faces) and <u>octa</u>hedron (<u>8</u> faces)] then elicit its properties. T prompts only if necessary.

BB: <u>Polyhedra</u>

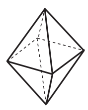
e.g.



<u>Tetrahedron</u>



<u>Hexahedron</u>
<u>Cube</u>



<u>Octahedron</u>

e.g.	Tetrahedron	Hexahedron	Octahedron
	6 edges	12 edges	12 edges (equal)
	4 faces: (congruent, regular triangles)	6 faces: (congruent squares)	8 faces: (congruent, regular triangles)
	4 vertices	8 vertices	6 vertices

T elicits/points out that in each case:

BB: edges + 2 = faces + vertices or $\boxed{e + 2 = f + v}$

T: Polyhedra which have congruent, regular faces (i.e. their faces have equal sides and equal angles) are called <u>regular</u> polyhedra.

Extension Discuss whether each solid has planar and/or rotational symmetry.

14 min

Whole class activity

T has isometric diagrams of each solid drawn on BB too.

(If possible, Ps have smaller versions on desks.)

If possible, T also shows:

- a regular <u>dodecahedron</u> (12 congruent, regular pentagon faces)
- a regular <u>icosahedron</u> (20 congruent regular triangular faces)

Involve several Ps.

Reasoning/demonstrating, agreement, praising only

(Ps might remember this from Y5 as <u>Euler's Formula</u>)

Ps show the planes of symmetry and centres of rotation on the diagrams.

Y6 *Lesson Plan 96*

Activity		Notes

3 **Centre of rotation**

Study these shapes. Which of them has a point around which the shape can be rotated so that when it is turned, it covers itself exactly? (In addition to those below, T could also show shapes which do not have rotational symmetry.)

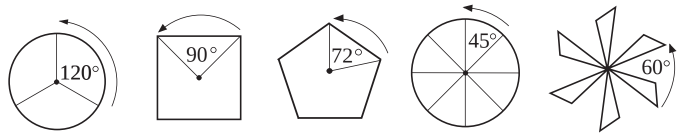
Where are thesecentral points? Ps come to BB to point to them (or to construct them). Class agrees/disagrees. T helps if necessary.

T checks that the points are in the correct position by pinning and rotating cut-out transparent shapes on top of the diagrams.

T: We call such a point the <u>centre of rotation</u> of the shape.

What is the smallest angle of rotation needed for the shapes to line up? T asks 2 or 3 Ps what they think and why. Class agrees/disagrees.

BB: e.g.



It has rotational symmetry of 120°. It has rotational symmetry of 90°. It has rotational symmetry of 72°. It has rotational symmetry of 45°. It has rotational symmetry of 60°.

Notes:

Whole class activity

Drawn (stuck) on BB or use enlarged copy master or OHP

At a good pace

Demonstration, agreement, praising

BB: <u>Centre of rotation</u>

Discussion reasoning, agreement, praising

(Ps can check using a BB protractor if T has one, or explain into how many equal parts the whole central angle has been divided, e.g.

<u>square</u>: 360° ÷ 4 = <u>90°</u>

<u>pentagon</u>: 360° ÷ 5 = <u>72°</u>

20 min

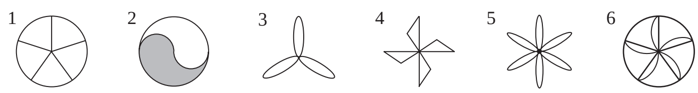
4 ***PbY6b, page 96***

Q.1 Read: *List the numbers of the shapes which match the descriptions.*

Set a time limit. Encourage Ps to answer by studying the diagrams, <u>without</u> using protractors to help them.

Review with whole class. Ps could show numbers on scrap paper or slates on command. Ps with different answers explain their reasoning at BB and class decides who is correct. Ps mark the lines of symmetry and centres of rotation on relevant diagrams on BB. Mistakes discussed and corrected.

Solution:



a) It has line symmetry. [1, 3, 5]

b) It has rotational symmetry. [1, 3, 4, 5, 6]

c) It has rotational symmetry of 60°. [5]

d) It has rotational symmetry of 120°. [3]

e) It has rotational symmetry of 72°. [1, 6]

f) It has rotational symmetry of 90°. [4]

g) It has rotational symmetry of 180°.
(None has <u>smallest</u> angle of rotation as 180°, but 4 and 5 can be rotated by this angle and cover themselves exactly.)

Notes:

Whole class activity

Drawn (stuck) on BB or use enlarged copy master or OHP

Responses shown in unison.

Discussion, reasoning, agreement, self-correction, praising

If possible, T has shapes copied onto OHTs and cut out so that the rotations can be demonstrated and checked.

d) Accept [5] also, although 120° is not its <u>smallest</u> angle of rotation.

Feedback for T

25 min

Y6

Lesson Plan 96

Activity | *Notes*

5

PbY6b, page 96

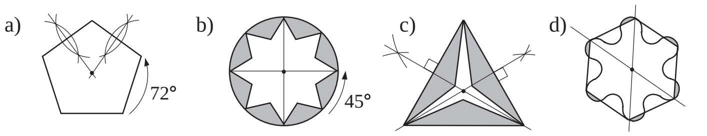
Q.2 Read: *Mark the centre of rotation. Write the smallest angle of rotation.*

First discuss how to find the centre of rotation. (Elicit that only 2 diagonals or perpendicular bisectors of sides are needed, as their point of intersection is the centre of the shape.)

Set a time limit. Ps use rulers and compasses to mark the points, then write an operation to calculate the angle of rotation.

Review with whole class. Ps could show the smallest angles of rotation on slates or scrap paper. Ps with correct answers explain reasoning at BB, showing how they constructed the centres of rotation. Who did the same? Who found it another way? etc. Mistakes discussed and corrected.

Solution:



a) $360° \div 5 = 72°$ b) $360° \div 8 = 45°$ c) $360° \div 3 = 120°$ d) $360° \div 6 = 60°$

Which shapes also have line symmetry? (a, b, c)

Notes: Individual work, monitored, helped, corrected. Drawn on BB or use enlarged copy master or OHP. Initial whole class discussion on method of construction. Responses shown in unison. Reasoning, agreement, self-correction, praising. T demonstrates constructions where necessary. Ps draw the lines of symmetry.

30 min

6

PbY6b, page 96

Q.3 Read: a) *Reflect points A and B in point O.*

b) *Join up the points A, B', A'. B and A in order. What shape have you formed?*

c) *Join A to A' and B to B'. What do you notice?*

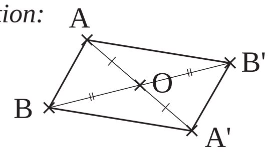
Set a time limit. Ps join A to O then extend the line by the same distance on the opposite side of O. Ps write the name of the shape below it in *Pbs* and write what they notice in *Ex. Bks*.

Review with whole class. Ps could show name on scrap paper or slates on command Ps with correct answer come to BB demonstrate the construction, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Ps tell class what they noticed about the completed shape. (e.g. diagonals bisect each other.) Elicit other properties too.

Solution:

a)



b) Pallelogram

e.g. Properties

AB = A'B', AB || A'B'

AB' = A'B, A'B || B'A

AO = OA', BO = B'O,

$\angle A = \angle A'$, $\angle B = \angle B'$

c) e.g. ABA'B' has rotational symmetry of 180° (or of order 2) about the point O; AO = OA', BO = OB'.

Notes: Individual work, monitored, helped. Points drawn on BB or SB or OHT. Discuss the procedure first. Responses shown in unison. Discussion, reasoning, agreement, self-correction, praising. Praising, encouragement only. Feedback for T. 'Order 2' means that twice during a whole turn, the shape covers its original position exactly. (at 180° and 360°).

35 min

Y6

Lesson Plan 96

Activity		*Notes*

7

PbY6b, page 96

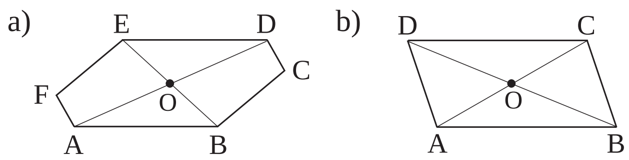
Q.4 Read: *Draw any lines of symmetry and mark the centres of rotation.*

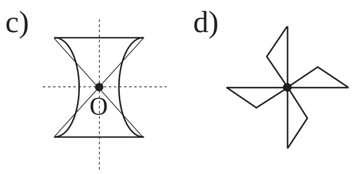
Set a time limit. Ask Ps to write the name of any shape they know.

Review with whole class. Ps come to BB to draw and mark, explaining what they are doing. Who did the same? Who did it a different way? etc. Mistakes discussed and corrected.

Extension What are the properties of each shape?

Solution:





Elicit that:

a) is a hexagon

b) is a parallelogram.

40 min

Notes: Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

(T could also have cut-out shapes to demonstrate rotation or to fold to check lines of symmetry.)

Discussion, reasoning, agreement, checking, self-correcting, praising

Extra praise for unexpected properties (e.g. angle or order of rotation) or if Ps suggest labelling points in c) and d) to make explanation of the properties easier.

8

PbY6, page 96*, *Q.5

Read: *Form a **regular polygon** with congruent triangles so that the line segments from the centre of the polygon to its vertices divide the whole central angle into angles of* $30°$.

T has congruent isosceles triangles cut from coloured paper on desk.

T holds one up. What kind of triangle is this? (isosceles) Which angle is $30°$? P points to it. If this angle is $30°$, what size are the other 2 angles? How could we calculate it? Ps come to BB or dictate what T should write. Class agrees/disagrees.

BB: $(180° - 30°) \div 2 = 150° \div 2 = 75°$

Agree that each congruent triangle has angles of $30°$, $75°$ and $75°$.

What do we know about any regular polygon? (It has equal sides and equal angles; it can be inscribed in a circle.) We should keep this in mind when we make the polygon.

Ps come to BB to stick the triangles on BB to form a polygon. Class points out any errors. (e.g. $30°$ angles should be at the centre) Before the shape is completed, ask 2 or 3 Ps how many triangles they think will be needed and why. Let's see if you are correct! Ps complete the polygon and check that there are 12 triangles.

a) *How many vertices does the polygon have?* (12)

How many sides does the polygon have? (12)

Who remembers the name of a 12-sided polygon? (duodecagon)

b) *What size are its angles?* $(150°)$ BB: $75° + 75° = 150°$

c) *What is the sum of its angles?* $(1800°)$ BB: $150° \times 12 = 1800°$

Extension T labels vertices and midpoint and Ps say true statements about the polygon. Class agrees/disagrees. (sides, angles, symmetry, etc.)

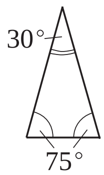
45 min

Notes: Whole class activity

(If possible, Ps have triangles on desks too.)

Use copy master, enlarged and cut out, or use as one thick card template for Ps to draw around on BB or OHT.

Discussion, reasoning, agreement, praising

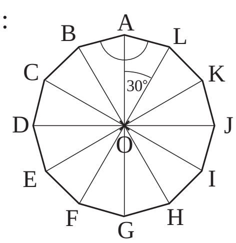


At a good pace. Involve several Ps.

BB: $360° \div 30° = \underline{12}$ (times)

or $30° \times \underline{12} = 360°$

BB:



duodecagon

12-sided polygon

Y6

R: Calculation

C: Angles. Calculating angles in a triangle or around a point

E: Recognise where a shape will be after rotation by $90°$

Lesson Plan 97

Activity | ***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 97 is a prime number Factors: 1, 97
  (as not exactly divisible by 2, 3, 5, 7 and $11^2 > 97$)
- 272 $= 2 \times 2 \times 2 \times 2 \times 17 = 2^4 \times 17$
  Factors: 1, 2, 4, 8, 16, 17, 34, 68, 136, 272
- 447 $= 3 \times 149$ Factors: 1, 3, 149, 447
- 1097 is a prime number Factors: 1, 1097
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and $37^2 > 1097$)

Notes:

Individual work, monitored (or whole class activity)

BB: 97, 272, 447, 1097

Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

272	2
136	2
68	2
34	2
17	17
1	

447	3
149	149
1	

8 min

2

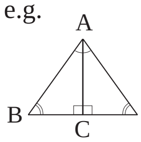
Revision of polygons

What can you tell me about the 2 triangles on your desk? (right-angled, congruent)

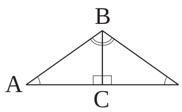
a) Form different polygons with the 2 triangles and draw the shape you have made in your *Ex. Bks*. Write the name of the shape below it.

T monitors closely and chooses Ps to draw their different shapes on the BB (Ps could use a triangular template to help them). Elicit the name of the polygon and what was done to one triangle to get the position of the other triangle.

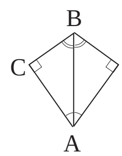
BB: e.g.



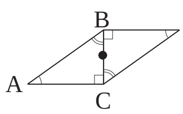
(Reflection in AC)
isosceles triangle



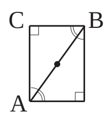
(Reflection in BC)
isosceles triangle



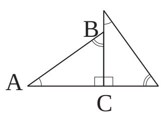
(Reflection in AB)
deltoid



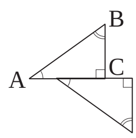
(Reflection in midpoint of BC)
parallelogram



(Reflection in midpoint of AB)
rectangle

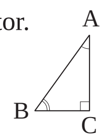


(Rotation by $90°$ around C)
concave quadrilateral



concave hexagon

b) Measure the acute angles of triangle ABC using a protractor.
(e.g. $\angle A = 35°$, $\angle B = 55°$)



Calculate the sum of its angles in your *Ex. Bks.*

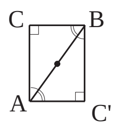
BB: $\angle A + \angle B + \angle C = 35° + 55° + 90° = \underline{180°}$

How could we prove it ?

[The two triangles can form a rectangle, AC'BC:

In the rectangle, $\angle A + \angle B = 90°$, $\angle C = 90°$

So $\angle A + \angle B + \angle C = 90° + 90° = 180°$]



Notes:

Individual work, monitored, helped, but findings discussed with the whole class

Ps have 2 congruent right-angled triangles on desks.

(Use cut-out copy master.)

T has larger version for demonstration and/or for use as a template.

Reasoning, agreement, praising

T shows any not made by Ps and asks Ps to say what they can about it.

Feedback for T

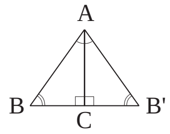
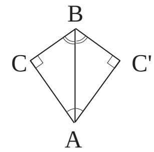
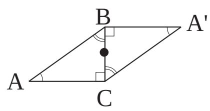
Revise how to use a protractor accurately if necessary.

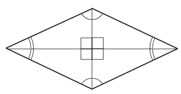
Ps dictate angles to T, then the operation needed for the calculation.

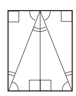
Agreement, praising

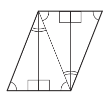
T gives hint about the rectangle if no P thinks of it.

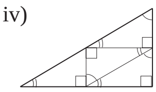
Y6 — *Lesson Plan 97*

Activity		*Notes*
2	(Continued) c) Calculate the sum of the angles in this polygon. (T points to it.) Ps do calculation in E*x. Bks* then dictate to T. Class agrees/disagrees. e.g. $\angle B = \angle B' = 55°$, $B'\hat{A}B = C\hat{A}B + B'\hat{A}C = 2 \times 35°$ so $\sum$ angles $= 2 \times (55° + 35°) = 2 \times 90° = \underline{180°}$ d) Calculate the sum of the angles in this polygon. (T points to it.) Ps do calculation in E*x. Bks* then dictate to T. Class agrees/disagrees. e.g. $\angle C = \angle C' = 90°$, $C'\hat{B}A = A\hat{B}C = 55°$, $B\hat{A}C' = C\hat{A}B = 35°$ so $\sum$ angles $= 2 \times (90° + 55° + 35°) = 2 \times 180° = \underline{360°}$ e) Calculate the sum of the angles in this polygon. (T points to it.) Ps might realise that the calculation is the same as d): $\sum$ angles $= 2 \times (90° + 55° + 35°) = 2 \times 180° = \underline{360°}$	BB:  (Ps might remember that the sum of the angles in <u>any</u> triangle is 180°.) BB:  (Ps might remember that the sum of the angles in <u>any</u> qadrilateral is 360°.) 
	20 min	
3	***PbY6b, page 97*** Q.1 Read: *These polygons have been formed from 4* ***congruent*** *right-angled triangles.* *a) Write the names of the shapes.* *b) Calculate the sum of the angles in each polygon in your exercise book.* Which shapes make up each polygon? (4 right-angled triangles) Keep this in mind when calculating the sum of their angles. Set a time limit. Review with whole class. Ps could show names and sums on scrap paper or slates on command. Ps with different answers explain reasoning at BB. Ps either label the vertices or T shows how to use notation for different angles to make it easier to write out the calculations. Class agrees/disagrees. Mistakes discussed and corrected. *Solution:*	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP Encourage Ps to mark the equal angles in the 4 triangles. Responses shown in unison. Reasoning, agreement, self-correction, praising Ps who were wrong, or think that their way of writing the calculations is not as good, copy those on BB.

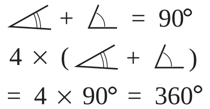
a) i)  rhombus

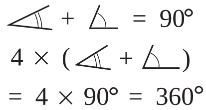
ii)  rectangle

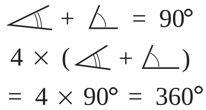
iii)  parallelogram

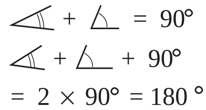
iv)  right-angled triangle

b)









Extension	What do you notice about the triangles in question iv)? (Each small triangle is <u>similar</u> to the large triangle. The <u>ratio</u> of the large triangle to each small triangle is 2 : 1.)	Whole class activity Agreeement, praising
	25 min	

Y6 — *Lesson Plan 97*

Activity		Notes
4	***PbY5b, page 97***	Individual work in measuring and marking, monitored, helped

Q.2 Read: *The two triangles have been formed from* ***congruent*** *triangles.*

a) Measure the angles of the small internal triangles and of the large triangles.

b) ***Prove*** *that the sum of the angles in each triangle is* 180°.

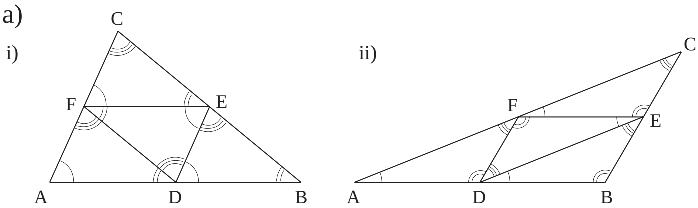
Set a time limit. Ps use protractors to determine which angles are equal and mark them using the appropriate notation.

Review at BB with whole class. Ps come to BB or dictate the equal angles to T. (e.g. $\angle$AFD = $\angle$ DEB = $\angle$FCE)
Class agrees/disagrees. Mistakes corrected.

How can we <u>prove</u> that the sum of the angles is 180°? Ps tell their ideas. Who agrees? Who thinks something else? etc. Class agrees on the clearest way to write the 'proof'. Mistakes corrected.

Solution:

a)



b) e.g. At D, the 3 angles form a <u>straight</u> angle, which is 180°

so  = <u>180°</u>

Notes:
- Drawn on BB or use enlarged copy master or OHP
- T tells Ps that they need not write the actual sizes of the angles on their diagrams – just mark equal angles with the same number of arcs.
- Discussion, reasoning, agreement, self-correction, praising
- Extra praise for Ps who noticed that the 3 different angles in both diagrams form a straight line.
- (Or at E or at F)

Extension

What else can you tell me about the triangles? e.g.

- The large triangle is <u>similar</u> to each of its small triangles.
- The ratio of the large triangle to a small triangle is 2 : 1.
- AC || DE, BC || DF, FE || AB
- D, E and F are the midpoints of the sides of the triangle.

Notes:
- Whole class activity
- Praising, encouragement only
- These apply to both diagrams.

30 min

5 ***PbY6b, page 97***

Q.3 Read: *a) Mark the centres of rotation.*

b) By how many degrees has each shape been rotated?

c) Draw on the diagrams the paths taken by the vertices when they were rotated.

Deal with one part at a time or set a time limit.

Elicit/remind Ps that the centre of rotation must be an <u>equal</u> distance from each point in a corresponding pair. Ask Ps to label the rotated triangle appropriately. Ps use compasses to draw the paths of rotation.

Review with whole class. Ps come to BB to mark points, write the angles of rotation and draw arcs, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Notes:
- Individual work, monitored, helped
- (or whole class activity if Ps are unsure what to do)
- Drawn on BB or use enlarged copy master or OHP
- (In ii), Ps will need to construct the perpendicular bisectors of, e.g. AA' and BB'. The point of intersection of the 2 bisectors is the centre of rotation.)
- Reasoning, agreement, self-correction, praising

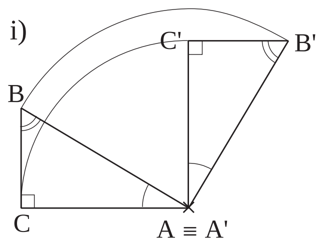
Y6

Lesson Plan 97

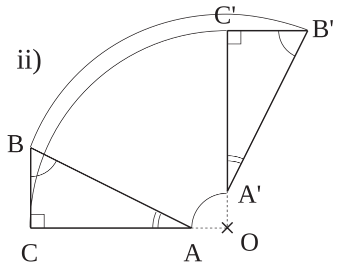
Activity		*Notes*

5 (Continued)

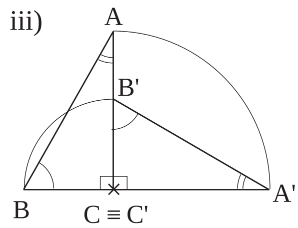
Solution:



Rotation by $90°$ around A



Rotation by $90°$ around O



Rotation by $90°$ around C

35 min

6 ***PbY6b, page 97***

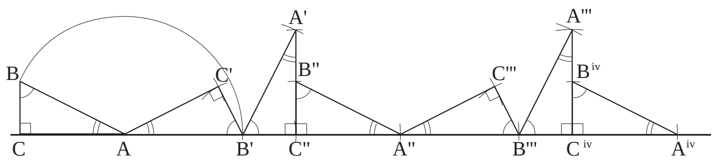
Q.4 Read: *Draw the paths of the vertices when the triangle is turned over along the straight line. (Use compasses.)*

Set a time limit of 3 minutes. (Ps could also have a template of triangle ABC to manipulate before construction and to check that they are correct afterwards.) Ask Ps to label the vertices of the triangles they draw.

Review with whole class. (T could have diagram already prepared or Ps finished early construct the solution on BB or OHT, as a model for slower Ps to follow.) Ps correct any mistakes.

Let's mark the equal angles. Ps come to BB, while rest of Ps mark the angles in *Pbs*.

Solution:



Construction

1. Set compasses to width AB and draw an arc around A. The point where the arc cuts the horizonal line is B'.
2. Set compasses to width BC and draw an arc around B'.
3. Set compasses to width AC and draw an arc around A. The point of intersection of the 2 arcs is C'.
4. Join A and B' to C'.

Δ AB'C' is the position of Δ ABC after the 1st turn onto AB.

Continue in a similar way for the next 2 turns onto B'C' and A'C'', contructing the vertices in the appropriate order. Ps might notice that the 1st and 4th positions have the same orientation.

What do you notice about the angles of rotation? e.g.

1st rotation around A is $180° - \angle A$
2nd rotation around B' is $180° - \angle B'$
3rd rotation around C''' is $180° - \angle C''$
and then these 3 steps are repeated.

40 min

Notes:

Individual work, monitored, helped, corrected

Drawn on BB or SB or OHT (or T has large cut-out triangle so that Ps can demonstrate the turns to the whole class)

Differentiation by time limit.

Discussion, demonstration, agreement, self-correction, praising

Elicit the steps from Ps if possible.

T points this out if no P notices it.

Y6		*Lesson Plan 97*
Activity		***Notes***

7

PbY6b, page 97

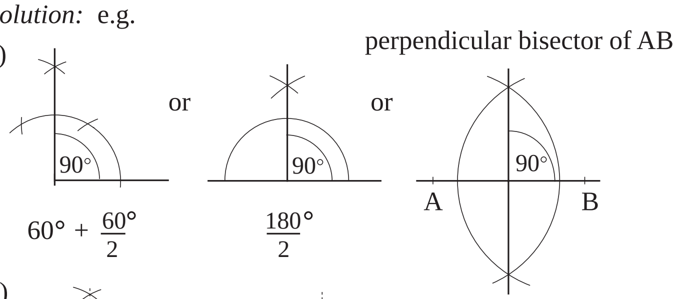
Q.5 Read: *Construct:* *a)* *a* 90° *angle* *b)* *a* 45° *angle* *c)* *a* 240° *angle.*

Deal with one at a time. The more able Ps could be asked to construct each angle in 2 different ways. Ps should use only compasses and rulers (' construct' does not mean 'measure').

