

Student Text *UNIT 31 Angles and Symmetry*

Answers

31.1 Measuring Angles

Note that measured angles are approximate answers

1. (a) 78° (b) 120° (c) 60° (d) 130° (e) 125° (f) 60°
3. (a) 315° (b) 195° (c) 240° (d) 325° (e) 264° (f) 350°
5. (a) $a = 62^\circ, b = 118^\circ$ (b) $a = 58^\circ, b = 76^\circ, c = 46^\circ$
(c) $a = 104^\circ, b = 76^\circ$ (d) $a = 42^\circ, b = 74^\circ, c = 64^\circ$

The angles add up to 180°

6. (a) $50^\circ, 60^\circ, 70^\circ$ (b) $31^\circ, 59^\circ, 90^\circ$ (c) $15^\circ, 19^\circ, 147^\circ$
(d) $33^\circ, 40^\circ, 107^\circ$ The three angles add up to 180°
7. (a) $a = 150^\circ, b = 90^\circ, c = 120^\circ$ (b) $a = 152^\circ, b = 116^\circ, c = 63^\circ, d = 29^\circ$
(c) $a = 48^\circ, b = 154^\circ, c = 35^\circ, d = 123^\circ$ (d) $a = 45^\circ, b = 45^\circ, c = 270^\circ$

In each case the angles add up to 360°

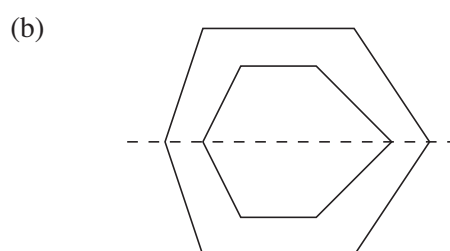
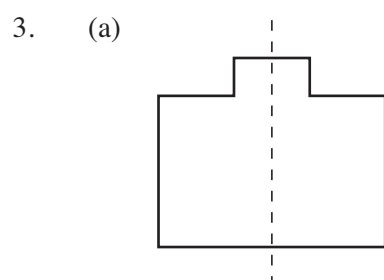
8. (c) 7.7 cm and 6.4 cm, 90°
9. (b) 11.5 cm, $34^\circ, 66^\circ$
10. (a) $34^\circ, 34^\circ, 51^\circ, 241^\circ$ (b) $25^\circ, 29^\circ, 98^\circ, 208^\circ$

In both cases the angles add up to 360°

11. The interior angles will always add up to 540°

31.2 Line and Rotational Symmetry

1. (a) B - 2 lines, D - 2 lines, E - 1 line, F - 1 line, G - 4 lines, I - 1 line
(b) A - order 4, B - order 2, D - order 2, G - order 4, H - order 3
2. A - has symmetry, no lines, order 3 B - has symmetry, 1 line, no order
C - has symmetry, 1 line, no order D - has symmetry, 1 line, no order
E - has symmetry, 1 line, no order F - has symmetry, 4 lines, order 8
G - has symmetry, 1 line, no order H - has symmetry, no lines, order 4
I - no symmetry, no lines, no order

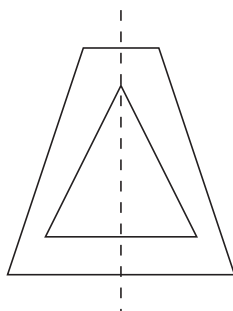


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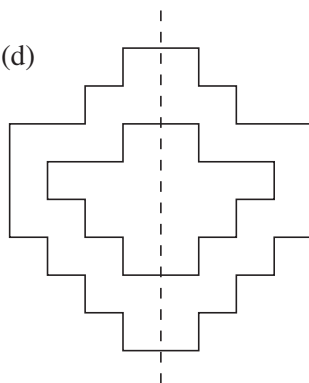
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31.2

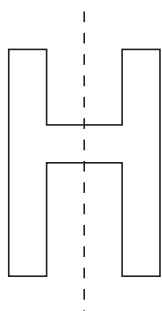
(c)