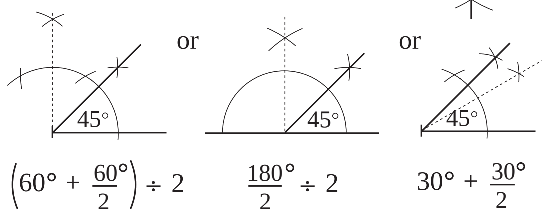
T monitors closely, choosing Ps to demonstrate and explain their constructions to the class. Who did the same? Who did it a different way? Come and show us.

Solution: e.g.

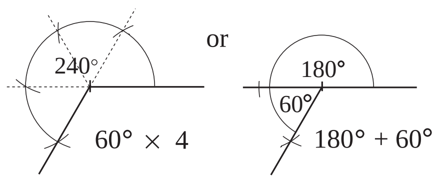
a)



b)



c)



45 min

Notes:

Individual work, monitored, helped, corrected

If necessary, quickly revise how to construct a 60° angle (equilateral triangle) and how to bisect an angle.

Reasoning, demonstration, (self-correction), praising

Accept any valid method.

Feedback for T

T could demonstrate the methods not used by Ps and ask if they are correct.

If time runs out, ask Ps to complete the activity at home. Review before the start of *Lesson 98*.

[Ps should have their <u>own</u> sets of mathematical instruments.]

Y6

R: Calculation
C: Angles (acute, obtuse, reflex)
E: Problems

Lesson Plan
98

Activity

Notes

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 98 = $2 \times 7 \times 7 = 2 \times 7^2$ Factors: 1, 2, 7, 14, 49, 98
- 273 = $3 \times 7 \times 13$
  Factors: 1, 3, 7, 13, 21, 39, 91, 273
- 448 = $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 7 = 2^6 \times 7$
  Factors: 1, 2, 4, 7, 8, 14, 16, 28, 32, 56, 64, 112, 224, 448
- 1098 = $2 \times 3 \times 3 \times 61 = 2 \times 3^2 \times 61$
  Factors: 1, 2, 3, 6, 9, 18, 61, 122, 183, 366, 549, 1098

Individual work, monitored (or whole class activity)

BB: 98, 273, 448, 1098

T decides whether Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

98	2
49	7
7	7
1	

273	3
91	7
13	13
1	

448	2
224	2
112	2
56	2
28	2
14	2
7	7
1	

1098	2
549	3
183	3
61	61
1	

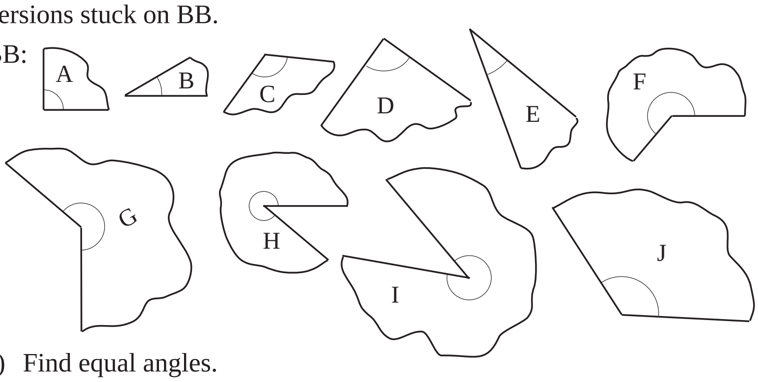
8 min

2

Angles 1

Each pair of Ps has angle models cut from coloured paper. T has larger versions stuck on BB.

BB:



Whole class activity, but Ps work in pairs

Use copy master, copied on coloured paper and cut out. T has enlarged version for demonstration.

a) Find equal angles.

Ps can use protractors to measure the angles (or extra praise for Ps who put one angle on top of the other with the vertices lined up to see if the arms of the angles coincide). Ps dictate the equal angles and T writes on BB. Ask for the type of angle too. Class agrees/disagrees.

Agree that the length of the arms does not determine the angle size! (T extends the arms of an angle on BB to show this.)

Checking, agreement, praising

BB:

$\angle A = \angle D$ (right angles)
$\angle B = \angle E$ (acute angles)
$\angle C = \angle J$ (obtuse angles)
$\angle F = \angle G$ (reflex angles)
$\angle H = \angle I$ (reflex angles)

b) Put the angles in increasing order. (Equal angles can be laid one on top of the other or one below the other.) Ps dictate to T and T writes on BB. Class agrees/disagrees. (See below)

Agreement, praising

c) What size are these angles? (Ps give accurate measurements if they used protractors or estimates if they did not.)

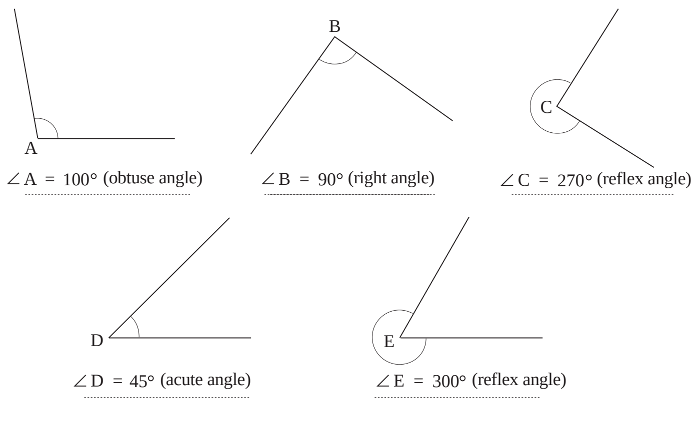
BB: (If using copy master)

$\angle B = \angle E < \angle A = \angle D < \angle C = \angle J < \angle F = \angle G < \angle H = \angle I$
(30°) (90°) (120°) (230°) (320°)

15 min

Y6

Lesson Plan 98

Activity		*Notes*
3	**Angles 2** Let's revise what we know about angles. What is an angle? (It is a turn around a point.) What unit do we use to measure angles? (Degrees, angle minutes, angle seconds) What is the relationship betwen them? BB: (1 degree) $1° = 60'$ (60 angle minutes), $1' = 60''$ (angle seconds) What tool do we use to meaure angles? (protractor) T shows it. What types of angles are there? Let's start from the smallest. Ps dictate the names and size ranges. Class points out errors. BB: Null angle $= 0°$ (no turn) $0° <$ Acute angle $< 90°$ Right angle $= 90°$ (arms perpendicular, quarter of a turn) $90° <$ Obtuse angle $< 180°$ $180° =$ Straight angle (straight line, half a turn) $180° <$ Reflex angle $< 360°$ Whole angle $= 360°$ (a complete turn) a) T (P) says an angle type and Ps show examples on slates or scrap paper on command. T (P) points out errors. b) T (P) draws an angle on BB and Ps say its name. c) Everyone stand up! I will say an angle size and you show me what you think it roughly looks like using 2 pencils (or 2 rulers). Point to the angle you want me to look at. T: e.g. 60°, 150°, 2 70°, 100°, 340°, etc. *20 min*	Whole class activity At a good pace In good humour. Involve all Ps. Elicit that angle minutes and angle seconds are so small that only computers or scientists use them in calculations. Ps could come to BB to draw an example for each type. Class agrees/disagrees. Elicit that we show the angle by drawing an arc between its 2 arms. Responses shown in unison. Agreement, praising T quickly checks all Ps with a large protractor, praising or correcting where necessary.
4	***PbY6b, page 98*** Q.1 Read: *Measure the angles and name them.* Quickly review how to use a protractor. Show how the arms of the angles can be extended where necessary to make reading the scale on the protractor easier. Set a time limit. T helps less able Ps to use their protractors. Review with whole class. Ps could show angles on scrap paper or slates on command. (Accept $\pm 1°$) Ps with wrong answers measure angles on B\`B, with the help of Ps who were correct. *Solution:*  *25 min*	Individual work, monitored, helped in measuring Drawn on BB or use enlarged copy master or OHP Differentiation by time limit. Responses shown in unison. Demonstration, agreement, self-correction, praising Show the 2 methods of meauring reflex angles: e.g. $\angle C = 180° + 90° = 270°$ or $\angle C = 360° - 90° = 270°$ $\angle E = 180° + 120° = 300°$ or $\angle E = 360° - 60° = 300°$

Y6

Lesson Plan 98

Activity

Notes

5

PbY6b, page 98

Q.2 Read: *Work in your exercise book.*

Draw two parallel lines, then draw a line which crosses both of them. Label the angles as shown in the sketch.

T monitors closely to make sure that Ps' diagrams are correctly drawn and labelled. Ps use 2 rulers (or ruler and set square) to draw the parallel lines. Then Ps mark them with arrows. (The arcs indicating the angles can be drawn freehand.)

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

Make sure that Ps have a correct diagram before they attempt the questions.

Read: a) *Measure the angles formed and write down the values.*

b) *List the angles which are equal.*

c) *Find other relationships among the angles.*

Set a time limit. Ps measure angles and write statements.

Review with whole class. T chooses 3 or 4 Ps to come to BB or dictate their angles and findings.

Although we have different angle sizes depending on where we drew line *w*, what <u>general</u> statements can we make about the angles? Ps come to BB or dictate to T. Ps check that it is also true for their angles. (Ask Ps who disagree to measure again!)

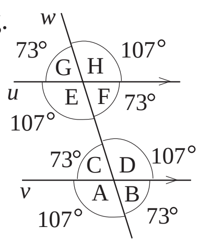
Differentiation by time limit

Reasoning, agreement, self-correction, praising

Agree that the sum of any two angles which form a straight angle (i.e. a straight line) <u>must</u> be $180°$.

Solution:

a) e.g.



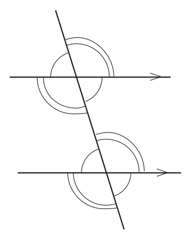
b) $\angle A = \angle D = \angle E = \angle H$

$\angle B = \angle C = \angle F = \angle G$

Let's mark the equal angles on a <u>general</u> diagram so that we can see the pattern more clearly.

Ps come to BB. Rest of class disagrees.

BB: <u>General diagram</u>



c) e.g. There are 4 equal acute angles and 4 equal obtuse angles. (Altogether, they form 8 right or 4 straight angles.)

$\angle A + \angle B = \angle C + \angle D = \angle A + \angle C = \angle B + \angle D = 180°$

$\angle E + \angle F = \angle G + \angle H = \angle E + \angle G = \angle F + \angle H = 180°$

$\angle A + \angle B + \angle C + \angle D = \angle E + \angle F + \angle G + \angle H = 360°$

Extra praise if a P reasons like this:

$\angle A + \angle B = 180°$,

but $\angle A + \angle C = 180°$

so $\angle B = \angle C$

T shows it if no P does so.

Extension

T: Angles such as A and D, formed when 2 lines intersect are called <u>opposite</u> angles. <u>Opposite</u> angles are always equal.

Angles such as A and E, formed when a line crosses 2 parallel lines, are in corresponding positions and are called <u>corresponding angles</u>. <u>Corresponding</u> angles are always equal.

Angles such as C and F, on alternate sides of the line which intersects the parallel lines, are called <u>alternate</u> angles. <u>Alternate</u> angles are always equal.

Angles such as A and B, or C and E, together form a straight angle. They are called <u>complementary</u> angles. <u>Complementary</u> angles always sum to $180°$.

Ps point out other pairs of:

<u>opposite</u> angles:

B and C, E and H, F and G

<u>corresponding</u> angles:

B and F, C and G, D and H

<u>alternate</u> angles:

D and E

<u>complementary</u> angles:

C and D, E and F, G and H, D and F, A and C, etc.

30 min

Y6

Lesson Plan 98

Activity | ***Notes***

6

PbY6b, page 98

Q.3 Read: *Calclate the sizes of the unkown angles.*

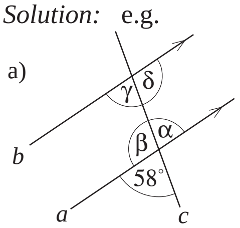
First ask Ps to say the Greek letters labelling the angles.
T reminds Ps if they have forgotten. (alpha, beta, gamma, delta)

Deal with one part at a time or set a time limit. Tell Ps that their general diagram for Q.2 will help them in parts a) and c).

Review with the whole class. Ps come to BB or dictate to T, explaining reasoning. T repeats Ps' reasoning in a clearer way if necessary. Who agrees? Who worked it out another way? etc. Mistakes discussed and corrected.

Solution: e.g.

a)



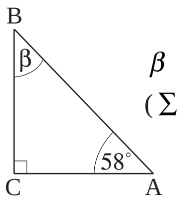
$\alpha = \underline{58°}$ (opposite angles)

$\beta = 180° - 58° = \underline{122°}$

$\gamma = 58°$ (corresponding angles)

$\delta = 180° - 58° = \underline{122°}$

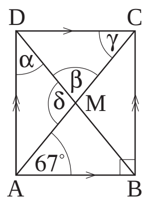
b)



$\beta = 180° - 90° - 58° = 90° - 58° = \underline{32°}$

(Σ angles in any triangle is $180°$)

c)



e.g. $\Delta ABD \equiv \Delta ABC$

(equal base and height)

so $\alpha = B\hat{C}A = 180° - 90° - 67°$
$= 90° - 67° = \underline{23°}$

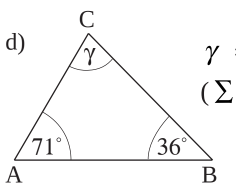
$\gamma = C\hat{A}B = \underline{67°}$ (alternate angles)

In ΔAMD, $D\hat{A}M = 90° - 67° = 23°$,

so $\delta = 180° - 23° - \alpha = 157° - 23° = \underline{134°}$

$\beta + \delta = 180°$, so $\beta = 180° - \delta = 180° - 134° = \underline{46°}$

d)



$\gamma = 180° - 71° - 36° = 109° - 36° = \underline{73°}$

(Σ angles in any triangle is $180°$)

35 min

Notes:

Individual trial, monitored, helped

(or whole class activity if Ps prefer)

Drawn on BB or use enlarged copy master or OHP

Discussion, reasoning, agreement, self-correction, praising

Accept any valid method with correct reasoning.

Feedback for T

or $\Delta DAB \equiv \Delta CDA$

(equal base and height)

so $\gamma = A\hat{B}D$
$= 180° - 90° - \alpha$
$= 90° - 23°$
$= \underline{67°}$

Y6

Lesson Plan 98

Activity		*Notes*

7 ***PbY6b, page 98***

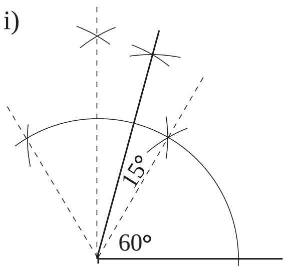
Q.4 a) Read: *Construct these angles in your exercise book and write their names below them.*

Deal with one at a time or set a time limit. Ps use only compasses and rulers.

T monitors closely, choosing Ps to demonstrate and explain their constructions to the class. Who did the same? Who did it a different way? Come and show us. Mistakes corrected, or construction done again.

Solution: e.g.

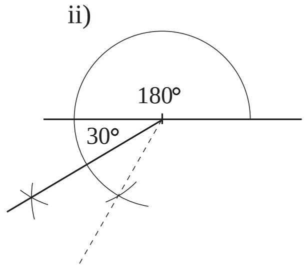
i)



$60° + 60° \div 2 \div 2$
$= 60° + 30° \div 2$
$= 60° + 15°$
$= \underline{75°}$

acute angle

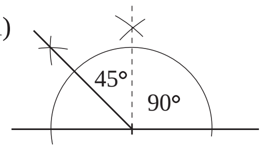
ii)



$180° + 60° \div 2$
$= 180° + 30°$
$= \underline{210°}$

reflex angle

iii)



$90° + 90° \div 2$
$= 90° + 45°$
$= \underline{135°}$

obtuse angle

Notes: Individual work, monitored, helped

(If Ps are struggling, stop individual work and continue as a whole class activity, with Ps working on BB with help of T and rest of Ps following the steps in *Ex. Bks.*)

Reasoning, agreement, self-correction, praising or encouragement only

Feedback for T

b) Read: *Draw an angle of* 40°.

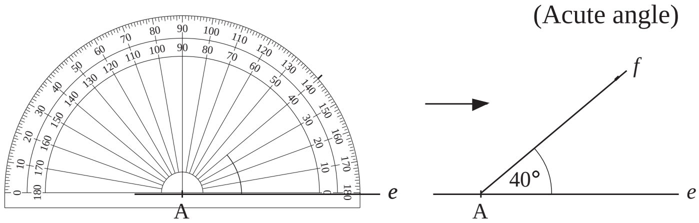
As we are not asked to construct this angle, how can we draw it? (Use a protractor)

Ps suggest what to do first and how to continue. T (P) works on BB or OHT while rest of class work in *Ex. Bks*. e.g.

1. Draw a straight line, *e*, and mark on it a point, A.
2. Place the protractor so that its zero line lies along *e* and its 90 degree line is on A.
3. Make a mark at the 40° line on the right of A.
4. Remove protractor and draw a ray from A through through the marked point to form the 2nd arm of the angle. Label it *f*.
5. Draw an arc around A from *e* to *f* to show the angle and write 40° inside it.

Solution:

(Acute angle)



40 min

Notes: Whole class activity but individual drawing

Revision of how to draw an angle using a protractor.

Discussion, agreement on the steps.

T monitors, helps, corrects.

Stress the difference between drawing an angle using a protractor and constructing an angle using only compasses and ruler.

Which method do you think is more accurate? T asks several Ps what they think and why.

(Ps will probably think that using a protractor is more accurate, as there are more chances of inaccuracies in a construction.)

Y6

Lesson Plan 98

Activity		*Notes*
8	***PbY6b, page 98***	
	Q.5 Read: *Calculate with angles. (1° = 60')*	Individual work, monitored, less able Ps helped
	What other unit of measuring angles do we know and what is its relation to those given? Ps dictate to T. (BB)	Written on BB or SB or OHT BB: 1' = 60" (1 angle minute = 60 angle seconds)
	Set a time limit of 3 minutes. Ps can work in *Pbs* or in *Ex. Bks* if they need more space.	Differentiation by time limit.
	Review with whole class. Ps who have an answer show results on scrap paper or slates on command. Ps answering correctly come to BB to explain reasoning to Ps who were wrong. Who did the same? Who did it another way? etc. Mistakes discussed and corrected.	Discussion, reasoning, agreement, self-correction, praising
	Solution: e.g.	Accept any valid method of calculation.
	a) $\begin{array}{r} 22^\circ\ 20' \\ 38^\circ\ 30' \\ +\ 75^\circ\ 75' \\ \hline 137^\circ\ 05' \\ \hline 2^\circ \end{array}$ (120' = 2°) b) $\begin{array}{r} 179^\circ\ 60' \\ \cancel{180^\circ} \\ -\ 68^\circ\ 32' \\ \hline 111^\circ\ 28' \\ \hline \end{array}$ c) $\begin{array}{r} 71^\circ\ 103' \\ \cancel{72^\circ\ \ 43'} \\ -\ 28^\circ\ \ 51' \\ \hline 43^\circ\ \ 52' \\ \hline \end{array}$	Ps say what <u>type</u> of angle each result is (and estimate what it looks like using 2 pencils) Feedback for T
	d) $16^\circ\ 42' \times 5 = 80^\circ + 210' = 80^\circ + 3^\circ + 30' = \underline{83^\circ\ 30'}$	
	e) $13^\circ\ 24' \div 6 = 12^\circ\ 84' \div 6 = \underline{2^\circ\ 14'}$	
	f) $173^\circ\ 15' \div 10 = 17.3^\circ + 1.5' = 17^\circ + 0.3 \times 60' + 1' + 30''$ $= 17^\circ + 18' + 1' + 30''$ $= \underline{17^\circ\,19'\ 30''}$ or $173^\circ\ 15' \div 10 = 170^\circ\ 195' \div 10 = 17^\circ\ 19.5' = \underline{17^\circ\,19'\ 30''}$	(or $\frac{3}{10}$ of $1^\circ = \frac{3}{10}$ of $60'$ $= 18'$)
	45 min	

Y6	R: Calculations **C: Measures: time; money, converting £s to other currencies** *E: Percentage problems*	*Lesson Plan* 99

Activity		*Notes*
1	**Factorisation** Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes. Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected. Elicit that: • <u>99</u> = $3 \times 3 \times 11 = 3^2 \times 11$ Factors: 1, 3, 9, 11, 33, 99 • <u>274</u> = 2×137 Factors: 1, 2, 137, 274 • <u>449</u> is a prime number Factors: 1, 449 (not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19 and $23^2 > 449$) • <u>1099</u> = 7×157 Factors: 1, 7, 157, 1099 *7 min*	Individual work, monitored (or whole class activity) BB: 99, 274, 449, 1099 Ps could practise calculation <u>without</u> calculators. Reasoning, agreement, self-correction, praising e.g. 1099 | 7 157 | 157 1 |
2	**Measures: revision** a) <u>Mass</u> T has various objects on desk at front of class and various types of weighing equipment. [e.g. a balance with different weights (1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 10 g, 5 g, 2 g, and 1 kg), scales with metric and imperial units and metric digital scales] Let's measure the <u>mass</u> of each of these objects. What is mass? Ps come to front of class to choose an object and weigh it using one type of equipment, then another P weighs it on a different type. Ps write the values on BB. Class discusses the different forms of the same mass and the pros and cons of each type of weighing machine. Repeat for different objects. (Pupils could be weighed too!) Let's list the metric units of mass. Ps dictate to T in unison. BB: 1 gram (g) < 1 kilogram (kg) < 1 tonne (t) $\times$ 1000 $\times$ 1000 Are there any smaller or greater units? Ps say what they know, otherwise T tells them and writes them on BB. BB: Smaller: 1 milligram (1 mg) = 0.001 g Greater: 1 kilotonne (kt) = 1000 t = 1 million kg 1 Megatonne (Mt) = 1 million tonnes = 1 billion kg b) <u>Capacity</u> T has various spoons, cups, glasses, bottles, measuring jugs and cylinders and a bucket of water at front of class. What is capacity? (How much liquid a container can hold) Let's measure the <u>capacity</u> of each of these containers. Ps come to front of class to choose a measuring container and to use it to measure the capacity of other containers. e.g. With a 1 litre bottle, measure a larger jug. With a 1 litre measuring jug, measure a glass. • Note the amount of water in the jug, fill the glass, then note how much is left in the jug. (e.g. 100 cl – 70 cl = <u>30 cl</u> • or fill the glass, pour the water into the jug and read the scale.	Whole class activity Have bathroom scales too. At a good pace. In good humour. Involve several Ps. Discussion, agreeement, praising Agreement, praising Ps could write the units of mass on the back page of *Pbs* as a reminder. Elicit or remind Ps that 'milli' means $\frac{1}{1000}$ 'kilo' means 1000 times At a good pace but encourage Ps to take care when pouring the water! Ps explain to class what they are doing and write any calculations on BB. Reasoning, agreement, praising

Y6		*Lesson Plan 99*
Activity		***Notes***
2	(Continued) Let's list the units of capacity. Ps dictate to T or come to BB. BB: 1 millilitre (1 ml) < 1 centilitre (1 cl) < 1 litre (1 ℓ) $\times$ 10 $\times$ 100 These units measure capacity as how much liquid a container can hold but we can also think of capacity as the volume of space inside a container. Let's list the corresponding values of capacity and volume. Ps dictate to T if they know it or can work it out. BB: 1 ml $\rightarrow$ 1 cm^3 (1 ml of pure water can fill a 1 cm cube) 1 cl $\rightarrow$ 10 cm^3 (1 cl . . . . 10 1 cm cubes) 1 litre $\rightarrow$ 1000 cm^3 (1 litre . . . . a 10 cm cube) 1000 litres $\rightarrow$ 1 m^3 (1000 litres . . . . . . a 1 m cube) Who remembers a connection between length, capacity and mass? Allow Ps to explain if they can, otherwise T reminds them. Using pure water at sea level and at a temperature of $4°C$: BB: 1 litre $\rightarrow$ 1000 cm^3 $\rightarrow$ 1 kg (Ps write it in *Pbs*.) *20 min*	Agreement, praising Ps could write the units on back page of *Pbs* as a reminder. Discussion, reasoning, agreement, praising If possible, T has 1 cm and 10 cm open cubes for demonstration. Ps write corresponding values on back page of *Pbs*. How can we check it? (Weigh an empty 1 litre jug, then fill it with water and weigh it again. The difference is the mass of 1 litre of water.)
3	***PbY6b, page 99*** Q.1 Read: *The temperature was* $16°C$ *at 07:00.* *a) By 12:00 the temperature had risen by 60%. What was the temperature at 12:00?* *b) By 18:00, the mid-day temperature had fallen by 60%. What was the temperature at 18:00?* Set a time limit of 3 minutes. Ps write a plan, do the calculation, check the result and write the answer as a sentence. Review with whole class. Ps could show answer on scrap paper or slates on command. Ps answering correctly explain reasoning at BB. Who did the same? Who worked it out a different way? Come and show us what you did. Mistakes discussed and corrected. *Solution:* e.g. a) *Plan:* $16 + 60\%$ of $16 = 16 + 0.6 \times 16 = 16 + 9.6$ $= \underline{25.6}$ (°C) or 160% of $16 = 16 \div 100 \times 160$ $= 0.16 \times 160 = 1.6 \times 16 = \underline{25.6}$ (°C) *Answer:* At 12:00 the temperature was 25.6 degrees Celsius. b) *Plan*: $25.6 - 60\%$ of $25.6 = 25.6 - 0.6 \times 25.6$ $= 25.6 - 15.36 = \underline{10.24}$ (°C) or 40% of $25.6 = 25.6 \times 0.4 = 2.56 \times 4 = \underline{10.24}$ (°C) *Answer:* At 18:00 the temperature was 10.24 degrees Celsius. *25 min*	Individual work, monitored, helped Responses shown in unison. Reasoning, agreement, self-correction, praising Deal with all methods used by Ps and accept any correct method of solution. Feedback for T $\begin{array}{r} 1.6 \\ \times\ 1\ 6 \\ \hline 9\ 6 \\ 1\ 6\ 0 \\ \hline 2\ 5.6 \end{array}$

Y6

Lesson Plan 99

Activity | ***Notes***

4

PbY6b, page 99

Q.2 Read: *On 20 November 2003, 1 EUR (Euro) was worth 0.7021 GBP (£).*

a) Calculate the value of 1 GBP in Euros on that day.

b) i) If 1 GBP = 1.42 EUR, what is the Euro equivalent of 532 GBP?

ii) What perentage of 1 Euro is 1 GBP?

c) i) If 1 EUR = 0.7 GBP, what is the GBP equivalent of 532 Euros?

ii) What percentage of 1 GBP is 1 Euro?

Why is a certain date given in the question? (The exchange rate of currencies change from day to day. These values were correct on that day but might not be correct now!)

Deal with one part at a time. Ps suggest what to do first and how to continue, with T prompting where necessary. Ps come to BB or dictate to T. Class agrees/disagrees. Ps work in *Ex. Bks*. at the same time. Ps do any calculations on BB without a calculator as revision, then use a calculator to check the result.

Elicit/remind Ps that to find the value of a whole unit from a known part, divide the whole by the known part.

Solution: e.g.

a) £0.7021 = 1 Euro

£1 = (1 ÷ 0.7021) Euros

= (10 000 ÷ 7021) Euros

≈ 1.4243 Euros

BB:

								1.	4	2	4	2	9
7	0	2	1	1	0	0	0	0.	0	0	0	0	0
			−		7	0	2	1					
					2	9	7	9	0				
				−	2	8	0	8	4				
						1	7	0	6	0			
					−	1	4	0	4	2			
							3	0	1	8	0		
						−	2	8	0	8	4		
								2	0	9	6	0	
							−	1	4	0	4	2	
									6	9	1	8	0

T shows Ps how to check with a calculator. Ps follow.

1 $\boxed{\div}$ 0.7021 $\boxed{=}$ 1.42429853

or using the 1/*x* button:

0.7021 $\boxed{1/x}$ 1.42429853, which is 1.4243 correct to 4 d.p.

Answer: On 20 November 2003, £1 was worth 1.4243 Euros.

b) i) £1 = 1.42 Euros

£532 = 1.42 Euros × 532 = 755.44 Euros

Answer: 755.44 Euros is the equivalent of 532 GBP.

ii) £1 = 1.42 of 1 Euro = 142% of 1 Euro

Answer: One GBP is 142 percent of one Euro.

c) i) 1 Euro = £0.7

532 Euros = £0.7 × 532 = £372.40

Answer: 372.40 GBP is the equivalent of 532 Euros.

ii) 1 Euro = 0.7 of £1 = 70% of £1

Answer: One Euro is 70 percent of one GBP.

30 min

Notes

Whole class activity

If possible, T has a few of the relevant coins and notes to pass round class. Ps tell class if they know about any of them (e.g. Ps might have seen or used them on holiday)

Discuss the countries in which the currencies are used and ask Ps to point them out on a world map.

[Ps could be asked to find out what today's exchange rates are for homework (from newspapers or the internet)]

Discussion, reasoning, agreement, checking, praising

At a good pace.

Involve many Ps.

T tells Ps that it is usual to give the answer correct to the same number of decimal places as the value in the question, unless stated otherwise.

So to find a result correct to 4 decimal places, we need to calculate to 5 decimal places so that we can round correctly.

BB: 1.42429 ≈ 1.4243 (to 4 d.p.)

BB:

			5.	3	2
		×	1.	4	2
		1	0	6	4
	2	1	2	8	0
+	5	3	2	0	0
	7	5	5.	4	4

<table>
<tr><td>Y6</td><td></td><td>Lesson Plan 99</td></tr>
<tr><td>Activity</td><td></td><td>Notes</td></tr>
<tr><td>5</td><td>
PbY6b, page 99
Q.3 Read: On 20 November 2003, 1 GBP was worth 1.6998 USD ($).
a) If 1 GBP = 1.7 USD, how many £s can you get for 1 USD?
b) i) If 1 GBP = 1.7 USD, what is the USD equivalent of 532 GBP?
ii) What percentage of 1 USD is 1 GBP?
c) i) If 1 USD = 0.59 GBP, what is the GBP equivalent of 532 USD?
ii) What percentage of 1 GBP is 1 USD?

Deal with a), b), c) one at a time or set a time limit. Ps write operation and do the calculation (using a calculator and rounding as appropriate). Ps write the answer in a sentence.

Review with whole class. Ps could show results on scrap paper or slates in unison. Ps answering correctly explain at BB to Ps who were wrong. Class agrees/disagrees. Mistakes discussed and corrected. (If possible, Ps use the calculator on a computer projected on to a screen, so that class can see what they do.)

Solution: e.g.
a) 1.7 USD = £1
1 USD = £1 $\div$ 1.7 = £10 $\div$ 17 $\approx$ £0.5882 (to 4 d.p.)
Answer: You can get 0.5882 GB Pounds for one US Dollar.

b) i) £1 = 1.7 USD
£532 = 1.7 USD $\times$ 532 = <u>904.40</u> USD
Answer: 904.40 US Dollars is the equivalent of £532.

ii) £1 = 1.7 of 1 USD = 170% of 1 USD
Answer: One pound is 170 percent of one US Dollar.

c) i) 1 USD = £0.59
532 USD = £0.59 $\times$ 532 = <u>£313.88</u>
Answer: £313.88 is the equivalent of 532 US Dollars.

ii) 1 USD = 0.59 of £1 = 59% of £1
Answer: One USD is 59 percent of one GBP.
</td><td>
Individual work, monitored, helped

Elicit that 1 USD means 1 United States Dollar ($)

(T has dollars to show to class if possible.)

Ps say what they know about the USA.

(or Ps do calculations in Ex. Bks and use a calculator to check their results.)

Responses shown in unison.

Reasoning, agreement, self-correction, praising

Allow any form of each currency (e.g. £ or GBP or pounds)

Extra praise for Ps who used the 1/x button.
</td></tr>
<tr><td></td><td>35 min</td><td></td></tr>
</table>

Y6		*Lesson Plan 99*
Activity		***Notes***
6	***PbY6b, page 99*** Q.4 Read: *On 20 November 2003, 1 GBP was worth 185.11 JPY.* *a) If 1 GBP = 185 JPY, how many £s can you get for 1 Japanese Yen?* *b) i) If 1 GBP = 185 JPY, what is the JPY equivalent of 532 GBP?* *ii) What percentage of 1 JPY is 1 GBP?* *c) i) If 1 JPY = 0.0054 GBP, what is the GBP equivalent of 532 JPY?* *ii) How much more or less than 1% of £1 is 1 Japanese Yen?* Deal with this in a similar way to Activity 5. *Solution:* e.g. a) 185 JPY = £1 1 JPY = £1 ÷ 185 ≈ £0.0054054 ≈ £0.0054 (to 4 d.p.) *Answer:* You can get 0.0054 pounds for one Japanese Yen. b) i) £1 = 185 JPY £532 = 185 JPY × 532 = <u>98420</u> JPY *Answer:* 98 420 JPY is the equivalent of £532. ii) £1 = 185 JPY = 185% of 1 JPY *Answer:* One pound is 185 percent of one Japanese Yen. c) i) 1 JPY = £0.0054 532 JPY = £0.0054 × 532 = £2.8728 ≈ <u>£2.87</u> *Answer:* £2.87 is the equivalent of 532 Japanese Yen. ii) 1 JPY = 0.0054 of £1, which is 0.54% of £1 *Answer:* One JPY is about half a percent less than 1% of £1. *40 min*	Individual work, monitored, helped Ps may use calculators where necessary. Responses shown in unison. Reasoning, agreement, self-correction, praising Feedback for T Also accept 532 ÷185 ≈ <u>2.88</u> (GBP)
7	***PbY6b, page 99*** Q.5 Who can explain what a gross price and a net price are? (<u>Gross</u> price is the full price, including VAT. <u>Net</u> price is the price before VAT has been added on.) What is VAT? (The tax put on certain goods by the government to collect extra money for its treasury.) Let's see how many of these you can solve in 4 minutes! Start . . now! Ps work in *Ex. Bks* and may use calculators. Review with whole class. Ps show results on scrap paper or slates on command. Ps answering correctly explain reasoning to class. Who agrees? Who did it another way? etc. Mistakes discussed and corrected. T choooses Ps to say the anwer as a sentence.	Individual work, monitored, helped Initial whole class discussion to make sure that Ps understand the context. Differentation by time limit. Responses shown in unison. Reasoning, agreement, self-correction, praising Feedback for T

Y6		*Lesson Plan 99*

Activity		***Notes***
7	(Continued) *Solution*: a) *The price of a bicycle is £60 + VAT. Calculate its **gross** price if the Value Added Tax (VAT) is 15% of the **net** price.* *Plan:* £60 + 15% of £60 = £60 × 1.15 = £6 × 11.5 = <u>£69</u> *Answer*: The <u>gross</u> price of the bicycle is £69. b) *The **gross** price of a computer is £450, includingVAT. Calculate the **net** price if the VAT is 12.5% of the net price.* *Plan:* £450 ÷ 1.125 = £450 000 ÷ 1125 = <u>£400</u> or 112.5% → £450 225% → £900 1% → £900 ÷ 225 = £4 100% → £4 × 100 = £400 *Answer*: The <u>net</u> price of the computer is £400.	
	c) *How much is the VAT on a product which can be bought for £37.50 but its **net** price is £30?* *Plan:* VAT = £37.50 – £30 = £7.50 % rate of VAT: $\frac{7.5}{30} = \frac{75}{300} = \frac{25}{100} \rightarrow \underline{25\%}$ or 37.50 ÷ 30 = 3.75 ÷ 3 = 1.25 Gross price is 1.25 or 125% of the net price, so VAT is 25% of the net price. *Answer*: The VAT on the product is £7.50, which is 25% of the net price.	Deal with all methods used by Ps. Accept any valid method of solution but also show the simplest calculation if no P used it. Any questions not done in the time in class could be completed for homework and reviewed before the start of *Lesson 100.*
	45 min	

Y6

Lesson Plan *100*

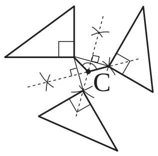
Activity

Factorising 100, 275, 450 and 1100. Revision, activities, consolidation

PbY6b, page 100

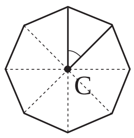
Solutions:

Q.1 a)



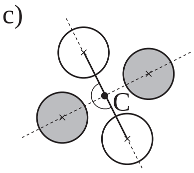
$360° \div 3 = \underline{120°}$

b)



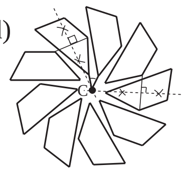
$360° \div 8 = \underline{45°}$

c)



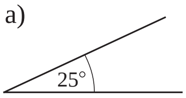
$360° \div 2 = \underline{180°}$

d)

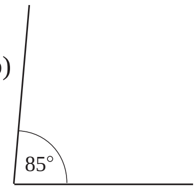


$360° \div 9 = \underline{40°}$

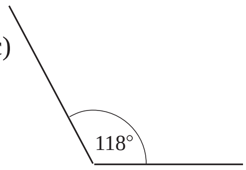
Q.2 a)



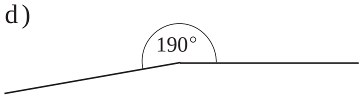
b)



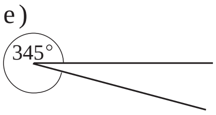
c)



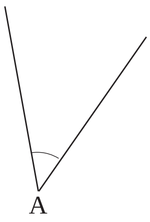
d)

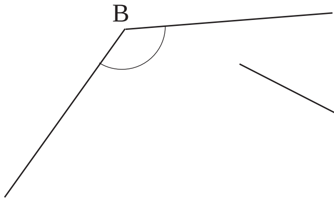


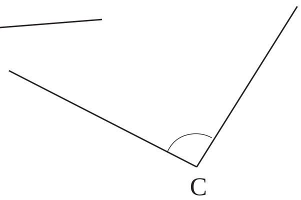
e)



Q.3

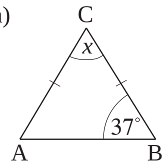




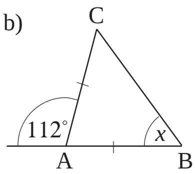


$\angle A = 45°$ $\angle B = 130°$ $\angle C = 95°$

Q.4 a)



b)



a) $\angle A = \angle B = 37°$

$x = 180° - 2 \times 37° = 180° - 74° = 106°$

b) $C\hat{A}B = 180° - 112° = 68°$, $\angle B = \angle C = x$

$x = (180° - 68°) \div 2 = 112° \div 2 = 56°$

Notes

$\underline{100} = 2^2 \times 5^2$ (= 10^2)

Factors: 1, 2, 4, 5, 10, 20, 25, 50, 100

$\underline{275} = 5^2 \times 11$

Factors: 1, 5, 11, 25, 55, 275

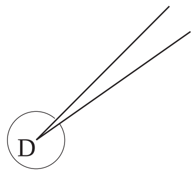
$\underline{450} = 2 \times 3^2 \times 5^2$

Factors: 1, 2, 3, 5, 6, 9, 10, 15, 18, 25, 30, 45, 50, 75, 90, 150, 225, 450

$\underline{1100} = 2^2 \times 5^2 \times 11$

Factors: 1, 2, 4, 5, 10, 11, 20, 22, 25, 44, 50, 55, 100, 110, 220, 275, 550, 1100

(or set factorising as homework at the end of *Lesson 99* and review at the start of *Lesson 100*

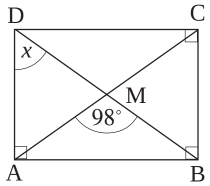


$\angle D = 360° - 10° = 350°$

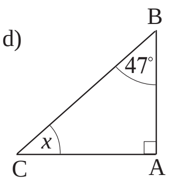
Y6		*Lesson Plan 100*
Activity		***Notes***

Solutions (Continued)

Q.4 c)



d)



c) In Δ AMD,

$A\hat{M}D = 180° - 98° = 82°$

AM = DM (as diagonals in a rectangle are equal and bisect one another)

so $D\hat{A}M = M\hat{D}A = x$ (base angles in an isosceles triangle)

$2 \times x = 180° - 82° = 98°$

so $x = 98° \div 2 = 49°$

d) $180° - 90° - 47° = 90° - 47° = 43°$

Q.5 a) *Plan:* $12°C - (-6°C) = 12°C + 6°C = 18°C$

Answer: The temperature rose by 18 degrees Celsius.

b) *Plan*: 117.5% of £240 = £240 × 1.17.5

= £24 × 11.75 = £264 + £18 = <u>£282</u>

Answer: We will have to pay £282 for the gate.

c) Sum of the angles in a quadrilateral is 360°.

Plan: $360° - (41°\,56' + 63°\,45' + 122°\,8')$

$= 360° - 227°\,49' = 132°\,11'$

Answer: The size of the 4th angle is $132°\,11'$.

d) *Plan*: $360° \div 18° = 20$ (times)

Answer: There are 20 spokes on the wheel.

e) *Plan:* 15% → 60$

1% → 60$ ÷ 15 = 4$

100% → 4$ × 100 = <u>400$</u>

1.6 USD = £1

400 USD = £1 ÷ 1.6 × 400 = £400 ÷ 1.6

= £4000 ÷ 16

= £1000 ÷ 4

= <u>£250</u>

Answer: Molly changed £250 to US Dollars for her holiday.

Notes:

$$\begin{array}{r} 41°\ 56' \\ 63°\ 45' \\ +\ 122°\ \ 8' \\ \hline 227°\ 49' \\ \hline 1° \end{array} \qquad \begin{array}{r} 359°\ 60' \\ \cancel{360°} \\ -\ 227°\ 49' \\ \hline 132°\ 11' \\ \hline \end{array}$$

Y6

R: Calculations

C: Measures. Conversions. Money. Percentage

E: Problems in context

Lesson Plan 101

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 4 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 101 is a prime number Factors: 1, 101
  (not exactly divisible by 2, 3, 5, 7 and $11 \times 11 > 101$)
- $276 = 2 \times 2 \times 3 \times 23 = 2^2 \times 3 \times 23$
  Factors: 1, 2, 3, 4, 6, 12, 23, 46, 69, 92, 138, 276
- $451 = 11 \times 41$ Factors: 1, 11, 41, 451
- $1101 = 3 \times 367$ Factors: 1, 3, 367, 1101
  (367 is a prime number, as not exactly divisible by 2, 3, 5, 7, 11, 13, 19 and $23 \times 23 > 367$)

Notes: Individual work, monitored (or whole class activity)
BB: 101, 276, 451, 1101
Ps may use calculators.
Reasoning, agreement, self-correction, praising
e.g.

$$\begin{array}{r|l} 276 & 2 \\ 138 & 2 \\ 69 & 3 \\ 23 & 23 \\ 1 & \end{array} \qquad \begin{array}{r|l} 451 & 11 \\ 41 & 41 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1101 & 3 \\ 367 & 367 \\ 1 & \end{array}$$

6 min

2

Length: revision

a) Stand up and hold your hands about 1 m apart. (When you were in Year 1 you needed to stretch out your arms to show it but now they need not be so far apart!) T quickly checks all Ps with a metre rule, praising or correcting.
Repeat for 10 cm, 25 cm, 1 cm, 500 mm, 200 mm, 10 mm, etc.

b) Let's list the units we use to measure length, Ps dictate to T.
BB: 1 mm < 1 cm < 1 m < 1 km
$\times 10$ $\times 100$ $\times 1000$

Extension

T might mention smaller and greater units and ask Ps if they have heard of them and who might use them.

BB: Smaller units: 1 micrometre (μm) = 0.001 mm
(used by scientists using microscopes)
1 angstrom (A) = 0.000 000 1 mm
(used to measure wave lengths of radiation)

Greater units: (used by astronomers, space scientists)

1 Astronomical Unit (AU) = 1.495×10^8 km
(mean distance of the Earth from the Sun)

1 light-year = 9.46×10^{12} km = 63 275 AU
(= 9 460 000 000 000 km)

1 parsec (pc) = 3.08×10^{13} km = 3.26 light-years

c) Ps choose different items to measure with rulers, estimating first and writing estimated and actual lengths in *Ex. Bks*.
(e.g. width/length of *Pb*, *Ex. Bk*, pencil, rubber, desk, etc.)
Review with whole class. T chooses Ps to tell class their results and compare their estimated and actual measurements. Class applauds Ps) whose estimates were closest to their measurements.

Notes:
Whole class activity
At a good pace
In good humour!
Praising, encouragement only

Agreement, praising
Ps could write units on blank page in *Pbs* too.

T might also mention that in some countries they use a unit of length called a decimetre (1 tenth of a metre)
BB: 1 decimetre (dm)
= 10 cm = 0.1 m

Why is it a *mean* distance?
(Distance between Earth and Sun varies according to the time of year)

A *light year* is the distance that light travels in 1 year.
(about 6 million million miles)

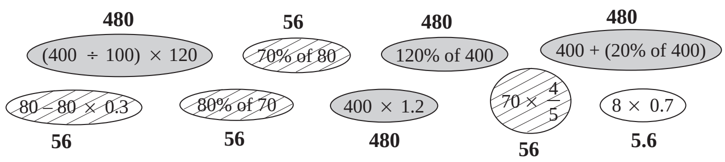
Individual estimation and measurement then whole class check and discussion
Involve several Ps.
Agreement, evaluation, praising

15 min

e.g. BB:

Y6

Lesson Plan 101

Activity		*Notes*
3	***PbY6b, page 101*** Q.1 Read: *Colour the equal values in the same colour.* Set a time limit. Ps calculate mentally (or in *Ex. Bks*.), write values above or below each ellipse then colour appropriately. Review with whole class. Which operation does not have a matching value? (8×0.7) Who can think of a partner for it? Ps come to BB to write results, explaining reasoning, and to colour appropriately. Class agrees/disagrees. Mistakes discussed and corrected. *Solution:*  *20 min*	Individual work, monitored helped Drawn (stuck) on BB or use enlarged copy maste or OHP Ps make suggestions. Class checks that they are valid. Reasoning, agreement, self-correction, praising Ps show details of calculations on BB if there is disagreement. e.g. 70% of 80 = $80 \times 0.7 = \underline{56}$ 120% of 400 = 400×1.2 $= 40 \times 12$ $= \underline{480}$
4	***PbY6b, page 101*** Q.2 Read: *Convert the quantities.* Deal with one part at a time or set a time limit. Review with whole class. Ps come to BB to fill in missing values or dictate to T, explaining reasoning. Class agrees/ disagrees. Mistakes discussed and corrected. *Solution:* a) 45.8 kg = <u>45 800</u> g; 718 g = <u>0.718</u> kg; 5.1 t = <u>5100</u> kg b) 3.4 litres = <u>340</u> cl = <u>3400</u> ml; 216 cl = <u>2.16</u> litres; 470 ml = <u>0.47</u> litres c) 2.9 km = <u>2900</u> m; 53 cm = <u>0.53</u> m; 4280 mm = <u>4.28</u> m d) 233 min = $\underline{3\frac{53}{60}}$ hr; 10.4 hr = <u>624</u> min; 45 sec = $\underline{\frac{3}{4}}$ min *25 min*	Individual work, monitored, helped Written on BB or use enlarged copy master or OHP Reasoning, agreement, self-correction, praising Feedback for T (or <u>0.75</u> min)
5	***PbY6b, page 101*** Q.3 Read: a) *If 1 EUR (Euro) = 7.4 DK (Danish Kroner) and £1 = 1.4 EUR:* *i) how many Danish Kroner is £1 worth* *ii) how many £s is 1 DK worth?* b) *Calculate 18% of 360 DK and give your answer in £s.* Deal with one part at a time or set a time limit. Ps write operations, do calculations and write the answers as sentences in *Ex. Bks.* Ps may use calculators for a) ii) and b). Review with whole class. Ps could show answers on scrap paper or slates on command. Ps with correct answers explain at BB to Ps who were wrong. Who did the same? Who worked it out in a different way? etc. Mistakes discussed and corrected.	Individual work, monitored, helped (If possible, T has Euros and Danish Kroner to pass round class.) Elicit which countries use each currency and ask Ps to point them out on a wall map. Ps who have used them tell class of their experiences. Answers shown in unison. Reasoning, agreement, self-correction, praising Feedback for T

Y6 *Lesson Plan 101*

Activity		***Notes***

5

(Continued)

Solution: e.g.

a) i) £1 = 1.4 EUR = 1.4 × 7.4 DK = <u>10.36 DK</u>

Answer: One pound is worth 10.36 Danish Kroner.

ii) 1 DK = £ (1 ÷ 10.36) ≈ <u>£0.0965</u> ≈ £0.10 (i.e. 10 p)

Answer: One Danish Kroner is worth about £0.10.

b) 18% of 360 DK = 360 DK × 0.18 = 64.80 DK

64.80 DK ≈ £ (64.80 × 0.0965) ≈ <u>£6.25</u>

Answer: 18% of 360 Danish Kroner is worth about £6.25.

30 min

Notes:

a)

		7.	4
	×	1.	4
	2	9	6
+	7	4	0
1	0.	3	6

or 360 × 0.0965 ÷ 100 × 18
≈ <u>6.25</u> (£)

6

PbY6b, page 101

Q.4 Read: *On 1 January, Martin put £3600 into an account which had an interest rate of 4% per year.*

a) Calculate the yearly interest for Martin's account.

b) If Martin did not touch his account, how much money would be in his account:

i) 1 year later ii) 2 years later?

c) What ***percentage*** *of his starting amount would be in his account:*

i) 1 year later ii) 2 years later?

Set a time limit or deal with one part at a time.

Review with whole class. Ps show answers on scrap paper or slates on command. Ps answering correctly explain at BB to Ps who were wrong. Who did the same? Who did it a different way? etc. Mistakes discussed and corrected.