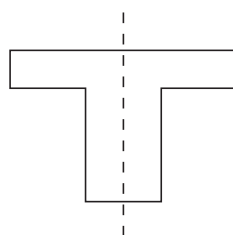
(d)



(e)

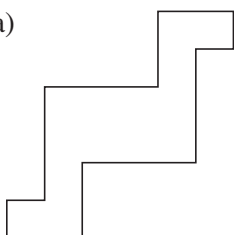


(f)



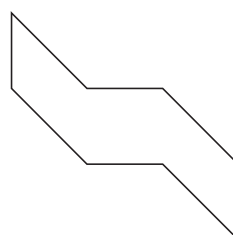
4.

(a)



order 2

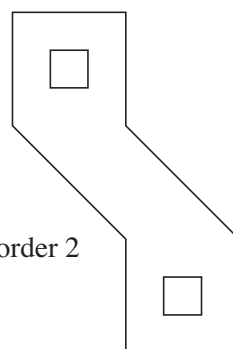
(b)



order 2

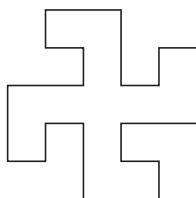
(c) Not possible

(d)



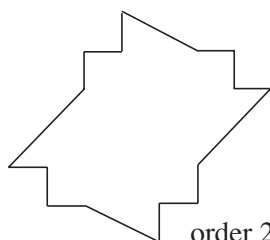
order 2

(e)



order 4

(f)



order 2

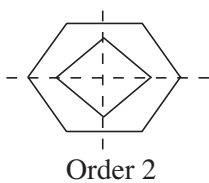
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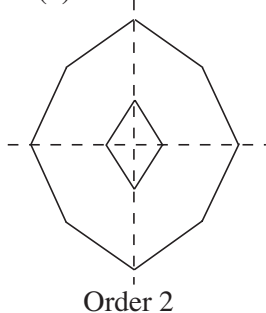
31.2

5.

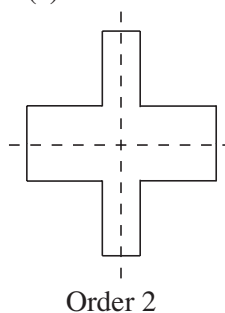
(a)



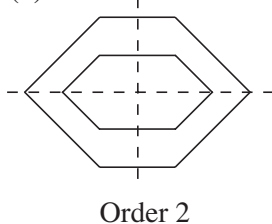
(b)



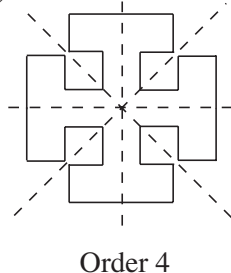
(c)



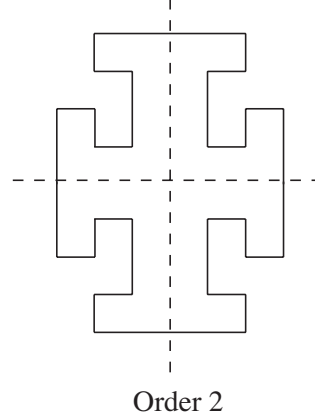
(d)



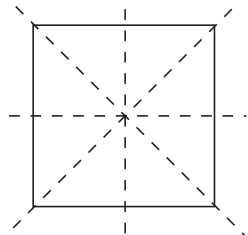
(e)



(f)

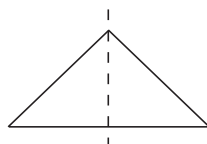


6.



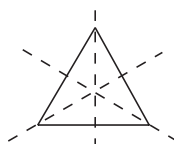
7.

(a) (i)



(ie. any isosceles triangle)

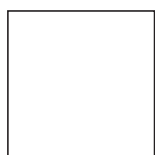
(ii)



(ie. any equilateral triangle)

(b) No

8.



(eg. a square)

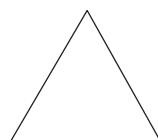
9.