Solution:

a) 4% of £3600 = £3600 ÷ 100 × 4 = £36 × 4 = <u>£144</u>

or = £3600 × 0.04 = £36 × 4 = <u>£144</u>

Answer: The yearly interest for Martin's account was £144.

b) i) £3600 + £144 = <u>£3744</u>

Answer: After 1 year, there would be £3744 in his account.

ii) £3744 + £3744 × 0.04 = £3744 + £149.76

= <u>£3893.76</u>

Answer: After 2 years, there would be £3893.76 in Martin's account.

c) i) 100% + 4% = <u>104%</u>

Answer: After one year, there would be 104% of Martin's starting amount in his account.

ii) 3893.76 ÷ 3600 × 100 = 1.0816 × 100 = <u>108.16</u> (%)

Answer: After 2 years, there would be 108.16% of Martin's starting amount in his account.

[Point out that the calculation is <u>not</u> 4% + 4% = 8%, as Martin had more money in his account during the 2nd year so he received more interest than in the 1st year.}

35 min

Notes:

Individual work, monitored, helped

Ps who have a bank account tell class about it. (e.g. name of bank, where it is, how long they have had it, how often they put money in/take money out, etc.) Otherwise T talks about his/her account.

Differentiation by time limit.

Calculators can be used where necessary.

Answers shown in unison.

Reasoning, agreement, self-correction, praising

or £3600 × 1.4 = <u>£3744</u>

or £3600 × 1.4 × 1.4
(using a calculator)

or 1.04 → <u>104%</u>

or 1.04 × 1.04 = 1.0816
→ <u>108.16%</u>

Y6

Lesson Plan 101

Activity		*Notes*
7	***PbY6b, page 101, Q.5***	
	Read: *Mr. Yamamoto is a very clever businessman. His software company has made a profit of 262 million JPY this year. The company's value is now 140% of what it was last year.*	Whole class activity T chooses Ps to read out the questions.
	a) *By what* ***percentage*** *has his company's value increased?* Show me . . . now! (40%)	Ps show answer on scrap paper or slates in unison.
	b) *What was the value of the company at the end of last year?* Allow Ps a minute to think about it or discuss with their neighbours, then Ps come to BB to write an operation and do the calculation, explaining reasoning. Who thought of doing the same? Who thought of a different way? If Ps have no ideas, T gives hints or directs Ps' thinking. T chooses a P to say the answer in a sentence.	Discussion, reasoning, agreement, praising Involve several Ps.
	Solution: e.g. 40% $\rightarrow$ 262 million JPY (or $262 \div 40 \times 100$, 10% $\rightarrow$ 65.5 million JPY or $262 \div 0.4 = 2620 \div 4$) 100% $\rightarrow$ <u>655 million</u> JPY *Answer:* At the end of last year, the value of the company was 655 million Japanese Yen.	Ps write the method they like best in *Ex. Bks.*
	c) *What is the value of the company now?* Allow Ps a minute to think about it and discuss. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Who thought of another way to do it? Come and show us. Which do you think is best? Why?	Discussion, reasoning, agreeement, praising Ps write the method they like best in *Ex. Bks*.
	Solution: e.g. 140% of 655 million JPY = (655 million+ 262 million) JPY = <u>917 million JPY</u> *Answer:* The company is now worth 917 million Japanese Yen.	or 655 million $\times$ 1.4 or 655 million $\div$ 100 $\times$ 140 or 655 million $\div$ 10 $\times$ 14
	40 min	

Y6		*Lesson Plan 101*
Activity		***Notes***
8	***PbY6b, page 101*** Q.6 Read: *Calculate the* ***whole quantity*** *if:* *a)* $\frac{3}{8}$ *of it is 210 kg* *b) 35% of it is £1812.30* *c)* $2\frac{1}{2}$ *of it is* $11\frac{2}{3}$ m^2 *d) 130% of it is 32.5 miles.* Set a time limit of 3 minutes. Ps work in *Ex. Bks*. Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly show their solution on the BB. Who did the same? Who did it another way? Mistakes discussed and corrected. *Solution:* a) 210 kg ÷ 3 × 8 = 70 kg × 8 = <u>560 kg</u> (or 210 kg ÷ 0.375) b) £1812.30 ÷ 35 × 100 = £362.46 ÷ 7 × 100 = £51.78 × 100 = <u>£5178</u> c) $11\frac{2}{3} \div 5 \times 2 = 10\frac{5}{3} \div 5 \times 2 = 2\frac{1}{3} \times 2 = 4\frac{2}{3}$ (m^2) or $11\frac{2}{3} \div \frac{5}{2} = \frac{\cancel{35}^{7}}{3} \times \frac{2}{\cancel{5}_{1}} = \frac{14}{3} = 4\frac{2}{3}$ (m^2) d) 32.5 ÷ 130 × 100 = 32.5 ÷ 13 × 10 = 2.5 × 10 = <u>25</u> (miles) or 32.5 ÷ 1.3 = 325 ÷ 13 = <u>25</u> (miles)	Individual work, monitored, helped (or whole class activity if time is short) Differentiation by time limit Responses shown in unison. Reasoning, agreement, self-correction, praising Accept any valid method of solution. or $210 \div \frac{3}{8} = \cancel{210}^{70} \times \frac{8}{\cancel{3}_{1}} = \underline{560}$ or £1812.30 ÷ 0.35 = £181230 ÷ 35 = <u>£5178</u> Elicit or remind Ps that to divide by a fraction, multiply by its <u>reciprocal</u> value (i.e. the value which multiplies the original fraction to make 1)

45 min

Y6	R: Calculation **C: Measures: metric and Imperial units; conversion** *E: Problems*	*Lesson Plan* *102*

Activity		***Notes***
1	**Factorisation** Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes. Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected. Elicit that: • 102 $= 2 \times 3 \times 17$ Factors: 1, 2, 3, 6, 17, 34, 51, 102 • 277 is a prime number Factors: 1, 277 (as not exactly divisible by 2, 3, 5, 7, 11, 13 and $17 \times 17 > 277$) • 452 $= 2 \times 2 \times 113 = 2^2 \times 113$ Factors: 1, 2, 4, 113, 226, 452 • 1102 $= 2 \times 19 \times 29$ Factors: 1, 2, 19, 29, 38, 58, 551, 1102 *7 min*	Individual work, monitored (or whole class activity) BB: 102, 277, 452, 1102 Ps could practise calculation without using calculators. Reasoning, agreement, self-correction, praising e.g. $\begin{array}{r\|l} 102 & 2 \\ 51 & 3 \\ 17 & 17 \\ 1 & \end{array}$ $\begin{array}{r\|l} 452 & 2 \\ 226 & 2 \\ 113 & 113 \\ 1 & \end{array}$ $\begin{array}{r\|l} 1102 & 2 \\ 551 & 19 \\ 29 & 29 \\ 1 & \end{array}$
2	**Units of measure: conversion practice (using calculators)** T gives the metric $\rightarrow$ Imperial rate of conversion. Ps use calculators to work out the Imperial $\rightarrow$ metric conversion rate. All Ps do the calculation, then T chooses a P to dictate the reverse rate (rounding to an agreed number of decimal places: the more decimal places, the closer to the actual value) and class agrees or disagrees. T writes agreed value in a table on BB (or on a prepared wall chart) and Ps write it on their own Units of Measure sheet. [If possible, in the case of disagreement, use a calculator on a computer projected onto a screen so that the whole class can see the buttons pressed and the result generated before agreement on an appropriate rounding.] Ps stick completed sheet in the back of their *Pbs/Ex. Bks*. for reference.	Whole class activity but individual use of calculators. Written on BB or use enlarged copy master or OHP Ps have a copy on desks too. At a good pace. Calculation: e.g. $1 \div 2.54 = 0.3937007...$ ≈ 0.3937 (to 4 d.p.) ≈ 0.4 (to 1 d.p.) so 1 cm $\approx$ 0.3937 " ($\approx$ 0.4")

Rates given by T: Calculated by Ps: e.g.

Units of Measure

Length	
1 inch (1 ") = 25.4 mm (= 2.54 cm)	1 cm $\approx$ 0.3937 " ($\approx$ 0.4 ")
1 foot (1 ') = 12 " = 30.48 cm ($\approx$ 0.3 m)	1 m $\approx$ 3.281 ' ($\approx$ 3.3 ')
1 yard (1 yd) = 3 ' = 914.4 mm (= 0.9144 m)	1 m $\approx$ 1.0936 yd ($\approx$ 1.1 yd)
1 mile = 1.609 km	1 km $\approx$ 0.6215 mile ($\approx$ 0.6 mile)
1 Nautical mile = 1.852 km	1 km $\approx$ 0.53996 Naut. mile ($\approx$ 0.54 N. mile)
Area	
1 square inch $\approx$ 6.54 cm^2	1 cm^2 $\approx$ 0.153 square inches
1 square foot $\approx$ 929 cm^2	1 m^2 $\approx$ 10.76 square feet
1 square yard $\approx$ 0.836 m^2	1 m^2 $\approx$ 1.196 square yards
1 acre $\approx$ 0.4047 hectares (ha)	1 ha $\approx$ 2.471 acres
1 hectare = 10 000 m^2	1 km^2 = 1 000 000 m^2 = 100 hectares

Y6

Lesson Plan 102

Activity		Notes
2	(Continued)	

Mass (weight)

1 grain (1 gr) ≈ 0.06481 g	1 g ≈ 15.43 grains
1 ounce (1 oz) ≈ 28.33 g	1 kg ≈ 35.30 oz
1 pound (1 lb) ≈ 0.4535 kg	1 kg ≈ 2.205 lb
1 hundredweight (1 cwt) ≈ 50.792 kg	1 tonne (t) ≈ 19.688 cwt

Capacity

1 pint (1 pt) ≈ 0.5682 litre	1 litre ≈ 1.76 pints
1 gallon (1 gal) ≈ 4.5455 litres	1 litre ≈ 0.22 gallons

Volume

1 cubic inch ≈ 16.387 cm^3	1 cm^3 ≈ 0.06 102 cubic inches
1 cubic foot ≈ 0.02832 m^3	1 m^3 ≈ 35.311 cubic feet
1 cubic yard ≈ 0.764 m^3	1 m^3 ≈ 1.31 cubic yards

Temperature

Fahrenheit → Celsius	Celsius → Fahrenheit
$x°\text{F} = (x - 32) \times \frac{5}{9}$ (°C)	$x°\text{C} = \frac{9}{5} \times x + 32$ (°F)

Notes: T gives Ps an idea of what each measure is. (e.g. a grain of rice, a pint of milk, a gallon can, an ounce of sugar, 1 lb of potatoes, 1 yard marked on classroom wall, a metre rule, places which are 1 km and 1 mile from school, etc.to make the measures more relevant)

Ps suggest values for *x* and use the formulae to convert degrees Fahrenheit to degrees Celsius and vice versa. Discuss temperature related to daily life (weather, ovens, body, washing machines, etc.)

20 min

3

PbY6b, page 102

Q.1 Read: *One foot is approximately equal to 30 cm.*

*a) Calculate the height i**n cm** of:*

i) a child who is 5 feet tall

ii) a boy who is 5.9 feet tall

iii) a basketball player who is 7.1 feet tall.

*b) Calculate the height i**n feet** of:*

i) a man who is 186 cm tall

ii) a man who is 162 cm tall.

Set a time limit of 2 minutes. Ps write operations in *Ex. Bks* but work out the results without using calculators.

Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain what they did. Mistakes discussed and corrected.

Solution: e.g.

a) i) 1 foot ≈ 30 cm,
5 feet ≈ 30 cm × 5 = <u>150 cm</u>

ii) 5.9 feet ≈ 30 cm × 5.9 = 3 cm × 59 = <u>177 cm</u>

iii) 7.1 feet ≈ 30 cm × 7.1 = 3 cm × 71 = <u>213 cm</u>

b) i) 30 cm ≈ 1 foot,
180 cm ≈ (180 ÷ 30) feet = (18 ÷ 3) feet = <u>6 feet</u>

ii) 162 cm ≈ (162 ÷ 30) feet = (16.2 ÷ 3) feet = <u>5.4</u> feet

25 min

Notes:

Individual work, monitored, helped

T reminds Ps that:
BB: 1 foot = 1 ft = 1'

Responses shown in unison.

Reasoning, agreement, self-correction, praising

Ask Ps to demonstrate the heights, first without a tape measure then with one to see how close their estimate was.

In good humour! Praising

Feedback for T

Y6

Lesson Plan 102

Activity | **Notes**

4

PbY6b, page 102

Q.2 Read: *One inch is approximately equal to 25.4 millimetres and 1 zoll is approximately equal to 26.3 mm.*

a) Calculate what percentage: i) 1 inch is of 1 zoll
ii) 1 zoll is of 1 inch.

b) Convert 52.6 cm into: i) zolls ii) inches.

T: A zoll is an old unit of length which is still used in some Central European countries (e.g. in local markets in Germany).

Set a time limit of 3 minutes. Ps write operations in *Ex. Bks* and use calculators to work out the answers.

Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain what they did. Mistakes discussed and corrected.

Solution: e.g.

a) i) $25.4 \div 26.3 \times 100 = 254 \div 263 \times 100 \approx \underline{96.6}$ (%)

Answer: 1 inch is about 96.58% of 1 zoll.

ii) $26.3 \div 25.4 \times 100 = 263 \div 254 \times 100 \approx \underline{103.5}$ (%)

Answer: 1 zoll is about 103.5% of 1 inch.

b) i) 52.6 cm = 526 mm

$526 \div 26.3 = 5260 \div 263 = \underline{20}$ (zolls)

Answer: 52.6 cm is approximately equal to 20 zolls.

ii) $526 \div 25.4 = 5260 \div 254 \approx \underline{20.71}$ (inches)

Answer: 52.6 cm is approximately equal to 20.71 inches.

Notes:

Individual work, monitored, helped

Allow Ps to use calculators but when reviewing, go through the vertical division below with Ps help, as revision practice.

Responses shown in unison.

Discussion, reasoning, agreement, self-correction, praising

BB:

a) i)

					0	.9	6	5	7
2	6	3	2	5	4.	0	0	0	0
		–	2	3	6	7			
				1	7	3	0		
			–	1	5	7	8		
					1	5	2	0	
				–	1	3	1	5	
						2	0	5	0
					–	1	8	4	1
							2	0	9

$0.965\underline{8} \times 100 = 96.58$

$\approx \underline{96.6}$ (%)

T chooses Ps to say the answers in sentences.

30 min

5

PbY6b, page 102

Q.3 Read: *One mile is approximately equal to 1.6 km and 1 Natutical mile is approximately equal to 1.85 km.*

What is a nautical mile? (Used in navigation: distance at sea)

Deal with one question at a time under a time limit. Ps read question themselves and solve it in *Ex. Bks.* (Write an operation, estimate, calculate, check and write the answer in a sentence.)

Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain reasoning to Ps who were wrong. Mistakes discussed and corrected.
T chooses Ps to say each answer in a sentence.

Solution:

a) *A French sailor reported that his ship had sailed 620 km. How would an English sailor have reported sailing the same distance?*

Plan: $620 \div 1.85 = 62\,000 \div 185 \approx \underline{335}$ (Nautical miles)

Answer: An English sailor would have reported sailing 335 Nautical miles.

Notes:

Individual work, monitored, helped

Allow Ps to use calculators.

Answers shown in unison.

Reasoning, agreement, self-correction, praising

Feedback for T

Extension

What percentage of a normal (or statutory) mile is a Nautical mile?

$1.85 \div 1.6 \times 100$

$= 1.15625 \times 100 \approx \underline{116}$ (%)

Y6		*Lesson Plan 102*
Activity		***Notes***
5	*(Continued)* *b) Michael Schumacher, the German racing driver, did a road test on his car and said that he had covered a distance of 410 km.* *If David Coulthard, the Scottish racing driver, had done the same road test, what distance would he say that he had covered?* *Plan:* 410 ÷ 1.6 = 4100 ÷ 16 = 256.25 ≈ <u>256</u> (miles) *Answer:* He would have said that he had covered a distance of about 256 miles (or 256 and a quarter miles). *35 min*	If possible, T has pictures of the racing drivers and asks Ps what they know about them. (T should have information already prepared in case Ps know nothing.) or 256.25 miles = $256\frac{1}{4}$ miles
6 ***Erratum*** In *Pbs*: 'c)' should be 'b)'	***PbY6b, page 102*** Q.4 Read: *One acre is approximately equal to 0.4 of a hectare.* *Lazlo, a Hungarian farmer, has a farm covering 120 hectares. Ian, a British farmer, has a farm covering 375 acres.* *a) What is the ratio of: i) Ian's land to Lazlo's land* *ii) Lazlo's land to Ian's land?* *b) By what percentage is Ian's land greater than Lazlo's land?* Set a time limit or deal with one part at a time. Allow calculators. Review with whole class. Ps show results on scrap paper or slates on command. Ps answering correctly explain reasoning at BB. Who did the same? Who worked it out a different way? etc. Mistakes discussed and corrected. *Solution:* e.g. a) i) I : 375 acres = 375 × 0.4 hectares = 150 hectares Ratio of I : L = 150 : 120 = <u>5 : 4</u> ii) Ratio of L : I = 120 : 150 = <u>4 : 5</u> *Answer:* The ratio of Ian's land to Lazlo's land is 5 to 4. The ratio of Lazlo's land to Ian's land is 4 to 5. b) 150 – 120 = 30 (ha) $\frac{30}{120} = \frac{1}{4} \rightarrow \underline{25\%}$ or $\frac{5-4}{4} \times 100 = \frac{1}{4} \times 100 = \underline{25}$ (%) *Answer:* Ian's land is 25% greater than Lazlo's land. *40 min*	Individual work, monitored, helped T could ask a P to point out Hungary on a world map and ask Ps what they know about it. Differentiation by time limit. Reasoning, agreement, self-correction, praising Feedback for T

Y6		*Lesson Plan 102*
Activity		***Notes***
7	***PbY6b, page 102, Q.5*** Read: *1 kilogram is approximately equal to 2.2 pounds (lb).* *Sarah bought* $1\frac{1}{2}$ *lb of meat for £12 in a butcher's shop.* *Olga bought 500 g of the same kind of meat for £7 in the supermarket.*	Whole class activity (or individual work, monitored, helped and reviewed as usual)
	a) *Who had the better bargain?* Allow Ps 2 minutes to think about it. If you think Sarah had the better bargain, stand up . . . now! T chooses a P standing and a P sitting to explain their reasoning at BB. Class decides who is correct. *Solution:* e.g. S: £12 ÷ 1.5 = £24 ÷ 3 = £8 (per lb) O: 500 g = 0.5 kg, 1 kg ≈ 2.2 lb, so 0.5 kg ≈ 1.1 lb £7 ÷ 1.1 = £70 ÷ 11 ≈ £6.36 (per lb) *Answer:* Olga had the better bargain.	Ps work it out on scrap paper or in *Ex. Bks*. Discussion, reasoning, agreement, praising or £12 ÷ 1.5 = £120 ÷ 15 = £40 ÷ 5 = £8
	b) *What would 1 kg of the meat cost in each shop?* Show me what it would cost in the supermarket . . . now! (£14) **A**, tell us how you worked it out. (£7 × 2 = £14) How can we work out what it would cost in the butcher's shop? **B**, come and show us. Who agrees? Who would do it another way? etc. Class helps if necessary. e.g. £12 ÷ 1.5 × 2.2 = £8 × 2.2 = £17.60 T chooses a P to say the answer in a sentence. *Answer:* One kilogram of the meat would cost £14 in the supermarket and £17.60 in the butcher's shop.	Answers shown in unison. Reasoning, agreement, praising Discussion, reasoning, agreement, praising or 1 lb → £8 2.2 lb ≈ 1 kg → £8 × 2.2 = £17.60

45 min

Y6

R: Calculations

C: Measures: conversions; time, 24 hour clock

E: Word problems

Lesson Plan 103

Activity — ***Notes***

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 4 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 103 is a prime number — Factors: 1, 103
  (as not exactly divisible by 2, 3, 5, 7 and $11 \times 11 > 103$)
- $278 = 2 \times 139$ — Factors: 1, 2, 139, 278
- $453 = 3 \times 151$ — Factors: 1, 3, 151, 453
- 1103 is a prime number — Factors: 1, 1103
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 19, 23, 29, 31 and $37^2 > 1103$)

Notes: Individual work, monitored (or whole class activity)

BB: 103, 278, 453, 1103

Ps could practise calculation without a calculator.

Reasoning, agreement, self-correction, praising

e.g.

$$\begin{array}{r|l} 278 & 2 \\ 139 & 139 \\ 1 & \end{array} \qquad \begin{array}{r|l} 453 & 3 \\ 151 & 151 \\ 1 & \end{array}$$

and 139 and 151 are prime numbers

6 min

2

Problem 1

How many times do the two hands on a clock cover each other exactly from 12 noon to 12 midnight? T asks several Ps what they think.

Let's check it. T has large traditional analogue clock at a height that Ps can reach and class can see easily. (The hands must turn together.)

Let's list the times when they cover each other exactly. Agree that the first time is 12 noon. Then Ps say what they think the next time will be and a P turns the hands to check. T writes checked times on BB.

BB: At 12:00 (noon), after 13:05, after 14:10; after 15:15, after 16.20, after 17:25, after 18:30, after 19:35, after 20:40, after 21:45, after 22:50, at 12:00 (midnight)

Agree that they cover each other exactly 12 times (not 13).

Notes: Whole class activity

If possible, Ps have own clocks too.

At a good pace

In good humour.

Agreement, praising

Class applauds Ps who were correct at the beginning.

10 min

3

Problem 2

Listen carefully and think about how you would work out the answer.

a) How much time has passed from

BB: 6 h 14' 25" to 13 h 08' 43"?

What kind of operation do we need to do? (subtraction) How could we do it? Ps come to BB to write it vertically and to do the calculation, explaining reasoning in detail. Who can think of another way to do the subtraction? T shows it if no P does.

BB:

$$\begin{array}{rrrr} & 13\text{ h} & \overset{60}{08}\,' & 43\,'' \\ - & {}_{1}6\text{ h} & 14\,' & 25\,'' \\ \hline & 6\text{ h} & 54\,' & 18\,'' \end{array} \quad \text{or} \quad \begin{array}{rrrr} & \overset{12\text{ h}}{\cancel{13\text{ h}}} & \overset{68}{\cancel{08}}\,' & 43\,'' \\ - & 6\text{ h} & 14\,' & 25\,'' \\ \hline & 6\text{ h} & 54\,' & 18\,'' \end{array}$$

Here are some calculations about time but they are written in a different form. Who can explain them? (No units are given so, e.g., 11: 43 could mean 11 h 43 minutes or 11 minutes 43 seconds)

Let's work out the result and then think of a word problem about it.

Ps come to BB, explaining reasoning. Class points out errors. Ps suggest contexts and class decides whether they are valid.

Notes: Whole class activity

Elicit that 1 h = 60 min (60 ')
1 ' = 60 sec (60 ")

Discussion, reasoning, agreement, praising

Methods:

- Borrow 1 h (= 60 ') from the hours column, then pay it back, or
- Change 1 hour in the hours column to 60 minutes and add it to minutes column.

Written on BB or SB or OHT

Elicit that the result does not depend on whether they are hours or minutes, as there are 60 minutes in 1 hour and also 60 seconds in 1 minute

Y6

Lesson Plan 103

Activity		*Notes*

3

(Continued)

b) BB:

i)

$$\begin{array}{r} 11:43 \\ +\ \ 7:38 \\ \hline 19:21 \\ \hline {}_{1}\ \ \ \ \ \ \end{array}$$

e.g.
A train left the station at 11:43 and the journey took 7 hours 38 minutes.

When did it arrive at its destination?

ii)

$$\begin{array}{r} 1:52.34 \\ -\ \ 1:51.72 \\ \hline 0:00.62 \\ \hline \end{array}$$

e.g.
An athlete ran the first lap of a race in 1 minute 52.34 seconds and the 2nd lap in 1 minute 51.72 seconds.

How much faster was he on the 2nd lap?

Notes:

Agreement, prraising

Ask several Ps for word problems.

Extra praise for creativity!

(If the time was 1 hour, 52 minutes 34 seconds, it would be written as:

BB: 1 : 52 : 34

not as 1 : 52.34)

15 min

4

PbY6b, page 103

Q.1 Read: *One foot is approximately equal to 30.5 cm and 1 yard is approximately equal to 91.5 cm.*

The members of a school's athletics team were training for a competition and their coach noted how far they could run in a set time.

a) Leslie ran 610 yards 2 feet. Cora ran 90% of Leslie's distance in the same time.
How many metres did Cora run?

b) Jane ran 502 m 88 cm. Adam ran 120% of Jane's distance in the same time.
How many yards did Adam run?

Set a time limit or deal with one at a time. Ps write plans, do calculations (with calculators) and write answers in sentences in *Ex.Bks*.

Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain reasoning at BB. Who did the same? Who did it a different way? etc. Mistakes discussed and corrected.

Solution:

a) L: 610 yards 2 ft $\approx$ (610 $\times$ 91.5 + 2 $\times$ 30.5) cm
= 55 815 cm + 61 cm
= 55 876 cm = 558.76 m

C: 90% of 558.76 m = 558.76 m $\times$ 0.9 = 502.884 m

Answer: Cora ran 502.884 metres.

b) J: 502 m 88 cm = 50 288 cm $\approx$ (50 288 $\div$ 91.5) yd
= (502 880 $\div$ 915) yd
$\approx$ 549.60 yd

A: 120% of 549.60 yd = 549.60 yd $\times$ 1.2 = 659.52 yd

Answer: Adam ran 659.52 yards.

Notes:

Individual work, monitored, helped

Ps may use calculators.

(If majority of Ps are struggling, stop individual work and continue as a whole class activity.)

Responses shown in unison.

Discussion, reasoning, agreement, self-correction, praising

(If possible, when reviewing, use a calculator on a computer projected onto a screen so that the whole class can see.)

Extension (for quicker Ps)

Put the children in order of speed.

1st: Adam (659.52 yd)

2nd: Leslie: (610 yd 2 ft)

3rd equal: Cora and Jane (549.6 yd)

20 min

Y6		*Lesson Plan 103*

Activity		*Notes*
5	***PbY6b, page 103***	
	Q.2 BB: $\boxed{^\circ\text{C} \to {}^\circ\text{F}: \ \frac{9}{5} \times x + 32, \quad {}^\circ\text{F} \to {}^\circ\text{C}: \ \frac{5}{9} \times (x - 32)}$	Whole class activity to start Written on BB or SB or OHT
	Who can explain what the formulae in the box mean? Allow Ps to explain if they can, otherwise T reminds class. Degrees Celsius is a metric unit of measure and degrees Fahrenheit is an Imperial unit of measure. • To convert degrees Celsius (x) to degrees Fahrenheit: multiply the value (x) by 9 fifths and add 32. • To convert degrees Fahrenheit (x) to degrees Celsius: subtract 32 from the value (x) and multiply the difference by 5 ninths.	Discussion involving several Ps. Agreement, praising
	a) Read: *"Its 32° here and I'm cold!" said Kate on the phone in London.* *"Its 32° here and I'm hot!" Lucia answered from Sao Paolo in Brazil.* *Who is correct? Give a reason for your answer.*	
	Allow Ps a minute to think about it. Stand up if you think that Kate is correct . . . now! Raise your hand if you think that Lucia is correct . . .now! Ps who did both explain to class. Both are correct, as Kate could have meant 32 degrees Fahrenheit which is very cold and Lucia could have meant 32 degrees Celsius, which is hot. Let's work out what the actual temperatures are so that we can compare them. Ps come to BB or dictate what T should write, substituting 32 for x in each formula.	In good humour! Responses given in unison. Class applauds Ps who did both for the correct reason. At a good pace Agreement, praising
	BB: K: $32^\circ\text{F} = [\frac{5}{9} \times (32 - 32) = \frac{5}{9} \times 0]\ ^\circ\text{C} = \underline{0}\ ^\circ\text{C}$ L: $32^\circ\text{C} = (\frac{9}{5} \times 32 + 32 = \frac{288}{5} + 32 = 57.6 + 32)\ ^\circ\text{F}$	$= \underline{89.6}\ ^\circ\text{F}$
	Let's see if you can do parts b) and c) on your own. I will give you 3 minutes! Start . . . now! . . . . . Stop! Review with whole class. Ps come to BB or dictate to T. Class agrees/disagrees. Mistakes discussed and corrected. Ask Ps to say whether they think the temperatures are hot or cold.	Individual work, monitored, <u>helped</u> Differentiation by time limit Reasoning, agreement, self-correcting, praising
	Solution: *a) Convert to degrees Celsius:* i) $0^\circ\text{F} = [\frac{5}{9} \times (0 - 32) = \frac{5}{9} \times (-32) = -\frac{160}{9}]^\circ\text{C}$ $= -17.\dot{7}\,^\circ\text{C} \approx \underline{-17.8}\,^\circ\text{C}$ ii) $50^\circ\text{F} = [\frac{5}{9} \times (50 - 32) = \frac{5}{\cancel{9}_1} \times \cancel{18}^2]\ ^\circ\text{C} = \underline{10}\,^\circ\text{C}$ iii) $104^\circ\text{F} = [\frac{5}{9} \times (104 - 32) = \frac{5}{\cancel{9}_1} \times \cancel{72}^8]^\circ\text{C} = \underline{40}\,^\circ\text{C}$	Elicit/tell that water freezes at 0°C and boils at 100°C.

Y6

Lesson Plan 103

Activity		Notes
5	(Continued) *c) Convert to degrees Fahrenheit:* i) $100°C = (\frac{9}{5} \times 100 + 32 = 180 + 32)\ °F = \underline{212}\ °F$ ii) $30°C = (\frac{9}{5} \times 30 + 32 = 54 + 32)\ °F = \underline{86}\ °F$ iii) $-10°C = [\frac{9}{5} \times (-10) + 32 = -18 + 33]\ °F = \underline{14}\ °F$ *26 min*	
6	***PbY6b, page 103*** Q.3 What are these calculations about? (time) What units are used? [hours (h), minutes (min or '), seconds (sec or ")] Let's see if you can do them in 3 minutes! Start . . .now! . . Stop! Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Who did the same? Who did it another way? etc. Mistakes discussed and corrected. Ps finished early could think of a word problem for each one. *Solution*: e.g. a) $\begin{array}{rrrr} & 4\text{ h} & 16\text{ min} & 37\text{ sec} \\ + & 5\text{ h} & 57\text{ min} & 43\text{ sec} \\ \hline & 10\text{ h} & 14\text{ min} & 20\text{ sec} \\ & {\scriptstyle 1} & {\scriptstyle 1} & \end{array}$ b) $\begin{array}{rrrr} & & {\scriptstyle 60} & {\scriptstyle 60} \\ & 17\text{ h} & 31' & 18'' \\ - & 6\text{ h} & 50' & 32'' \\ & {\scriptstyle 1} & {\scriptstyle 1} & \\ \hline & 10\text{ h} & 40' & 46'' \end{array}$ *31 min*	Individual work, monitored, less able Ps helped Written on BB or SB or OHT Differentiation by time limit Reasoning agreeement, self-correction, praising Accept any valid reasoning. Feedback for T c) $\begin{array}{rrrr} & 168\text{ h} & {\scriptstyle 60} & {\scriptstyle 60} \\ - & 19\text{ h} & 26' & 41'' \\ & {\scriptstyle 1} & {\scriptstyle 1} & \\ \hline & 148\text{ h} & 33' & 19'' \end{array}$
7	***Pb6b, page 103*** Q.4 Read: *Calculate the arrival time if a plane took off at:* a) *3.24 pm and the flight lasted 9 hours 44 minutes* *b) 11.45 am and the flight lasted 3 hours 16 minutes* *c) 21:18 and the flight lasted 5 hours 33 minutes.* Set a time limit or deal with one at a time. Ps write plans, do calculations and write the answer in a sentence in *Ex. Bks*. Review with whole class. Ps show results on scrap paper or slates on command. Ps answering correctly explain at BB. Who did the same? Who did it another way? etc. Mistakes discussed and corrected. T chooses Ps to say the answer in a sentence. *Solution:* a) *Plan:* 3 h 24 min + 9 h 44 min *C:* $\begin{array}{rrr} & 3\text{ h} & 24' \\ + & 9\text{ h} & 44' \\ \hline & 13\text{ h} & 08' \\ & {\scriptstyle 1} & \end{array}$ (after 12 noon) (after 12 noon) or $\begin{array}{rrr} & 15\text{ h} & 24' \\ + & 9\text{ h} & 44' \\ \hline & 25\text{ h} & 08' \\ & {\scriptstyle 1} & \end{array}$ *Answer:* The arrival time was 01:08 the next day.	Individual work, monitored, helped Responses shown in unison. Reasoning, agreement, self-correction, praising Accept any valid method of calculation with correct reasoning. Extra praise for Ps who realised that: 25 h 8 ' = 24 h + 1 h + 8 ' = 1 day + 1 h + 8' (or 1.08 am)

Y6		*Lesson Plan 103*
Activity		***Notes***
7	(Continued) b) *Plan:* 11 h 45 min + 3 h 16 min *C:* $\begin{array}{r} 11\text{ h } 45' \\ +\ 3\text{ h } 16' \\ \hline 15\text{ h } 01' \\ \hline {}_1\quad\ \ \end{array}$ *Answer:* The plane arrived at 15:01 (or 3.01 pm, or 1 minute past 3 in the afternoon). c) *Plan:* 21 h 18 min + 5 h 33 min *C:* $\begin{array}{r} 21\text{ h } 18' \\ +\ 5\text{ h } 33' \\ \hline 26\text{ h } 51' \\ \hline {}_1\quad\ \ \end{array}$ *Answer:* The arrival time was 2.51 am (or 02:51) the next day. *36 min*	Elicit different ways to express the answer. 26 h 51' = 24 h + 1 h + 51' = 1 day + 1 h + 51'
8	***PbY6b, page103*** Q.5 Read: *Calculate tour journey time if we left at:* *a) 9:35 am and arrived at 11.56 am* *b) 9.35 am and arrived at 13:25* *c) 09:35 and arrived at 4.10 pm* *d) 09:35 and arrived at 07:25 the next day.* Set a time limit or deal with one at a time. Ps write plans, do calculations and write the answer in a sentence in *Ex. Bks*. Review with whole class. Ps show results on scrap paper or slates on command. Ps answering correctly explain at BB. Who did the same? Who did it another way? etc. Mistakes discussed and corrected. T chooses Ps to say the answer in a sentence. *Solution:* a) *Plan:* 11 h 56 min – 9 h 35 min *C:* $\begin{array}{r} 11\text{ h } 56' \\ -\ 9\text{ h } 35' \\ \hline 2\text{ h } 21' \\ \hline \end{array}$ *Answer:* Our journey time was 2 hours 21 minutes. b) *Plan:* 13 h 25 min – 9 h 35 min *C:* $\begin{array}{r} {}^{60}\quad \\ 13\text{ h } 25' \\ -\ 9\text{ h}_1 35' \\ \hline 3\text{ h } 50' \\ \hline \end{array}$ *Answer:* Our journey time was 3 hours 50 minutes. c) *Plan:* 16 h 10 min – 9 h 35 min *C:* $\begin{array}{r} {}^{60}\quad \\ 16\text{ h } 10' \\ -\ 9\text{ h}_1 35' \\ \hline 6\text{ h } 35' \\ \hline \end{array}$ *Answer:* Our journey time was 6 hours 35 minutes. d) *Plan:* 24 h – 9 h 35 min + 7 h 25 min = 14 h 25 min + 7 h 25 m = <u>21 h 50 min</u> or 09:35 one day to 09:35 the next day is 24 hours 24 h – 2 h 10 min = <u>21 h 50 min</u> *Answer:* Our journey time was 21 hours 50 minutes. *41 min*	Individual work, monitored, helped Responses shown in unison. Reasoning, agreement, self-correction, praising Accept any valid method of calculation with correct reasoning. Feedback for T or $\begin{array}{r} 12\text{ h } 85' \\ \cancel{13\text{ h } 25'} \\ -\ 9\text{ h } 35' \\ \hline 3\text{ h } 50' \\ \hline \end{array}$ or $\begin{array}{r} 15\text{ h } 70' \\ \cancel{16\text{ h } 10'} \\ -\ 9\text{ h } 35' \\ \hline 6\text{ h } 35' \\ \hline \end{array}$ Extra praise for this!

Y6		*Lesson Plan 103*
Activity		***Notes***
9	***PbY6b, page 103, Q.6*** Read: *When the time is 09:00 in Exeter in the UK, it is 10:00 in Kassel in Germany.* T (P) shows Exeter and Kassel on a map of Europe. Why is the time different in the two countries? (Talk about the Earth turning on its axis so the sunrise and sunset is at different times around the world. To make life easier, countries have been put into different agreed time zones, measured from the Meridien line in Greenwich, London.) Deal with one at a time. T chooses a P to read the sentence. Ps calculate mentally or in *Ex. Bks*. and show results on scrap paper or slates on command. Ps with different answers explain reasoning. Class decides who is correct. T chooses a P to say the answer in a sentence. *Solution:* e.g. *a) David left Exeter at 7.30 am and arrived in Kassel at 15:15. How long did his journey take?* When David arrived in Kassel the time would be 14:15 in Exeter. *Plan:* 14:15 – 07:30 = 6 h 45' *Answer*: David's journey took 6 and 3 quarter hours. b) *A month later, Werner left Kassel at 08:30 and arrived in Exeter at 14:15. How long did his journey take?* When Werner arrived in Exeter the time would be 15:15 in Kassel. *Plan:* 15:15 – 08:30 = 6 h 45' *Answer*: Werner's journey also took 6 and 3 quarter hours. *45 min*	Whole class activity (or individual work if there is time, reviewed as usual with whole class) Quick revision of time zones (T could use Y6 CM LP 47/2) Involve several Ps. Answers shown in unison. Reasoning, agreement, praising Accept any valid method of solution. *C:* e.g. $\begin{array}{rr} 14\text{ h} & \overset{60}{15}\,' \\ -\;7\text{ h}_1 & 30\,' \\ \hline 6\text{ h} & 45\,' \end{array}$ *C:* e.g. $\begin{array}{rr} 15\text{ h} & \overset{60}{15}\,' \\ -\;8\text{ h}_1 & 30\,' \\ \hline 6\text{ h} & 45\,' \end{array}$
Homework	When the time is 10:00 in London, it is 17:00 in Hanoi. A plane leaves London at 12:40 and 13 hours later it lands in Hanoi. What is the time in Hanoi when the plane lands? *Solution:* e.g. 12 h 40 ' + 13 h = 25 h 40' = 24 h + 1 h + 40' = 1 day + 1 h + 40' so the time in London when the plane lands is 01:40 the next morning. But Hanoi time is 7 hours ahead of London time, so the time in Hanoi when the plane lands is 01:40 + 07:00 = <u>08:40</u> (or 12:40 + 13:00 + 7:00 = 12:40 + 20:00 = <u>08:40)</u>	Optional Review before the start of *Lesson 104.* Ask Ps to find Vietnam on a map of the world and Hanoi on a map of Vietnam. Ps say what they know about Vietnam. (T could have information already prepared.)

Y6

R: Calculations

C: Perimeter and area. Area of squares, rectangles and triangles

E: Problems

Lesson Plan
104

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>104</u> $= 2 \times 2 \times 2 \times 13 = 2^3 \times 13$
  Factors: 1, 2, 4, 8, 13, 26, 52, 104
- <u>279</u> $= 3 \times 3 \times 31 = 3^2 \times 31$ Factors: 1, 3, 9, 31, 93, 279
- <u>454</u> $= 2 \times 227$ (227 is a prime number) Factors: 1, 2, 227, 454
- <u>1104</u> $= 2 \times 2 \times 2 \times 2 \times 3 \times 23 = 2^4 \times 3 \times 23$
  Factors: 1, 2, 3, 4, 6, 8, 12, 16, 23, 24, ↓
  1104, 552, 368, 276, 184, 138, 92, 69, 48, 46

Notes:

Individual work, monitored (or whole class activity)

BB: 104, 279, 454, 1104

T decides whether Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

$$\begin{array}{r|l} 104 & 2 \\ 52 & 2 \\ 26 & 2 \\ 13 & 13 \\ 1 & \end{array} \qquad \begin{array}{r|l} 279 & 3 \\ 93 & 3 \\ 31 & 31 \\ 1 & \end{array} \qquad \begin{array}{r|l} 454 & 2 \\ 227 & 227 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1104 & 2 \\ 552 & 2 \\ 276 & 2 \\ 138 & 2 \\ 69 & 3 \\ 23 & 23 \\ 1 & \end{array}$$

8 min

2

Perimeter and area

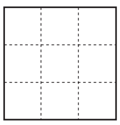
Ps each have a sheet of squares, rectangles and triangles and a transparent 10 cm by 10 cm measuring grid.

Use your grids to measure or calculate the area and the perimeter of the rectangles and only the area of the triangles. Write your results in your *Ex. Bks*. Deal with one set of polygons at a time.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes corrected.

Elicit the <u>general</u> formula for area and perimeter of rectangles and for area of triangles. e.g.

a) <u>Square</u> e.g.

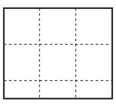
i) 
a

$P = 12$ cm (or $3 \text{ cm} \times 4 = 12$ cm)

$A = 9 \text{ cm}^2$ (or $3 \text{ cm} \times 3 \text{ cm} = 9 \text{ cm}^2$)

P (square) $= 4a$, A (square) $= a \times a = a^2$

<u>Rectangle</u> e.g.

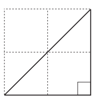
v) 
a, *b*

$P = 11$ cm $\left[2 \times \left(3 \text{ cm} + 2\frac{1}{2} \text{ cm}\right) = 11 \text{ cm}\right]$

$A = 7\frac{1}{2} \text{ cm}^2$ $\left(3 \text{ cm} \times 2\frac{1}{2} \text{ cm} = 7\frac{1}{2} \text{ cm}^2\right)$

P (rectangle) $= 2 \times (a + b)$, A (rectangle) $= a \times b$

b) <u>Right-angled triangles</u> e.g.

v) 
a, *b*

$A = 1 + \frac{1}{2} + \frac{1}{2} = 2 \text{ (cm}^2)$

(or as half the square: $\frac{2 \times 2}{2} \text{ cm}^2 = 2 \text{ cm}^2$)

A (right-angled Δ) $= \dfrac{a \times b}{2}$ (or $\dfrac{a \times a}{2}$ if also isosceles)

(or $= \dfrac{\text{base} \times \text{height}}{2}$)

Notes:

Whole class activity but individual (or paired) work in measuring, monitored, less able Ps helped

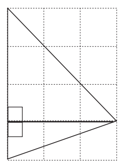
Use copy master and 1 cm measuring grids from Y6 LP 46/2 copied onto OHT and cut out.

Reasoning, agreement, self-correction, praising,

Discussion and agreement on the general formulae.

(Only one example for each type is shown here.)

c) <u>Triangles</u> (scalene) e.g.

iv) 

(Adding the areas of 2 right-angled triangles)

$$A = \frac{3 \times 3}{2} + \frac{3 \times 1}{2} = \frac{9}{2} + \frac{3}{2} = \frac{12}{2} = \underline{6} \text{ (cm}^2)$$

Ps might notice that the formula:

$A = \dfrac{\text{base} \times \text{height}}{2}$ is also true here.

20 min

Y6 — *Lesson Plan 104*

Activity		*Notes*

3

PbY6b, page 104

Q.1 Read: *Measure the data needed to calculate the perimeter and area of the rectangles.*

Write the perimeter and area inside each rectangle.

Set a time limit. Ask Ps to measure with rulers as accurately as they can (to the nearest mm). Ps do necessary calculations in *Ex. Bks*.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

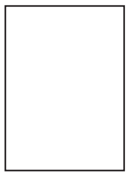
Solution:

a) 

$b = 3$ cm, $a = 5.3$ cm

$P = 2 \times (5.3 + 3) = 2 \times 8.3 = \underline{16.6 \text{ (cm)}}$

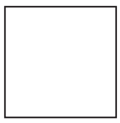
$A = 5.3 \times 3 = \underline{15.9 \text{ (cm}^2\text{)}}$

b) 

$d = 4.7$ cm, $c = 3.4$ cm

$P = 2 \times (3.4 + 4.7) = 2 \times 8.1 = \underline{16.2 \text{ (cm)}}$

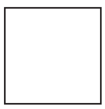
$A = 3.4 \times 4.7 = \underline{15.98 \text{ (cm}^2\text{)}}$

c) 

$a = 2.5$ cm

$P = 4 \times 2.5 \text{ cm} = \underline{10 \text{ cm}}$

$A = 2.5 \text{ cm} \times 2.5 \text{ cm} = \underline{6.25 \text{ cm}^2}$

d) 

$b = 2.1$ cm

$P = 4 \times 2.1 \text{ cm} = \underline{8.2 \text{ cm}}$

$A = 2.1 \text{ cm} \times 2.1 \text{ cm} = \underline{4.41 \text{ cm}^2}$

28 min

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP (for demonstration only)

Ps can estimate first using 1 cm grids, then calculate exactly.

Differentiation by time limit

Reasoning, agreement, self-correction, praising

Feedback for T

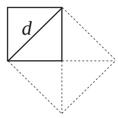
Which of the rectangles are similar? [c) and d) – as <u>all</u> squares are similar.]

Extension

What other measurement could we have used to find the area of a square?

(Measure a diagonal.) e.g.

d) $d \approx 3$ cm



$A \approx \dfrac{3 \times 3}{2} = \dfrac{9}{2} \text{ (cm}^2\text{)} = \underline{4.5 \text{ cm}^2}$

Agree that this method is not as accurate as measuring a side – but acceptable.

4

PbY6b, page 104

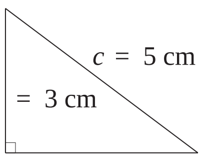
Q.2 Read: *Measure the necessary data, then calculate the area and perimeter as required.*

What kind of triangles are they? [a) and b) are right-angled, c) is isosceles and d) is scalene.]

Deal with one triangle at a time. Set a short time limit. Ps do necessary calculations in *Ex. Bks*.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Solution:

a) 

$c = 5$ cm, $b = 3$ cm, $a = 4$ cm

$A = \dfrac{3 \times 4}{2} = \dfrac{12}{2} = \underline{6 \text{ (cm}^2\text{)}}$

$P = 3 + 4 + 5 = \underline{12 \text{ (cm)}}$

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master (demonstration only)

(or do parts c) and d) as a whole class activity)

Reasoning, agreement, self-correction, praising

Accept ± 1 mm and any valid method of calculating area.

Feedback for T

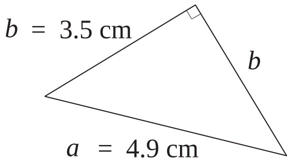
Y6

Lesson Plan 104

Activity		*Notes*

4 (Continued)

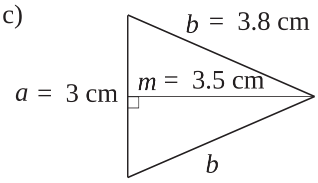
b)



$$A = \frac{3.5 \times 3.5}{2} = \frac{12.25}{2} = \underline{6.125 \text{ (cm}^2\text{)}}$$

$$P = 2 \times 3.5 + 4.9 = 7 + 4.9 = \underline{11.9 \text{ (cm)}}$$

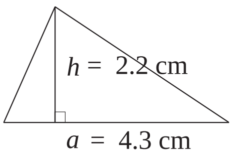
c)



$$A = \frac{3 \times 3.5}{2} = \frac{10.5}{2} = \underline{5.25 \text{ (cm}^2\text{)}}$$

$$P = 2 \times 3.8 + 3 = 7.6 + 3 = \underline{10.6 \text{ (cm)}}$$

d)

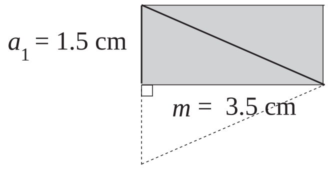


$$A = \frac{4.3 \times 2.2}{2} = \frac{9.46}{2} = \underline{4.73 \text{ (cm}^2\text{)}}$$

Notes:

or

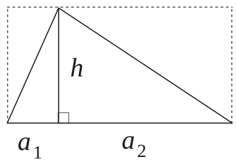
c)



$A = 1.5 \times 3.5 = \underline{5.25}$ (cm^2)

or

d)



$$A = \frac{a_1 \times h}{2} + \frac{a_2 \times h}{2}$$

36 min

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5 ***PbY6b, page 104, Q.3***

Deal with one question at a time. T chooses a P to read out the question, Ps calculate mentally or on scrap paper or slates and show result on command. Ps with different answers explain reasoning. Class points out any errors and decides on correct answer. Who did the same? Who worked out the correct answer another way? etc.
T chooses a P to say the answer in a sentence.

Solution:

a) *The landing strip at an airport is 4 km long and 200 m wide. What is the area of the landing strip?*

Plan: $A = 4 \text{ km} \times 200 \text{ m} = 4 \text{ km} \times 0.2 \text{ km} = \underline{0.8 \text{ km}^2}$

or $= 4000 \text{ m} \times 200 \text{ m} = \underline{800\,000 \text{ m}^2}$

Answer: The area of the landing strip is 0.8 km^2.

b) *A park is square-shaped and its sides are 3.1 km long.*

i) *How much fencing is needed to enclose it?*

Plan: $P = 3.1 \text{ km} \times 4 = \underline{12.4 \text{ km}}$

or $= 3100 \text{ m} \times 4 = 12\,400 \text{ m} = \underline{12 \text{ km } 400 \text{ m}}$

Answer: It would need 12.4 km of fencing to enclose the park.

ii) *What is the area of the park?*

Plan: $A = 3.1 \text{ km} \times 3.1 \text{ km} = \underline{9.61 \text{ km}^2}$

or $A = 3100 \text{ m} \times 3100 \text{ m} = 9\,610\,000 \text{ m}^2$ (= 961 hectares)

Answer: The area of the park is 9.61 km^2.