(a)



Rotational symmetry order 2

(b)



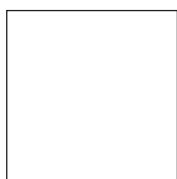
Rotational symmetry order 3

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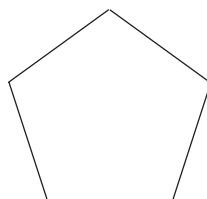
31.2

(c)



Rotational symmetry order 4

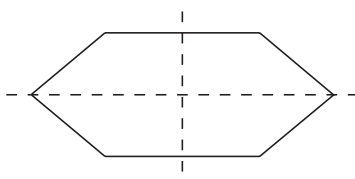
(d)



Rotational symmetry order 5

10. (a) No

(b)

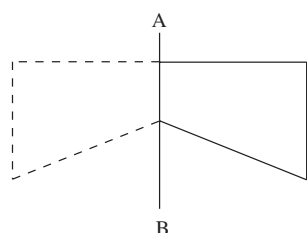


(c) No

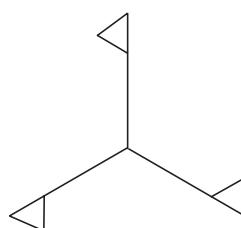
11. Letter I has rotational symmetry.

12. Designs (a), (b) and (d) have line symmetry.

13. (a)



(b)



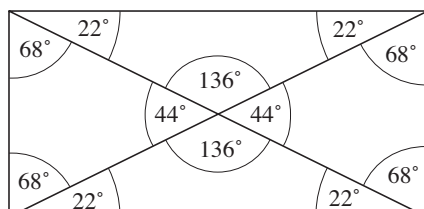
(c) Rotational symmetry of order 2.

31.3 Angle Geometry

1. (a) $a = 50^\circ$ (b) $x = 130^\circ$ (c) $b = 92^\circ$ (d) $a = 80^\circ$
 (e) $a = 111^\circ$ (f) $x = 82^\circ$ (g) $x = 110^\circ$ (h) $a = 45^\circ$
 (i) $x = 55^\circ$ (j) $a = b = 70^\circ$ (k) $a = b = c = 60^\circ$
 (l) $a = 50^\circ, b = 80^\circ$ (m) $a = 109^\circ$ (n) $x = 114^\circ$ (o) $x = 87^\circ$

2. (a) (i) $a = 70^\circ, b = 110^\circ$ (ii) $a = 53^\circ, b = 127^\circ$ (iii) $a = 48^\circ, b = 132^\circ$
 (b) b is equal to the sum of the two opposite angles in the triangle.
 (c) (i) $b = 105^\circ$ (ii) $b = 106^\circ$ (iii) $b = 135^\circ$

3.



4. (a) $a = 75^\circ, b = 75^\circ, c = 30^\circ, d = 75^\circ$
 (b) $a = 60^\circ, b = 60^\circ, c = 30^\circ, d = 60^\circ, e = 60^\circ, f = 60^\circ, g = 30^\circ$
 (c) $a = 80^\circ, b = 45^\circ, c = 45^\circ, d = 55^\circ, e = 80^\circ$
 (d) $a = 30^\circ, b = 20^\circ, c = 10^\circ, d = 80^\circ, e = 80^\circ, f = 60^\circ$