41 min

Notes:

Whole class activity but individual calculation.

(or individual work under a time limit, reviewed with whole class as usual)

Responses shown in unison.

Reasoning, agreement, self-correction, praising

Accept the answers in any correct form.

(or = 80 hectares, as 1 hectare = 10 000 m^2)

Extra praise if Ps point out that the actual amount needed would be less than this, as there needs to be space for a gate!

Feedback for T

Y6

Lesson Plan 104

Activity		Notes

6

PbY5b, page 104, Q.4

Read: *The length of one side of a triangular park is 2.6 km and the opposite corner is 2.1 km from this side.*

Calculate the area of the park.

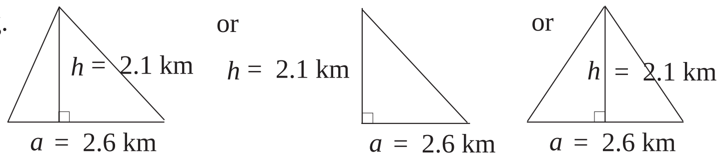
What should we do first? (Draw a diagram.) **A**, come and draw the diagram. Is **A** correct? Could it be drawn another way? Come and show us. Who can think of yet another way?

Now what should we do? (Write a plan.) Ps come to BB to write operation and do the calculation, explaining reasoning. Class agrees/ disagrees. Could we write the answer in a different form? (m^2 or hectares) Class says the answer in a sentence.

Solution:

Diagram:

e.g. or or



Plan: $A = \dfrac{2.6 \times 2.1}{2} = \dfrac{5.46}{2} = \underline{2.73\ (\text{km}^2)}$

$(= 2\ 730\ 000\ \text{m}^2 = 273 \text{ hectares})$

Answer: The area of the park is 2.73 square kilometres.

45 min

Notes

Whole class activity

(or individual work if Ps prefer and there is time)

P read out the question.

Ps suggest what to do first and how to continue.

Involve several Ps.

Reasoning, agreement, praising

Elicit that the triangle could be drawn as scalene, right-angled or isosceles but the calculation is the same.

	2 .	6
×	2 .	1
	2	6
5	2	0
5	4 .	6

	2	7 .	3
2	5	4 .	6
	1		

Y6

Lesson Plan *105*

Activity

Factorising 105, 280, 455 and 1105. Revision, activities, consolidation

PbY6b, page 105

Solutions:

Q.1 a) If £1 $\approx$ 1.43 Euros, 1 Euro $\approx$ £1 $\div$ 1.43 $\approx$ <u>£0.70</u>

b) If 1 EUR $\approx$ 7.47 DK, 1 DK $\approx$ 1 EUR $\div$ 7.47 $\approx$ <u>0.13 EUR</u>

c) If 1 USD $\approx$ 0.62 GBP, 1 GBP $\approx$ 1 USD $\div$ 0.62 $\approx$ <u>1.61 USD</u>

d) If £1 $\approx$ 183.2 JPY, 1 JPY $\approx$ £1 $\div$ 183.2 $\approx$ <u>£0.00546</u>
($\rightarrow$ 0.55 p)

Q.2 a) Interest after 1 year: £397.50 – £375 = £22.50

Rate of interest: $\dfrac{22.50}{375} \times 100\% = 0.06 \times 100\% = \underline{6\%}$

Answer: The interest rate on Jenny's account was 6%.

b) £397.50 $\times$ 106% = £397.50 $\times$ 1.06 = <u>£421.35</u>

Answer: Jenny would have £421.35 in her account at the end of the 2nd year.

Q.3 a) i) 312 ft $\approx$ (312 $\times$ 0.3) m = <u>93.6 m</u>
ii) 11 m $\approx$ (11 $\div$ 0.3 = 110 $\div$ 3) ft $\approx$ <u>36.67 ft</u>

b) i) 36.4 cm $\approx$ (36.4 $\div$ 2.54 = 3640 $\div$ 254) inches
$\approx$ <u>14.33 inches</u>

ii) 13 inch $\approx$ (13 $\times$ 25.4) m = <u>330.2 mm</u>

c) i) 580 lb $\approx$ (580 $\div$ 2.2 = 5800 $\div$ 22) kg $\approx$ <u>263.64 kg</u>
ii) 37 kg $\approx$ (37 $\times$ 2.2) lb = <u>81.4 lb</u>

d) i) $22°\text{C} = (\dfrac{9}{5} \times 22 + 32 = \dfrac{198}{5} + 32 = 39.6 + 32)\ °\text{F}$
$= \underline{71.6}\ °\text{F}$

ii) $28°\text{F} = [\dfrac{5}{9} \times (28 - 32) = \dfrac{5}{9} \times (-4) = -\dfrac{20}{9}]\ °\text{C}$
$\approx \underline{-2.2}\ °\text{C}$

Q.4 a) 14 h 10 min – 8 h 35 min = 13 h 70 min – 8 h 35 min
= <u>5 h 35 min</u>

b) 27 h 22 in – 17 h 55 min = 26 h 82 min – 17 h 55 min
= <u>9 h 27 min</u>

c) 24 h 24 min – 10 h 15 min = <u>14 h 9 min</u>

d) 18 h 52 min – 18 h 35 min = <u>17 min</u>

Notes

<u>105</u> = $3 \times 5 \times 7$

Factors: 1, 3, 5, 7, 15, 21, 35, 105

<u>280</u> = $2^3 \times 5 \times 7$

Factors: 1, 2, 4, 5, 7, 8, 10, 14, 20, 28, 35, 40, 56, 70, 140, 280

<u>455</u> = $5 \times 7 \times 13$

Factors: 1, 5, 7, 13, 35, 65, 91, 455

<u>1105</u> = $5 \times 13 \times 17$

Factors: 1, 5, 13, 17, 65, 85, 221, 1105

(or set factorising as homework at the end of *Lesson 104* and review at the start of *Lesson 105)*

Y6

Lesson Plan 105

Activity | **Notes**

Solutions (Continued)

Not to scale

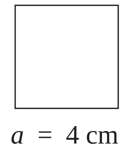
Q.5 a) $a \times b = \underline{16}$ cm^2 and $16 = 1 \times 16 = 2 \times 8 = 4 \times 4$

If $a = 1$, $b = 16$: $P = 2 \times (1 + 16) = 2 \times 17 = 34 \neq 16$

If $a = 2$, $b = 8$: $P = 2 \times (2 + 8) = 2 \times 10 = 20 \neq 16$

If $a = 4$, $b = 4$: $P = 2 \times (4 + 4) = 2 \times 8 = 16$ ✔

The rectangle is a square with side 4 cm.



b) $a \times b = \underline{24}$ cm^2

and $24 = 1 \times 24 = 2 \times 12 = 3 \times 8 = 4 \times 6$

If $a = 1$, $b = 24$: $P = 2 \times (1 + 24) = 2 \times 25 = 50 \neq 28$

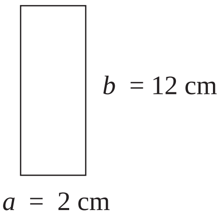
If $a = 2$, $b = 12$: $P = 2 \times (2 + 12) = 2 \times 14 = 28$ ✔

[If $a = 3$, $b = 8$: $P = 2 \times (3 + 8) = 2 \times 11 = 22 \neq 28$

If $a = 4$, $b = 6$: $P = 2 \times (4 + 6) = 2 \times 10 = 20 \neq 28$]

The rectangle has shorter side 2 cm and longer side 12 cm.

e.g.



(or vice versa)

c) $a \times b = \underline{72}$ cm^2

and $72 = 1 \times 72 = 2 \times 36 = 3 \times 24 = 4 \times 18$

$= 6 \times 12 = 8 \times 9$

If $a = 1$, $b = 72$: $P = 2 \times (1 + 72) = 2 \times 73 = 146 \neq 34$

If $a = 2$, $b = 36$: $P = 2 \times (2 + 36) = 2 \times 38 = 76 \neq 34$

If $a = 3$, $b = 24$: $P = 2 \times (3 + 24) = 2 \times 27 = 54 \neq 34$

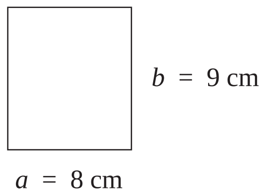
If $a = 4$, $b = 18$: $P = 2 \times (4 + 18) = 2 \times 22 = 44 \neq 34$

If $a = 6$, $b = 12$: $P = 2 \times (6 + 12) = 2 \times 18 = 36 \neq 34$

If $a = 8$, $b = 9$: $P = 2 \times (8 + 9) = 2 \times 17 = 34$ ✔

The rectangle has shorter side 8 cm and longer side 9 cm.

e.g.



(or vice versa)

Q.6 a) $b = 54 \times 2 \div 9 = 108 \div 9 = \underline{12}$ (cm)

b) $h = 42 \times 2 \div 12 = 84 \div 12 = \underline{7}$ (cm)

c) $A = 3.8 \times 2.2 = \underline{8.36}$ (cm^2)

d) $a = 37.1 \div 5.3 \times 2 = 371 \div 53 \times 2 = 7 \times 2 = \underline{14}$ (cm)

Y6

R: Calculations
C: Area. Squares and square roots
E: Problems

Lesson Plan *106*

Activity		*Notes*

1 Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>106</u> = 2 × 53 Factors: 1, 2, 53, 106
- <u>281</u> is a prime number Factors: 1, 281
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, and $17^2 > 281$)
- <u>456</u> = 2 × 2 × 2 × 3 × 19 = $2^3 \times 19$
  Factors: 1, 2, 3, 4, 6, 8, 12, 19 ↓
  456, 228, 152, 114, 76, 57, 38, 24,
- <u>1106</u> = 2 × 7 × 79 Factors: 1, 2, 7, 14, 79, 158, 553, 1106

Notes: Individual work, monitored (or whole class activity)
BB: 106, 281, 456, 1106
Ps can use calculators.
Reasoning, agreement, self-correction, praising
e.g.

456	2
228	2
114	2
57	3
19	19
1	

1106	2
553	7
79	79
1	

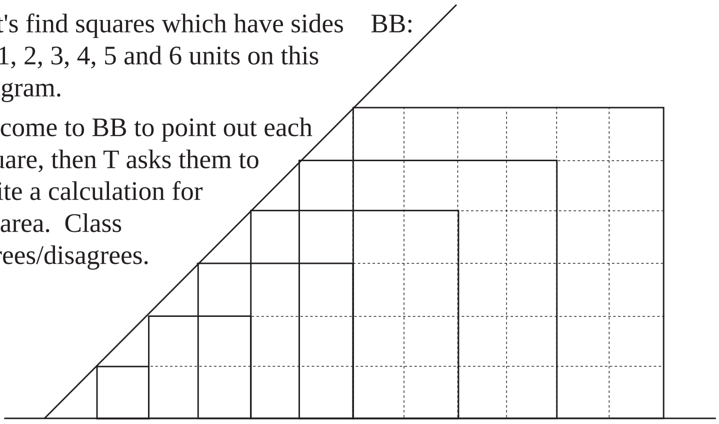
7 min

2 Square numbers

a) Let's find squares which have sides of 1, 2, 3, 4, 5 and 6 units on this diagram.

Ps come to BB to point out each square, then T asks them to write a calculation for its area. Class agrees/disagrees.

BB:



1 × 1 = 1 3 × 3 = 9 5 × 5 = 25
2 × 2 = 4 4 × 4 = 16 6 × 6 = 36

Notes: Whole class activity
Drawn on BB or use enlarged copy master or OHP
(If possible, Ps have copies on desk too.)
At a good pace
Reasoning, agreement, praising

Let's look closely at these areas. T lists them again.

BB: 1, 4, 9, 16, 25, 36, . . . [Square numbers]

These are special numbers. Who knows what they are called? (square numbers) T adds name to BB.

T: A square number is the product of a number multiplied by itself.

We can write square numbers like this using a 'power' symbol.

BB: $1^2 = 1$, $2^2 = 4$, $3^2 = 9$, $4^2 = 16$, $5^2 = 25$, $6^2 = 36$, . . .

Who can tell me the next square numbers in the sequence?

Ps dictate to T. (7^2 = <u>49</u>, 8^2 = <u>64</u>, 9^2 = <u>81</u>, etc.)

Notes: Praising
Class repeats in unison.
We read them as, eg., '1 squared', or '1 to the power 2'
Agreement, praising

b) Let's find isosceles right-angled triangles in the diagram. Ps come to BB to point them out. T asks Ps to write calculations for their areas (or T starts and Ps continue). Class points out errors.

BB: $\dfrac{1 \times 1}{2}$, $\dfrac{2 \times 2}{2}$, $\dfrac{3 \times 3}{2}$, etc. (i.e. <u>half</u> the area of the squares)

Notes: Accept any correct form of calculation, e.g.
$1^2 \div 2$, $2^2 \div 2$, etc.

c) Let's calculate the area of a square which has sides of length 11 cm (41 cm). Ps come to BB or dictate what T should write. Class agrees/disagrees.

BB: A = 11 cm × 11 cm = 11^2 cm^2 = <u>121 cm^2</u>

Notes: BB: A = 41 cm × 41 cm
= 41^2 cm^2
= <u>1681 cm^2</u>

15 min

Y6

Lesson Plan 106

Activity		***Notes***

3

PbY6b, page 106

Q.1 Read: *Calculate the area of these squares.*

What do a and e stand for on the diagram? (a is the length of each side and e is the length of each digonal)

Set a time limit of 4 minutes. Ps do calculations in *Ex. Bks*.

Review with whole class. Ps come to BB, draw a square and write on it the given data before doing the calculation. Class agrees/disagrees. Mistakes discussed and corrected.

Solution:

a) $a = 27$ cm:

$A = 27 \text{ cm} \times 27 \text{ cm} = 27^2 \text{ cm}^2 = \underline{729 \text{ cm}^2}$

b) $a = 365$ mm:

$A = 365 \text{ mm} \times 365 \text{ mm} = 365^2 \text{ cm}^2 = \underline{133\,225 \text{ mm}^2}$

c) $a = 2.3$ m:

$A = 2.3 \text{ m} \times 2.3 \text{ m} = 2.3^2 \text{ m}^2 = \underline{5.29 \text{ m}^2}$

d) $e = 15$ cm:

$$A = \frac{15 \times 15}{2} \text{ cm}^2 = \frac{15^2}{2} \text{ cm}^2 = \frac{225}{2} \text{ cm}^2 = \underline{112.5 \text{ cm}^2}$$

e) $e = 72$ mm:

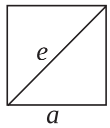
$$A = \frac{72 \times 72}{2} \text{ mm}^2 = \frac{72^2}{2} \text{ mm}^2 = \frac{5184}{2} \text{ mm}^2$$

$= \underline{2592 \text{ mm}^2}$ (= 25.92 cm^2)

21 min

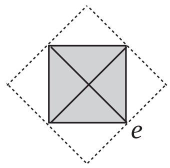
Notes:

Individual work, montored, d) and e) helped or done with whole class

BB: 

Reasoning, agreement, self-correction, checking with calculators, praising

(= 1332.25 cm^2)

BB: 

Elicit/show that to find the area of a square from its diagonal length, calculate the area of a square with side length e, then halve it.

4

PbY6b, page 106

Q.2 Read: *Fill in the missing numbers if* $A = a^2$.

Set a time limit of 2 minutes. Review with whole class.
Ps come to BB or dictate to T, explaining reasoning. Class agrees/ disagrees. Mistakes discussed and corrected.

Solution:

a	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	0	1	4	9	16	25	36	49	72	81	100	121	144	169	196	225

What kind of numbers are in the bottom row of the table? (square numbers) Ps turn over *Pbs* and T covers up table on BB.

Let's see if you can say the square numbers from 1 to 225 in increasing (decreasing) order. Encourage Ps to learn them by heart.

25 min

Notes:

Individual work, monitored

Drawn on BB or use enlarged copy master or OHP

Differentiation by time limit

Ps can calculate in *Ex. Bks.* for $a > 10$.

Reasoning, agreement, self-correction, praising

At speed in unison. T helps. In good humour! Praising

Y6 — *Lesson Plan 106*

Activity		***Notes***

5

PbY6b, page 106, Q.3

Read: *The area of a square is 1156 cm*^{2}. *Follow these methods to find the length of its sides.*

T draws a square on BB and writes the area inside it.

a) Read: *Between which two whole tens is the length of each side?*

Ps make suggestions, saying why they chose those tens. Who agrees? Who thinks something else? Class decides what T should write on BB and Ps write the same tens in *Pbs* too.

BB: $\boxed{30}^2 < a^2 < \boxed{40}^2$

as $900 < a^2 < 1600$

Now let's find a by trial and error. Ps suggest numbers to try and Ps check their squares on BB (or with calculators).

BB: $35^2 = 35 \times 35 = 175 + 1050 = 1225$ ✗ (too big) $34^2 = 34 \times 34 = 136 + 1020 = 1156$ ✔

So $a^2 = 1156 = 34^2$, and $\underline{a = 34}$

b) Read: *First factorise 1156, then work out the value of a.*

Ps factorise 1156 in *Ex. Bks* then dictate what T should write on BB.

BB:

$$\begin{array}{r|l} 1156 & 2 \\ 578 & 2 \\ 289 & 17 \\ 17 & 17 \\ 1 & \end{array}$$

$1156 = 2 \times 2 \times 17 \times 17$
$= (2 \times 17) \times (2 \times 17)$
$= (2 \times 17)^2 = 34^2$

So $a = \underline{34}$

T: We say that the <u>square root</u> of 1156 is 34, because 34 squared is 1156. We can write it mathematically like this.

Let's read the equation togther. 'The square root of 1156 equals 34.'

30 min

Notes:

Whole class activity

Written on BB or SB or OHT

BB: $A = 1156$ cm^2 (square with side a)

Discussion, reasoning, agreement, praising

Extra praise if Ps suggest 35 first as it is halfway between 30 and 40.

35 is too big, so try the next smaller integer.

Agreement, praising

T intervenes only if necessary.

Allow Ps to work it out if they can.

BB: <u>Square root</u>

$\sqrt{1156} = 34$

(as $a^2 = 1156$)

6

PbY6b, page 106

Q.4 Read: *Fill in the missing numbers if* $a = \sqrt{A}$ *(or* $a^2 = A$*).*

Set a time limit of 2 minutes. Ps complete table in *Pbs*, factorising in *Ex. Bks* where necessary.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. e.g. 'The square root of 4 is 2, as 2 squared is equal to 4. ' Class points out errors. Mistakes discussed and corrected. Show details of factorisation if there is disagreement.

What could A and a stand for? (e.g. A could be the area of a square and a could be the length of a side.)

Solution:

A	1	4	9	16	25	36	49	64	81	100	121	144	169	196	225
a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Who can think of another way to write the rule for the table?

(e.g. $A \div a = a$, or $\dfrac{A}{a} = a$, or $a \times a = A$)

Extension

Ps suggest values for extra columns in the table.

34 min

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

Reasoning, agreement, self-correction, praising

Extra praise for clever Ps who realised that this table is the reverse of the table in Q.2, so the missing values could be copied from the Q. 2 table!

Agreement, praising

Class checks that they are correct.

Y6		*Lesson Plan 106*
Activity		***Notes***
7	***PbY6b, page 106*, *Q.5*** Read: *Work out (or approximate) the side of each square if its area is:* *a) i) 25 cm² ii) 250 cm² iii) 2500 cm²* *b) i) 64 cm² ii) 6.4 cm² iii) 0.64 cm²*	Whole class activity
	Ps come to BB or dictate what T should write. Ps use calculators to make closer and closer approximations (with T's help) when the square roots are not whole numbers. Who could come and write it mathematically using square root notation?	Discussion, reasoning, checking, agreement, praising Involve many Ps.
	Solution: a) i) $A = 25\text{ cm}^2 = 5\text{ cm} \times 5\text{ cm}$, so $a = \underline{5\text{ cm}}$	BB: $\sqrt{25} = 5$
	ii) $A = 250\text{ cm}^2$: $15 \times 15 = 225$ (too small) $16 \times 16 = 256$ (too big but quite close) $15.9 \times 15.9 = 252.81$ (still too big but closer) $15.8 \times 15.8 = 249.64$ (very close) so $a \approx \underline{15.8\text{ cm}}$	BB: $\sqrt{250} \approx 15.8$
	iii) $A = 2500\text{ cm}^2$: $2500 = 25 \times 100$ $= 5 \times 5 \times 10 \times 10 = (5 \times 10)^2 = 50^2$ so $a = \underline{50\text{ cm}}$	BB: $\sqrt{2500} = 50$
	b) i) $A = 64\text{ cm}^2 = 8\text{ cm} \times 8\text{ cm}$, so $a = \underline{8\text{ cm}}$	BB: $\sqrt{64} = 8$
	ii) $A = 6.4\text{ cm}^2$: $2 \times 2 = 4$ (too small) $3 \times 3 = 9$ (too big) $2.5 \times 2.5 = 6.25$ (still too small but closer) $2.6 \times 2.6 = 6.76$ (too big) $2.52 \times 2.52 = 6.3504$ (slightly too small) $2.53 \times 2.53 = 6.4009$ (very close) so $a \approx \underline{2.53\text{ cm}}$	BB: $\sqrt{6.4} \approx 2.53$
	iii) $A = 0.64\text{ cm}^2 = 0.8\text{ cm} \times 0.8\text{ cm}$, so $a = \underline{0.8\text{ cm}}$ (or $0.64\text{ cm}^2 = 64\text{ mm}^2 = 8\text{ mm} \times 8\text{ mm} = 0.8\text{ cm} \times 0.8\text{ cm}$)	BB: $\sqrt{0.64} = 0.8$
	We have seen how difficult it is to work out square roots which are not whole numbers. We can do it easily using a calculator. T shows Ps how to use the $\boxed{\sqrt{\ }}$ button and the $\boxed{x^2}$ button as a check. Ps copy T.	If possible, T uses a calculator on a computer projected onto a screen.
	40 min	

Y6		*Lesson Plan 106*
Activity		***Notes***
8	***PbY6b, page 106*** Q.6 Read: *Work out the* ***square roots.*** *Use a calculator where necessary.* Set a time limit or deal with one row at a time. Encourage Ps to check their results by squaring the values. Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disgrees. Who worked it out another way? Come and show us. Mistakes discussed and corrected If no P thinks of it, T shows a method using fractions: BB: b) ii) $\sqrt{2.56} = \sqrt{\frac{256}{100}} = \frac{\sqrt{256}}{\sqrt{100}} = \frac{16}{10} = 1.6$ c) i) $\sqrt{0.25} = \sqrt{\frac{25}{100}} = \frac{\sqrt{25}}{\sqrt{100}} = \frac{5}{10} = 0.5$ d) i) $\sqrt{1.96} = \sqrt{\frac{196}{100}} = \frac{\sqrt{196}}{\sqrt{100}} = \frac{14}{10} = 1.4$ *Solution:* a) i) $\sqrt{100} = \underline{10}$ ii) $\sqrt{10\,000} = \underline{100}$ iii) $\sqrt{1\,000\,000} = \underline{1000}$ b) i) $\sqrt{256} = \underline{16}$ ii) $\sqrt{2.56} = \underline{1.6}$ iii) $\sqrt{25\,600} = \underline{160}$ c) i) $\sqrt{0.25} = \underline{0.5}$ ii) $\sqrt{25} = \underline{5}$ iii) $\sqrt{2500} = \underline{50}$ d) i) $\sqrt{1.96} = \underline{1.4}$ ii) $\sqrt{196} = \underline{14}$ iii) $\sqrt{19.6} \approx \underline{4.43}$	Individual work, monitored, helped (or whole class activity if time is short or Ps are unsure) Written on BB or use enlarged copy master or OHP Discussion, reasoning, agreement, self-correction, praising Note that d) iii) is the only calculation which requires a calculator, although it could be done using approximation if Ps do not have a square root button on their calculators: e.g. $4 \times 4 = 16$ (too small) $5 \times 5 = 25$ (too big) $4.5 \times 4.5 = 20.25$ (too big) $4.4 \times 4.4 = 19.36$ (too small) $4.42 \times 4.42 = 19.5364$ (too small) $4.43 \times 4.43 = 19.6249$ ✔ (very close) $4.44 \times 4.44 = 19.7136$ (too big)

45 min

Y6

R: Calculations

C: Volume of cubes and cuboids

E: Problems with squares and square roots

Lesson Plan 107

Activity | *Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 4 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 107 is a prime number Factors: 1, 107
  (as not exactly divisible by 2, 3, 5, 7 and $11^2 > 107$)
- $\underline{282} = 2 \times 3 \times 47$ Factors: 1, 2, 3, 6, 47, 94, 141, 282
- 457 is a prime number Factors: 1, 457
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19 and $23^2 > 457$)
- $\underline{1107} = 3 \times 3 \times 3 \times 41 = 3^3 \times 41$
  Factors: 1, 3, 9, 27, 41, 123, 369, 1107

Notes: Individual work, monitored (or whole class activity)

BB: 107, 282, 457, 1107

Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

282	2
141	3
47	47
1	

1107	3
369	3
123	3
41	41
1	

6 min

2

Area and volume of cuboids

T has 3 large cuboids on desk and if possible Ps have a smaller set on desks also. T's set could have edges which are 10 times greater: e.g. $2 \times 2 \times 2$ (cube), $4 \times 3 \times 2$ (cuboid), $2 \times 2 \times 4$ (square-based cuboid), each a different colour.

T should also have a diagram drawn on BB or OHT for each type.

What name can you give to all these shapes? (cuboids)

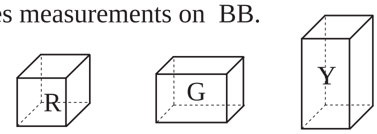
Who can tell me properties of a cuboid? (e.g. 3-D, 6 rectangular faces, 90° angles at the 8 vertices, 12 straight edges; Ps point out congruent, parallel/perpendicular faces and edges, equal sides, etc.)

a) Let's measure the edges of this cuboid. (T holds up one cuboid at a time and Ps measure it (with rulers or 1 cm square grids).

T writes measurements on BB.

BB:

e.g.



R	G	Y
$a = 2$ cm	$a = 4$ cm	$a = 2$ cm
$b = 2$ cm	$b = 2$ cm	$b = 2$ cm
$c = 2$ cm	$c = 3$ cm	$c = 4$ cm

Elicit that R and Y are special cuboids:

R: cube (equal edges)

Y: square-based cuboid

b) What is the area of each cuboid? Ps dictate to T. Class agrees/disagrees.

BB: R: $A = 6 \times 2 \text{ cm} \times 2 \text{ cm} = 6 \times 4 \text{ cm}^2 = \underline{24 \text{ cm}^2}$

G: $A = 2 \times (4 \text{ cm} \times 2 \text{ cm} + 4 \text{ cm} \times 3 \text{ cm} + 2 \text{ cm} \times 3 \text{ cm})$

$= 2 \times (8 \text{ cm}^2 + 12 \text{ cm}^2 + 6 \text{ cm}^2)$

$= 2 \times 26 \text{ cm}^2 = \underline{52 \text{ cm}^2}$

Y: $A = 2 \times 2 \text{ cm} \times 2 \text{ cm} + 4 \times 2 \text{ cm} \times 4 \text{ cm}$

$= 2 \times 4 \text{ cm}^2 + 4 \times 8 \text{ cm}^2$

$= 8 \text{ cm}^2 + 32 \text{ cm}^2 = \underline{40 \text{ cm}^2}$

What is the general formula for the area of any cuboid? Ps dicate to T. Class agrees/disagrees. T shows a short notation without '$\times$'

BB: $A \text{ (cuboid)} = 2 \times a \times b + 2 \times a \times c + 2 \times b \times c$

$= 2 \times (a \times b + a \times c + b \times c) = 2\,(ab + ac + bc)$

Notes: Whole class activity

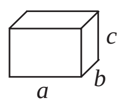
[It would be useful if the T's cuboids were transparent plastic containers with 1 unit grids on the faces and a lid so that unit cubes could be placed inside when dealing with volume.]

Involve several Ps.
Praising, encouragement only

Ps measure own cuboids if they have them or come to front of class to measure T's.

Agree on a consistent method of listing, e.g.

a = width
b = depth
c = height



At a good pace

Agreement, praising

Who can tell me other units of area? (e.g. mm^2, m^2, km^2, acres, hectares)

Also elicit the general formula for the surface area of a cube and a square-based cuboid.

BB: $A \text{ (cube)} = 6 \times a^2 = 6a^2$

$A \text{ (s. b. cuboid)} = 2a^2 + 4ab$

Ps write formulae in back of *Pbs*.

Y6

Lesson Plan 107

Activity		*Notes*

2

(Continued)

c) How many unit cubes would we need to build each cuboid? (How many would be needed along the front edge? How many in each layer? How many layers?) Elicit that this value is the volume of the cuboid, i.e. how much space it takes up.

Notes: If possible, Ps check by placing unit cubes in the transparent plastic cubes. At a good pace.

Let's write a calculation for each volume. Ps come to BB or dictate what T should write. Class agrees/disagrees.

BB: R: $V = 2\text{ cm} \times 2\text{ cm} \times 2\text{ cm} = 4\text{ cm}^2 \times 2\text{ cm} = \underline{8\text{ cm}^3}$

G: $V = 2\text{ cm} \times 2\text{ cm} \times 4\text{ cm} = 4\text{ cm}^2 \times 4\text{ cm} = \underline{16\text{ cm}^3}$

Y: $V = 4\text{ cm} \times 3\text{ cm} \times 2\text{ cm} = 12\text{ cm}^2 \times 2\text{ cm} = \underline{24\text{ cm}^3}$

Notes: Agreement, praising. Who can tell me other units of volume? (e.g. mm^3, m^3) Ps say what the lenghs of each edge would be in these cases. (1 mm, 1 m)

Who can tell me the general formula for the volume of any cuboid? Ps dicate to T. Class agrees/disagrees. T shows a shortened notation. Also elicit general formulae for the volume of a cube and a square-based cuboid.

BB: $V\,(\text{cuboid}) = a \times b \times c = abc$

$V\,(\text{cube}) = a \times a \times a = a^3$

$V\,(\text{square-based cuboid}) = a \times a \times b = a^2 \times b = a^2b$

Notes: Ps write formulae (including short forms) in back of *Pbs* or *Ex. Bks.*

20 min

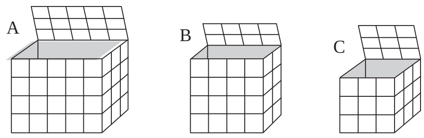
3

PbY6b, page 107

Q.1 Read: *These are 3 different boxes for storing unit cubes.*

Notes: Individual work, monitored, helped

BB:



Notes: Drawn on BB or use enlarged copy master or OHP (if possible, T has large transparent boxes and unit cubes for demonstration)

What shape are they? (All are cuboids, B is a square-based cuboid, although it is not standing on its square face; C is a cube.)

Set a time limit. Ps read questions themselves, write answers to a) and b) in *Ex Bks* (Ps might find it helpful to label the edges in digrams with letters) then complete the table in *Pbs*.

Notes: Differentiation by time limit

Review with whole class. Ps show answers to a) and b) on scrap paper or slates on command, then come to BB to write in table, referring to diagrams. Class agrees/disagrees. Mistakes discussed and corrected.

Notes: In unison. Reasoning, agreement, self-correction, praising. Feedback for T

Solution:

a) *How many cubes will fit along the front edge of the bottom layer in each box?*

A: $a = 5$; B: $a = 4$; C: $a = 3$

b) *How many: i) rows ii) cubes can be put in each bottom layer?*

i) A: $b = 3$; B: $b = 2$; C: $b = 3$

ii) A: $ab = 15$; B: $ab = 8$; C: $ab = 9$

c) *Fill in the table.*

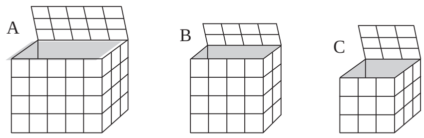
	Along an edge	In a layer	Total number of cubes
A	5	$5 \times 3 = 15$	$5 \times 3 \times 4 = 60$
B	4	$4 \times 2 = 8$	$4 \times 2 \times 4 = 32$
C	3	$3 \times 3 = 9$	$3 \times 3 \times 3 = 27$

Notes: Does it matter in which order we multiply the lengths? No, as the terms in a multiplication can be inter-changed without affecting the result.

26 min

Y6

Lesson Plan 107

Activity		*Notes*
2	(Continued) c) How many unit cubes would we need to build each cuboid? (How many would be needed along the front edge? How many in each layer? How many layers?) Elicit that this value is the <u>volume</u> of the cuboid, i.e. how much space it takes up. Let's write a calculation for each volume. Ps come to BB or dictate what T should write. Class agrees/disagrees. BB: R: $V = 2\text{ cm} \times 2\text{ cm} \times 2\text{ cm} = 4\text{ cm}^2 \times 2\text{ cm} = \underline{8\text{ cm}^3}$ G: $V = 2\text{ cm} \times 2\text{ cm} \times 4\text{ cm} = 4\text{ cm}^2 \times 4\text{ cm} = \underline{16\text{ cm}^3}$ Y: $V = 4\text{ cm} \times 3\text{ cm} \times 2\text{ cm} = 12\text{ cm}^2 \times 2\text{ cm} = \underline{24\text{ cm}^3}$ Who can tell me the <u>general</u> formula for the volume of any cuboid? Ps dicate to T. Class agrees/disagrees. T shows a shortened notation. Also elicit general formulae for the volume of a cube and a square-based cuboid. BB: $V\,(\text{cuboid}) = a \times b \times c = abc$ $V\,(\text{cube}) = a \times a \times a = a^3$ $V\,(\text{square-based cuboid}) = a \times a \times b = a^2 \times b = a^2b$ *20 min*	If possible, Ps check by placing unit cubes in the transparent plastic cubes. At a good pace. Agreement, praising Who can tell me other units of volume? (e.g. mm^3, m^3) Ps say what the lenghs of each edge would be in these cases. (1 mm, 1 m) Ps write formulae (including short forms) in back of *Pbs* or *Ex. Bks.*
3	***PbY6b, page 107*** Q.1 Read: *These are 3 different boxes for storing unit cubes.* BB:  What shape are they? (All are cuboids, B is a square-based cuboid, although it is not standing on its square face; C is a cube.) Set a time limit. Ps read questions themselves, write answers to a) and b) in *Ex Bks* (Ps might find it helpful to label the edges in digrams with letters) then complete the table in *Pbs*. Review with whole class. Ps show answers to a) and b) on scrap paper or slates on command, then come to BB to write in table, referring to diagrams. Class agrees/disagrees. Mistakes discussed and corrected. *Solution:* a) *How many cubes will fit along the front edge of the bottom layer in each box?* A: $a = 5$; B: $a = 4$; C: $a = 3$ b) *How many: i) rows ii) cubes can be put in each bottom layer?* i) A: $b = 3$; B: $b = 2$; C: $b = 3$ ii) A: $ab = 15$; B: $ab = 8$; C: $ab = 9$ c) *Fill in the table.* *26 min*	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP (if possible, T has large transparent boxes and unit cubes for demonstration) Differentiation by time limit In unison Reasoning, agreement, self-correction, praising Feedback for T Does it matter in which order we multiply the lengths? No, as the factors in a multiplication can be interchanged without affecting the result.

	Along an edge	In a layer	Total number of cubes
A	5	$5 \times 3 = 15$	$5 \times 3 \times 4 = 60$
B	4	$4 \times 2 = 8$	$4 \times 2 \times 4 = 32$
C	3	$3 \times 3 = 9$	$3 \times 3 \times 3 = 27$

Y6

Lesson Plan 107

Activity		Notes

7

PbY6b, page107

Q.5 T chooses a P to read out the question. Ps calculate in *Ex. Bks* and show answers on command. T chooses Ps with different answers to explain their reasoning. Class agrees/disagrees. Mistakes disussed and corrected. Use a model if necessary.

Solution:

a) *Calculate the volume of a cuboid which has edges 3 cm, 4 cm and 5 cm long.*

$V = 3\text{ cm} \times 4\text{ cm} \times 5\text{ cm} = 12\text{ cm}^2 \times 5\text{ cm} = \underline{60\text{ cm}^3}$

b) *What is the volume of a cuboid with edges a b and c?*

$V = a \times b \times c = \underline{abc}$

Notes:

Individual work, monitored

Responses shown in unison.

Reasoning, agreement, self-correction, praising

Who can put into words the rule for finding the volume of a cuboid ? T might suggest:

'The volume of a cuboid is the product of the lengths of the 3 edges which meet at a vertex.'

and ask Ps if it is correct. Class repeats it in unison.

39 min

8

PbY6b, page107

Q.6 Read: a) *The surface area of each face of an ice cube is 49 cm*^{2}. *Calculate:*

i) the volume of the ice cube

ii) its mass, if 1 cm^3 *of ice weighs 0.91 g.*

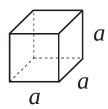
b) *The surface area of a square-based prism is 64 cm*^{2} *and its base edge is 2 cm. What is the volume of the prism?*

Set a time limit or deal with one part at a time. Ps draw a diagram, write an operation, do the calculation and write the answer in a sentence in *Ex. Bks*.

Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain reasoning at BB. Who did the same? Who did it another way? etc. Mistakes dicussed and corrected.

Solution:

a) i) A (face) $= a \times a = 49\text{ cm}^2$ BB:



$a = \sqrt{49}$ (cm) $= 7$ cm

$V = a \times a \times a = 7\text{ cm} \times 7\text{ cm} \times 7\text{ cm}$

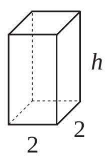
$= 49\text{ cm}^2 \times 7\text{ cm} = \underline{343\text{ cm}^3}$

ii) $M = 0.91\text{ g} \times 343 = \underline{312.13\text{ g}}$ ($\approx$ 0.312 kg)

Answer: The mass of the ice cube is 312.13 grams.

b) A (square-based prism): $2 \times a \times a + 4 \times a \times h = 64$ (cm^2)

BB:



$2 \times 2 \times 2 + 4 \times 2 \times h = 64$ (cm^2)

$8 + 8 \times h = 64$ (cm^2)

$8 \times h = 64 - 8 = 56$ (cm^2)

$h = 56 \div 8 = \underline{7}$ (cm)

V (square-based prism): $a \times a \times h = 2\text{ cm} \times 2\text{ cm} \times 7\text{ cm}$

$= 4\text{ cm}^2 \times 7\text{ cm}$

$= \underline{28\text{ cm}^3}$

Answer: The volume of the prism is 28 cm^3.

Notes:

Individual work, monitored, helped

Ps can discuss the method of solution with their neighbours.

(If majority of Ps are struggling, stop individual work and continue as a whole class activity.)

Differentiation by time limit

Responses shown in unison.

Discussion reasoning, agreement, self-correction, praising

Feedback for T

(If possible, T has a 7 cm cube weighing approximately 312 g to pass round class.)

Class applauds any Ps who worked out the answer without help.

45 min

Y6

R: Calculations

C: Area, volume. Cubes, cuboids

E: Cubes and cubic roots

Lesson Plan *108*

Activity		*Notes*

1 Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 5 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- <u>108</u> $= 2 \times 2 \times 3 \times 3 \times 3 = 2^2 \times 3^3$
  Factors: 1, 2, 3, 4, 6, 9, 12, 18, 27, 36, 54, 108
- <u>283</u> is a prime number Factors: 1, 283
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, and $17^2 > 283$)
- <u>458</u> $= 2 \times 229$ Factors: 1, 2, 229, 458
- <u>1108</u> $= 2 \times 2 \times 277 = 2^2 \times 277$ (and 277 is a prime number)
  Factors: 1, 2, 4, 277, 554, 1108

7 min

Notes:

Individual work, monitored (or whole class activity)

BB: 108, 283, 458, 1108

Ps could practise <u>without</u> using calculators.

Reasoning, agreement, self-correction, praising

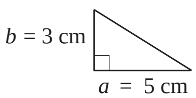
e.g.

$$\begin{array}{r|l} 108 & 2 \\ 54 & 2 \\ 27 & 3 \\ 9 & 3 \\ 3 & 3 \\ 1 & \end{array} \qquad \begin{array}{r|l} 458 & 2 \\ 229 & 2 \\ 1 & \end{array} \qquad \begin{array}{r|l} 1108 & 2 \\ 554 & 2 \\ 277 & 277 \\ 1 & \end{array}$$

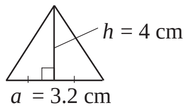
2 Area and volume

Let's calculate the values asked for. First elicit the name of the shape and the formula to use (in words). Then Ps come to BB to write operations and do calculations, explaining reasoning. Class helps and points out errors. T gives hints where necessary and helps Ps to write the units of measure in the correct place [within the operation or at the end with the operation in brackets: 7 cm $\times$ 7 cm = 49 cm^2 or (7×7) cm^2 = 49 cm^2]

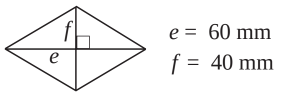
BB:

a) 

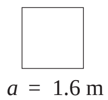
$A = \left(\dfrac{5 \times 3}{2} = \dfrac{15}{2}\right)$ cm^2 = <u>7.5 cm^2</u>

b) 

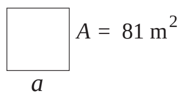
$A = \left(\dfrac{3.2 \times 4}{2} = \dfrac{12.8}{2}\right)$ cm^2 = <u>6.4 cm^2</u>

c) 

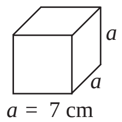
$A = \left(\dfrac{60 \times 40}{2} = \dfrac{2400}{2}\right)$ mm^2
= 1200 mm^2
= <u>12 cm^2</u>

d) 

A = 1.6 m $\times$ 1.6 m
= <u>5.6 m^2</u>

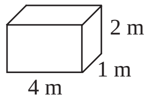
e) 

$a = \sqrt{81}$ m^2
= <u>9 m</u>

f) 

$A = 6 \times 7 \times 7$ cm^2 = 6×49 cm^2 = <u>294 cm^2</u>

$V = 7 \times 7 \times 7$ cm^3 = 49×7 cm^3 = <u>343 cm^3</u>

g) 

$A = 2 \times (4 \times 1 + 4 \times 2 + 1 \times 2)$ m^2
$= 2 \times (4 + 8 + 2)$ m^2 = 2×14 m^2 = <u>28 m^2</u>

$V = 4 \times 1 \times 2$ m^3 = <u>8 m^3</u>

15 min

Notes:

Whole class activity

Drawn on BB or use enlarged copy master or OHT

Ps could have copy on desks too.

At a good pace

Involve majority of class

Reasoning, agreement, praising

Feedback for T

Elicit that:

- Area of a triangle = half its base $\times$ its height
- Area of a rhombus = half the product of its diagonals
- Area of a square = the length of a side squared
- Length of the side of a square = the square root of its area
- Surface area of a cube = 6 $\times$ the length of an edge squared
- Volume of a cube is the length of an edge cubed

etc.

Y6

Lesson Plan 108

Activity		*Notes*

3

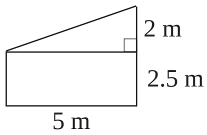
PbY6b, page 108

Q.1 Read: *Write the areas and volumes below the diagrams, as required.*

Set a time limit or deal with one at a time. Ps do calculations in *Ex. Bks*, then write only the results in *Pbs*.

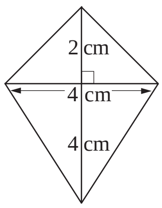
Review with whole class. Ps could show results on scrap paper or slates on command. Ps answering correctly explain reasoning at BB. Who did the same? Who did it another way? etc. Mistakes discussed and corrected.

Solution: e.g.

a) 

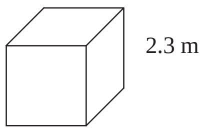
$A = 5 \times 2.5 + \dfrac{5 \times 2}{2}$

$= 12.5 + \dfrac{10}{2} = 12.5 + 5 = \underline{17.5}$ (m^2)

b) 

$A = \dfrac{4 \times 4}{2} + \dfrac{4 \times 2}{2}$

$= \dfrac{16}{2} + \dfrac{8}{2} = 8 + 4 = \underline{12}$ (cm^2)

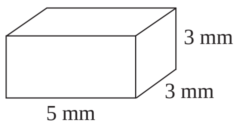
c) 

$A = 6 \times 2.3 \times 2.3 = 6 \times 5.29$

$= \underline{31.74}$ (m^2)

$V = 2.3 \times 2.3 \times 2.3 = 5.29 \times 2.3$

$= \underline{12.167}$ (m^3)

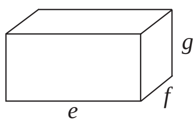
d) 

$A = 2 \times (3 \times 3) + 4 \times (5 \times 3)$

$= 2 \times 9 + 4 \times 15$

$= 18 + 60 = \underline{78}$ (mm^2)

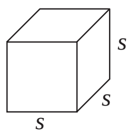
$V = 5 \times 3 \times 3 = \underline{45}$ (mm^3)

e) 

$A = 2 \times (e \times f + e \times g + f \times g)$

$= 2\,(ef + eg + fg)$

$V = e \times f \times g = efg$

f) 

$A = 6 \times s \times s = 6 \times s^2 = 6s^2$

$V = s \times s \times s = s^3$

25 min

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

Responses shown in unison.

Reasoning, agreement, self-correcting, praising

Feedback for T

Extra praise if Ps can write the short forms of the equations but if no P does so, T shows them.

Y6

Lesson Plan 108

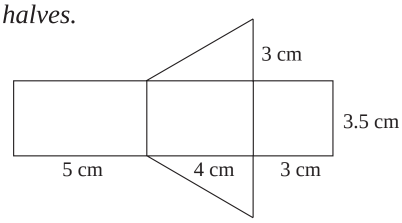
Activity		**Notes**

4

PbY6b, page 108, Q.2

Read: *A cuboid was cut into two equal pieces. This is the net of one of the halves.*

BB:



T has 2 enlarged copies of the nets cut out and pre-folded. (If possible, Ps have actual scale versions on desks too.) Who can show us what the whole cuboid looks like? Ps fold the two nets and hold them together to show T (or class if only using T's models). Now we have an idea of where this part of the cuboid fits.

Read: *Calculate the surface area and the volume of this prism.*

Why is half of the cuboid called a prism and what kind of prism is it? (It is a prism because it is a polyhedron with 2 of it faces: base and top, equal and parallel. It is a triangular-based prism.)

How can we calculate its area and volume? Ps come to BB or dictate what T should write on BB. Class agrees/disagrees or suggests other calculations. T gives help only if necessary. Ps work in *Ex. Bks* too.

Solution:

$$A = (5 \times 3.5 + 4 \times 3.5 + 3 \times 3.5 + 2 \times \frac{\cancelto{2}{4} \times 3}{\cancelto{1}{2}})\ \text{cm}^2$$

$$= (17.5 + 14 + 10.5 + 12)\ \text{cm}^2 = \underline{54\ \text{cm}^2}$$

or $A = 12\ \text{cm} \times 3.5\ \text{cm} + 4\ \text{cm} \times 3\ \text{cm} = 42\ \text{cm}^2 + 12\ \text{cm}^2 = \underline{54\ \text{cm}^2}$

$$V = \frac{4 \times 3 \times 3.5}{2}\ \text{cm}^3 = \frac{42}{2}\ \text{cm}^3 = \underline{21\ \text{cm}^3}$$

Notes:

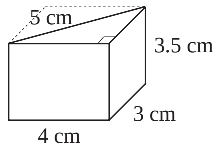
Whole class activity

(or individual trial first if Ps wish, using the net models afterwards to confirm or dispute their results)

Drawn on BB or use enlarged copy master or OHP

Differentiation by time limit

e.g.



Discussion, reasoning, agreement, praising

Extra praise for Ps who realise that:

- 3 of the faces form a wide rectangle 12 cm by 3.5 cm and the 2 triangular faces form another rectangle 3 cm by 4 cm;
- the volume of the prism is half the volume of the whole cuboid.

33 min

5

PbY6b, page 108

Q.3 Read: *What is the volume of a cube if its edge is 1, 2, 3, 4, 5, 6 or 7 units?*

Fill in the table to show the volumes for different edge lengths.

Set a time limit of 2 minutes. Encourage mental calculation where possible, otherwise Ps calculate in *Ex. Bks*. Ask for the rule too.

Review with whole class. Ps dictate to T or come to BB, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected. If disagreement, demonstrate with unit cubes.

Solution:

a (units)	1	2	3	4	5	6	7	8	9	10
V (unit cubes)	1	8	27	64	125	216	343	512	729	1000

Rule: $V = a \times a \times a = a^3$

The numbers in the bottom row are called <u>cubic numbers</u>. Let's say them together. Now let's try to say them with our eyes closed!

Another form of the rule is to say that a is the <u>cubic root</u> of V. We write it mathematically like this. Ps read out the equation, with T pointing to the relevant components.

Notes:

Individual work, monitored, helped

Drawn on BB or use enlarged copy master or OHP

Differentiation by time limit

Reasoning, agreement, self-correction, praising

In unison. In good humour. Encourage Ps to learn them.

BB: *Rule*: $a = \sqrt[3]{V}$

(as $a^3 = V$)

38 min

Y6		*Lesson Plan 108*

Activity		***Notes***
6	***PbY6b, page 108***	
	Q.4 Deal with one question at a time. T chooses a P to read out the question, and asks Ps to picture the shape in their heads first. Ps solve problem in *Ex. Bks*. under a short time limit, then show result on scrap paper or slates on command.	Individual work, monitored, helped, but class kept together. Differentiation by time limit. Advise Ps to use the results in the table in Q.2 to help them. Responses shown in unison.
	Ps with different answers explain reasoning at BB (with T's help if needed). Class points out errors and agrees on correct answer. Who worked it out another way? Mistakes discussed and corrected.	Discussion, reasoning, agreement, self-correction, praising
	T chooses a P to say the answer in a sentence.	Feedback for T
	Solution:	
	a) *An empty cubic box contains 8000 cm³ of air. How long is its edge?* $V = a \times a \times a = 8000\text{ cm}^3$ but $20\text{ cm} \times 20\text{ cm} \times 20\text{ cm} = 8000\text{ cm}^3$, so $a = \underline{20\text{ cm}}$ or $a = \sqrt[3]{V} = \sqrt[3]{8000} = 20$ (cm) [as $8000 = 8 \times 1000 = 2^3 \times 10^3 = (2 \times 10)^3 = 20^3$] *Answer*: The length of each edge of the box is 20 cm.	T: We say that the cubic root of 8000 is 20, as $20^3 = 8000$
	b) i) *How many metres long is the edge of a 1 km³ cube?* $V = a \times a \times a = a^3 = 1\text{ km}^3$ but $1\text{ km} \times 1\text{ km} \times 1\text{ km} = 1\text{ km}^3$, so $a = 1\text{ km} = \underline{1000\text{ m}}$ or $a = \sqrt[3]{V} = \sqrt[3]{1\text{ km}^3} = 1\text{ km} = \underline{1000\text{ m}}$ T: We say that the cubic root of 1 is 1, as $1^3 = 1$ *Answer*: The edge of a 1 km³ cube is 1000 m long.	or $V = 1\text{ km}^3$ $= 1000\text{ m} \times 1000\text{ m} \times 1000\text{ m}$ so $\underline{a = 1000\text{ m}}$
	ii) *What is the surface area of the cube?* $A = 6 \times 1\text{ km} \times 1\text{ km} = 6 \times 1\text{ km}^2 = \underline{6\text{ km}^2}$ *Answer*: The surface area of the cube is 6 km².	
	c) i) *How many centimetres long is the edge of a 1 m³ cube?* $V = a \times a \times a = a^3 = 1\text{ m}^3$ but $1\text{ m} \times 1\text{ m} \times 1\text{ m} = 1\text{ m}^3$, so $a = 1\text{ m} = \underline{100\text{ cm}}$ or $a = \sqrt[3]{V} = \sqrt[3]{1\text{ m}^3} = 1\text{ m} = \underline{100\text{ cm}}$ *Answer*: The edge of a 1 m³ cube is 100 cm long.	or $V = 1\text{ m}^3$ $= 100\text{ cm} \times 100\text{ cm} \times 100\text{ cm}$ so $\underline{a = 100\text{ cm}}$
	ii) *What is the surface area of the cube?* $A = 6 \times 1\text{ m} \times 1\text{ m} = 6 \times 1\text{ m}^2 = \underline{6\text{ m}^2}$ *Answer*: The surface area of the cube is 6 m².	
	d) *How many mm long is the edge of a 729 000 cm³ cube? Use the table in Question 3 to help you.* $V = a \times a \times a = 729\,000\text{ cm}^3$ but $90\text{ cm} \times 90\text{ cm} \times 90\text{ cm} = 729\,000\text{ cm}^3$, so $a = \underline{90\text{ cm}}$ or $a = \sqrt[3]{V} = \sqrt[3]{729\,000} = 90$ (cm) [as $729\,000 = 729 \times 1000 = 9^3 \times 10^3 = (9 \times 10)^3 = 90^3$] *Answer*: The length of each edge of the cube is 90 cm.	Finish lesson with mental practice at speed round class. e.g. a miscellany of: • T saying a number and Ps saying its square (cube). • T saying a square (cubic) number and Ps saying its square (cubic) root.
	45 min	

Y6

R: Calculations
C: Functions. Graphs. Sequences
E: Problems

Lesson Plan *109*

Activity		*Notes*

1

Factorisation

Factorise these numbers in your exercise book and list their positive factors. T sets a time limit of 6 minutes.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected.

Elicit that:

- 109 is a prime number Factors: 1, 109
  (as not exactly divisible by 2, 3, 5, 7, and $11^2 > 109$)
- $284 = 2 \times 2 \times 71 = 2^2 \times 71$ Factors: 1, 2, 4, 71, 142, 284
- $459 = 3 \times 3 \times 3 \times 17 = 3^3 \times 17$
  Factors: 1, 3, 9, 17, 27, 51, 153, 459
- 1109 is a prime number Factors: 1, 1109
  (as not exactly divisible by 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and $37^2 > 1109$)

Notes: Individual work, monitored (or whole class activity)

BB: 109, 284, 459, 1109

T decides whether Ps can use calculators.

Reasoning, agreement, self-correction, praising

e.g.

284	2
142	2
71	71
1	

459	3
153	3
51	3
17	17
1	

8 min

2

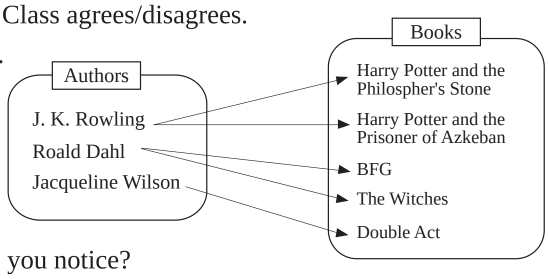
Connections

Let's join up the elements in one set to the matching elements in the other set. e.g.

a) Variable connections (Ps could suggest their favourite books and authors or T has sets already prepared, using books in class.)

Let's join up the authors with their books. Ps come to BB to draw arrows. Class agrees/disagrees.

BB: e.g.



What do you notice?

(An author can be joined to more than one book.)

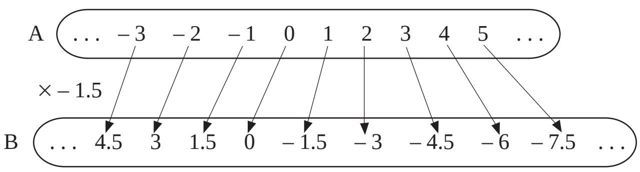
If we drew arrows in the opposite direction, what do you notice? (Each book can be joined to only one author.)

Agree that although some authors only ever write one book, generally they write several books, especially if they sell lots of copies of their first book.

b) Unique connections

What is the connection between these 2 sets? (Each element, a, in Set A has been multiplied by – 1.5, giving a number, b, in Set B.)

BB:



Could an element in A be connected to more than 1 element in B? (No) T: We say that the relationship between A and B is unique. i.e. each value in Set A can be connected to only one in Set B.

Notes: Whole class activity

Written on BB or SB or OHT

At a good speed

Involve several Ps.

Discussion, agreement, praising

(It is possible for a book to be written by more than one person, but make sure that only single auhored books are shown here.)

Drawn on BB or SB or OHT

Ps come to BB to draw the joining arrows.

What if we drew the arrows in the opposite direction?

Elicit that the rule would be:

BB: $a = -\dfrac{2}{3} \times b$

or $a = b \div (-1.5)$

which is also unique.

Y6

Lesson Plan 109

Activity

Notes

2

(Continued)

c) What can you tell me about the relationship between the rows in this table and is it unique?

BB:

x	-4.1	2	$-\frac{3}{4}$	0	-0.7	-11	-0.93	-2
$\lvert x \rvert$	4.1	2	$\frac{3}{4}$	0	0.7	11	0.93	2

First elicit or remind Ps that $\lvert x \rvert$ means the <u>absolute value</u> of x, i.e. its distance from zero. Then ask several Ps what they think about the connections from top to bottom row and bottom to top row.

Agree that:

- $x \rightarrow \lvert x \rvert$ is unique,
- $\lvert x \rvert \rightarrow x$ is <u>not</u> unique (as an absolute value of, e.g. 2, can be connected to + 2 or to – 2)

Drawn on BB or use enlarged copy master or OHP

Extra praise for Ps who remember about absolute value.

Discussion, reasoning, agreement, praising

18 min

3

PbY6b, page 109,

Q.1 Read: *Let y be 60% of x.*

What part of x is 60%? (60 hundredths, 6 tenths, 3 fifths, 0.6)

a) Read: *Complete the table.*

Set a short time limit. Review with whole class. Ps come to BB or dictate to T, explainng reasoning. Class agrees/ disagrees. Mistakes corrected.

BB:

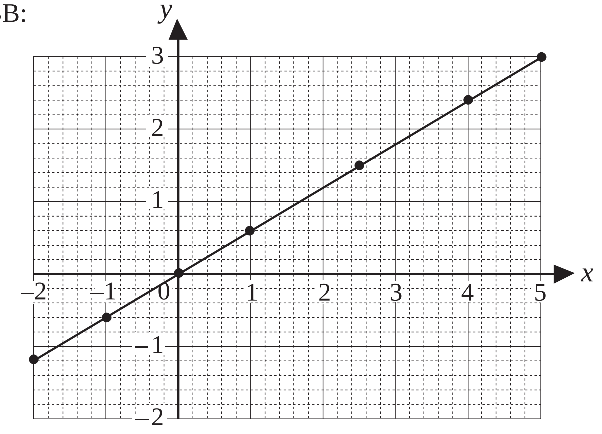
x	1	-1	4	0	2.5	-2	5
y	0.6	**– 0.6**	**2.4**	**0**	**1.5**	**–1.2**	**3**

b) Read: *Represent the pairs of values as dots in the coordinate grid. Join up the points with a line.*

What can you tell me about the grid? (e.g. The x axis ranges from – 2 to 3 and the y axis from – 2 to 5; there is a dotted grid line at every 0.2 of a unit and a solid grid line at every unit.)

Ps come to BB to mark the points on BB, explaining exactly what they are doing, while rest of Ps work in *Pbs*.
Ps join up the dots with rulers.

BB:



What do you notice about the graph? [Straight line, crosses the x and y axes at the point (0, 0).] We call (0, 0) the <u>origin</u>.

Individual work to start, monitored, (helped)

Drawn on BB or use enlarged copy master or OHP

Ps do necessary calculations in *Ex Bks* or on scrap paper.

Reasoning, agreement, self-correction, praising

Whole class activity but Ps working in *Pbs* at same time.

Discussion, reasoning, agreement, praising

Elicit that the coordinates of the first point in the table are written as (1, 0.6), with the x coordinate given first.

P at BB points to 1 on x axis with right hand and 0.6 on y axis with left hand, moves his or her fingers along the grid lines until they meet, then marks that point.

Agreement, praising

T monitors individual work as well as keeping an eye on Ps working on BB.

Are we correct to join up the dots? (Yes, as x and y could be any value between those given.)

Praising

Y6

Lesson Plan 109

Activity		*Notes*

3 (Continued)

Who can tell me the coordinates of points on the graph line which are not given in the table? [e.g. (3, 1.8), (2, 1.2), etc.]

If we increase the value of x by 2 (3) times, what happens to the y value? (It will also increase by 2 (3) times.)

Let's write the rule for the table in different ways. Ps come to BB or dictate to T. Class agrees/disagrees.

e.g. $y = 0.6 \times x$, $y = x \div 100 \times 60$, $y = \dfrac{3}{5}$ of x, etc.

What about defining x rather than y? Ps dictate. e.g.

$x = y \times \dfrac{5}{3}$, or $x = y \div 0.6$, or $x = \dfrac{10}{6} \times y$, etc.

Notes: Involve several Ps.

Ps come to BB to indicate the points on the graph.

Demonstrate with actual coordinates.

If Ps cannot think of any other forms, T suggests some and asks Ps if they are correct.

Ps check rules with values from the table.

23 min

4 ***PbY6b, page 109***

Q.2 Read: *a) Read the corresponding values from the graph and complete the table.*

b) What is the rule?

c) What could a and A represent?

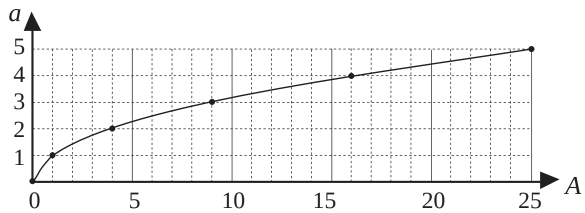
Set a time limit or deal with one part at a time. Ps write values in table in *Pbs* and answers to questions in *Ex. Bks.*

Review with whole class. Ps come to BB to complete table, explaining reasoning (in words). Who wrote a different number? Why? Class agrees on a valid rule. Mistakes corrected.

Ps dictate different forms of the rule and class checks with values from table. Ps say what A and a could be.

Solution:

a)



b) *Rule*: $A = a \times a = a^2$, or $a = \sqrt{A}$ ($A \geq 0$, $a \geq 0$)

c) a could be the length of a side of a square and A could be its area.

What do you notice about this graph? (It is curved, not straight) T tells Ps that if there is a square number in the rule, the graph is always curved.

Notes: Individual work. monitored, helped

Drawn on BB or use enlarged copy master or OHP

Reasoning, agreement, self-correction, praising

Elicit or point out that A and a cannot be negative numbers as you cannot have a negative length of a side or a negative area.

a	0	1	2	3	**4**	5
A	0	**1**	**4**	**9**	**16**	**25**

28 min

Y6		*Lesson Plan 109*

Activity		***Notes***
5	***PbY6b, page 109*** Q.3 Read: *Complete the table so that a is the edge of a cube and A is its surface area.* *Write the rule in different ways.* Agree on one form of the rule in words. (e.g. the surface area of a cube is equal to 6 times the square of the length of a side) Set a time limit or deal with one column at a time. The more difficult columns could be done with the whole class. Ps do any necessary calculations in *Ex. Bks*. Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Class agrees/disagrees. Mistakes discussed and corrected. Agree on different forms of the rule. *Solution:*	Individual work, monitored, helped Drawn on BB or use enlarged copy master or OHP Differentiation by time limit. Discussion, reasoning, agreement, self-correction, praising Ps could check with calculators. Show details on BB: e.g.

a	0.1	0.9	**2**	$\frac{3}{4}$	$\mathbf{\frac{1}{6}}$	**2.5**	5	**10**	1
A	**0.06**	**4.86**	24	$\mathbf{3\frac{3}{8}}$	$\frac{1}{6}$	37.5	**150**	600	**6**

Rule: $A = 6 \times a \times a = 6 \times a^2 = 6a^2$,

or $a^2 = \dfrac{A}{6}$, or $a = \sqrt{\dfrac{A}{6}}$

Notes:

$$A = 6 \times \left(\frac{3}{4}\right)^2 = 6 \times \frac{9}{16} = \frac{27}{8} = 3\frac{3}{8}$$

$$a = \sqrt{\frac{1}{6} \div 6} = \sqrt{\frac{1}{36}} = \frac{1}{6}$$

$$a = \sqrt{37.5 \div 6} = \sqrt{6.25} = 2.5 \text{ (as } 2.5^2 = 6.25)$$

34 min

6 ***PbY6b, page 109***

Q.4 Read: *The area of a rectangle is 5 cm².*

a) How long is side b if side a is: i) 1 cm ii) 0.5 cm

iii) $2\frac{1}{2}$ *cm iv) 5 cm v) 3 cm?*

b) Show the data in a table in your exercise book.

c) Represent the pairs of values on the coordinate grid. Join up the dots.

What equation could we write about the area of the rectangle?

What operation could we use to calculate b?

Deal with part a) first under a short time limit, then review and make sure that mistakes are corrected before Ps do parts b) and c).

Extra praise for Ps who notice that the b axis is not long enough to show 10 cm (ii). Ps could extend the b axis by another 5 units and mark the point or leave it out.

Is it correct to join up the dots? (Yes, because a and b could be any value between the given points – length is continuous.)

Should we join the dots with a straight or curved line?

Solution:

a) i) $5\text{ cm}^2 \div 1\text{ cm} = \underline{5\text{ cm}}$

ii) $5\text{ cm}^2 \div 0.5\text{ cm} = 50\text{ cm}^2 \div 5\text{ cm} = \underline{10\text{ cm}}$

iii) $5\text{ cm}^2 \div 2.5\text{ cm} = 50\text{ cm}^2 \div 25\text{ cm} = \underline{2\text{ cm}}$

iv) $5\text{ cm}^2 \div 5\text{ cm} = \underline{1\text{ cm}}$

v) $5\text{ cm}^2 \div 3\text{ cm} = \dfrac{5}{3}\text{ cm} = \underline{1\dfrac{2}{3}\text{ cm}}$

Notes:

Individual work to start, monitored, helped

Grid drawn on BB or use enlarged copy master or OHP

BB: $a \times b = 5\text{ cm}^2$
$b = 5\text{ cm}^2 \div a$

Reasoning, agreement, self-correction, praising

T should have extended grid already prepared on SB or OHT so that all Ps can see where the point should be.

Ask several Ps what they think and why.

(see following page)

Y6

Lesson Plan 109

Activity		**Notes**

6

(Continued)

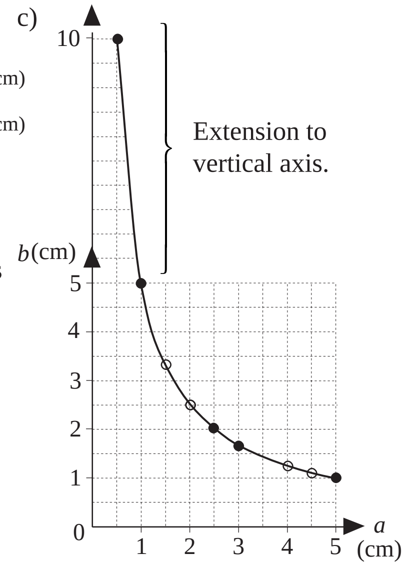
b)

a	1	0.5	$2\frac{1}{2}$	5	3	(cm)
b	5	10	2	1	$1\frac{2}{3}$	(cm)

When Ps have said what kind of joining line they think should be drawn, check by choosing values for a which are not in the table, working out what the b value is and marking the points on the graph (e.g. white dots opposite).

Agree that a curved line fits the extra points better than straight line segments.

c)



Notes: Ps could suggest extra values for a and T helps them to calculate the corresponding values for b.

Is there a squared value in the rule for the graph?

(Yes, $a \times b = 5$ square cm)

39 min

7

PbY6b, page 109

Q.5 Read: *Fill in the missing values if a is the edge of a cube and V is the volume of the cube.*

Elicit the rule for the table in words. (e.g. The volume of a cube is the length of an edge cubed.)

Set a time limit of 4 minutes. Ps do necessary calculations in *Ex. Bks.* T monitors closely and notes how Ps are tackling the task.

Review with whole class. Ps come to BB or dictate to T, explaining reasoning. Who did the same? Who worked it out in a different way? Show details on BB. Mistakes discussed and corrected.

Who can write the rule mathematically? Who can write it another way? Mistakes discussed and corrected.

Solution:

a	0.1	0.9	1.1	**4**	**1**	$\frac{2}{3}$	$\mathbf{\frac{3}{2}}$	10	**5**	**10**
V	**0.001**	**0.729**	**1.331**	64	1	$\mathbf{\frac{8}{27}}$	$\frac{27}{8}$	**1000**	125	1000

Rule: $V = a \times a \times a = a^3$ $\qquad a = \sqrt[3]{V}$

T: We say that 'V equals a cubed', or 'V equals a to the power 3.'

We say that 'a equals the cubic root of V'.

[Calculation details: e.g.

$$0.1^3 = \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = \frac{1}{1000} = \underline{0.001}$$

$$0.9^3 = \frac{9}{10} \times \frac{9}{10} \times \frac{9}{10} = \frac{729}{1000} = \underline{0.729}$$

$$\sqrt[3]{64} = \sqrt[3]{4 \times 4 \times 4} = \sqrt[3]{4^3} = \underline{4}; \quad \left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27};$$

$$\sqrt[3]{1} = 1; \quad \sqrt[3]{\frac{27}{8}} = \frac{\sqrt[3]{27}}{\sqrt[3]{8}} = \frac{3}{2} \ \begin{matrix}(\text{as } 3^3 = 27)\\(\text{as } 2^3 = 8)\end{matrix}; \quad \sqrt[3]{125} = 5 \ (\text{as } 5^3 = 125)$$

Notes: Individual work, monitored, helped

(or do more difficult columns with the whole class)

Drawn on BB or use enlarged copy master or OHP

Reasoning, agreement, self-correction, praising

Accept any valid method of calculation – give extra praise for creativity (see details).

T could show how to use the y^x button on a calculator if Ps have them and Ps use it to check the data in the table.

T could also demonstrate using a scientific calculator to work out cubic roots. e.g.

8 $\sqrt[x]{y}$ 3 = 2

or

$0.1 \times 0.1 = 0.01$,
$0.01 \times 0.1 = \underline{0.001}$

$0.9 \times 0.9 = 0.81$,
$0.81 \times 0.9 = \underline{0.729}$

or

$$\begin{array}{r} 1.1 \\ \times\ 1.1 \\ \hline 1\,1 \\ +\ 1\,1\,0 \\ \hline 1.2\,1 \end{array} \qquad \begin{array}{r} 1.2\,1 \\ \times\ 1.1 \\ \hline 1\,2\,1 \\ +\ 1\,2\,1\,0 \\ \hline 1.3\,3\,1 \end{array}$$

45 min

Y6

Lesson Plan *110*

Activity

Factorising 110, 285, 460 and 1110. Revision, activities, consolidation

PbY6b, page 110

Solutions:

Q.1 a) i) $A = 25 \text{ cm}^2$ ii) $A = 3.61 \text{ cm}^2$

iii) $A = 529 \text{ mm}^2$ $(= 5.29 \text{ cm}^2)$ iv) $A = 22.09 \text{ km}^2$

v) $A = 0.01 \text{ m}^2$ $(= 100 \text{ cm}^2)$

b) i) $a = 4$ cm ii) $a = 10$ m iii) $a = 13$ m

iv) $a = 16$ m v) $a = 35$ m $[1225 = 5^2 \times 7^2$
$= (5 \times 7)^2\,]$

Q.2 a) i) $V = (13 \times 13 \times 13) \text{ cm}^3 = \underline{2197 \text{ cm}^3}$

ii) $A = 6 \times (13 \times 13) \text{ cm}^2 = 6 \times 169 \text{ cm}^2 = \underline{1014 \text{ cm}^2}$

b) i) $a = \sqrt{\dfrac{486}{6}} = \sqrt{81} = \underline{9}$ (cm)

ii) $V = 9 \text{ cm} \times 9 \text{ cm} \times 9 \text{ cm} = 81 \text{ cm}^2 \times 9 \text{ cm}$
$= \underline{729 \text{ cm}^3}$

c) i) $a = \sqrt{\dfrac{100}{4}} = \dfrac{\sqrt{100}}{\sqrt{4}} = \dfrac{10}{2} = \underline{5}$ (cm)

ii) $A = (2 \times 25 + 4 \times 20) \text{ cm}^2 = (50 + 80) \text{ cm}^2$
$= \underline{130 \text{ cm}^2}$

Q.3

a (cm)	**1**	0.2	**5**	6	**12**	**0.1**	3.7	**4**	**10**	11
V (cm^3)	**1**	**0.008**	125	**216**	**1728**	0.001	**50.653**	**64**	1000	**1331**
A (cm^2)	6	**0.24**	**150**	**216**	864	**0.06**	**82.14**	96	**600**	**726**

Q.4 a) i) $\sqrt{81} = \underline{9}$ ii) $\sqrt{8100} = \underline{90}$ iii) $\sqrt{0.81} = \underline{0.9}$

b) i) $\sqrt{169} = \underline{13}$ ii) $\sqrt{1.69} = \underline{1.3}$ iii) $\sqrt{16\,900} = \underline{130}$

c) i) $\sqrt{1.44} = \underline{1.2}$ ii) $\sqrt{144} = \underline{12}$

iii) $\sqrt{1440\,000} = \underline{1200}$

Q.5 a)

x	0	0.8	2	3.2	4	– 0.8	– 1.6
y	0	0.6	1.5	2.4	3	– 0.6	– 1.2

b) *Rule*: $y = \dfrac{3}{4} \times x$, or $y = 0.75x$, or $y = \dfrac{3x}{4}$,

$x = \dfrac{4}{3} \times y$, or $x = \dfrac{4y}{3}$, or $x = y \div 3 \times 4$

c) x and y could be the sides of a rectangle, or Euros and £s, etc.

Notes

$\underline{110} = 2 \times 5 \times 11$

Factors: 1, 2, 5, 10, 11, 22, 55, 110

$\underline{285} = 3 \times 5 \times 19$

Factors: 1, 3, 5, 15, 19, 57 95, 285

$\underline{460} = 2^2 \times 5 \times 23$

Factors: 1, 2, 4, 5, 10, 20, 23, 46, 92, 115, 230, 460

$\underline{1110} = 2 \times 3 \times 5 \times 37$

Factors: 1, 2, 3, 5, 6, 10, 15, 30, 37, 74, 111, 185, 222, 370, 555, 1110

(or set factorising as homework at the end of *Lesson 109* and review at the start of *Lesson 110)*

or $y = x \div 4 \times 3$

(or $\dfrac{y}{x} = \dfrac{3}{4}$)