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5. (a) $a = 65^\circ, b = 80^\circ$ (b) $a = 40^\circ$,
 (c) $a = 60^\circ, b = 60^\circ, c = 60^\circ, d = 120^\circ, e = 30^\circ$
 (d) $a = 65^\circ, b = 65^\circ, c = 58^\circ, d = 90^\circ, e = 35^\circ$
 (e) $a = 90^\circ, b = 97^\circ, c = 41.5^\circ, d = 41.5^\circ, e = 69^\circ, f = 69^\circ, g = 104^\circ, h = 38^\circ$
 (f) $a = 60^\circ, b = 60^\circ, c = 60^\circ, d = 80^\circ, e = 100^\circ, f = 40^\circ, g = 40^\circ, h = 120^\circ, i = 38^\circ$
6. $a = 44^\circ, b = 68^\circ, c = 68^\circ, d = 112^\circ, e = 112^\circ, f = 68^\circ$
7. $a = 50^\circ, b = 40^\circ, c = 70^\circ, d = 20^\circ, e = 65^\circ, f = 50^\circ$
8. $a = 25^\circ, b = 110^\circ, c = 45^\circ, d = 65^\circ, e = 70^\circ, f = 25^\circ, g = 25^\circ$
9. (a) $9x = 180^\circ, x = 20^\circ$ (b) $3x - 30 = 180^\circ, x = 70^\circ$
 (c) $3x + 30 = 180^\circ, x = 50^\circ$ (d) $5x = 360^\circ, x = 72^\circ$
 (e) $4x + 20 = 180^\circ, x = 40^\circ$ (f) $4x = 360^\circ, x = 90^\circ$
 (g) $17x + 20 = 360^\circ, x = 20^\circ$ (h) $2x = 30^\circ, x = 15^\circ$
 (i) $5x + 90 = 360^\circ, x = 54^\circ$ (j) $10x + 80 = 180^\circ, x = 10^\circ$
 (k) $6x = 150^\circ, x = 25^\circ$ (l) $13x + 22 = 360^\circ, x = 26^\circ$
10. (a) order = 6 (b) (i) $\text{AOB} = 60^\circ$ (ii) Equilateral triangle
11. $\text{BCD} = 134^\circ$ $\text{ABC} = 77^\circ$

31.4 Angles with Parallel and Intersecting Lines

1. (a) $a = 38^\circ$, Opposite angles
 (b) $a = 57^\circ$, Opposite angles, $b = 123^\circ$, Straight line
 (c) $a = 60^\circ$, Straight line, $b = 120^\circ$, Opposite angles, $c = 60^\circ$, Opposite angles
 (d) $a = 100^\circ$, Straight line, $b = 100^\circ$, Opposite angles
 (e) $a = 145^\circ$, Straight line, $b = 35^\circ$, Opposite angles, $c = 145^\circ$, Opposite angles
 (f) $a = 50^\circ$, Corresponding angles
 (g) $a = 40^\circ$, Corresponding angles, $b = 140^\circ$, Straight line
 (h) $a = 60^\circ$, Straight line, $b = 60^\circ$, Corresponding angles, $c = 120^\circ$, Straight line
 (i) $a = 42^\circ$, Opposite angles, $b = 138^\circ$, Supplementary angles,
 $c = 42^\circ$, Corresponding angles
 (j) $a = 100^\circ$, Straight line, $b = 80^\circ$, Opposite angles, $c = 100^\circ$, Opposite angles
 $d = 80^\circ$, Corresponding angles
 (k) $a = 25^\circ$, Opposite angles, $b = 155^\circ$, Straight line,
 $c = 25^\circ$, Corresponding angles
 (l) $a = 124^\circ$, Alternate angles, $b = 56^\circ$, Straight line
 (m) $a = 37^\circ$, Corresponding angles, $b = 143^\circ$, Straight line,
 $c = 37^\circ$, Opposite angles

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31.4

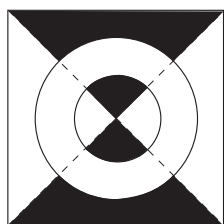
- (n) $a = 56^\circ$, Corresponding then Opposite angles, $b = 124^\circ$, Straight line,
 $c = 124^\circ$, Corresponding then Opposite angles,
- (o) $a = 160^\circ$, Straight line, $b = 160^\circ$, Corresponding angles,
 $c = 20^\circ$, Alternate angles
2. (a) $a = 70^\circ$, $b = 140^\circ$
 (b) $a = 60^\circ$, $b = 110^\circ$, $c = 70^\circ$, $d = 120^\circ$
 (c) $a = 52^\circ$, $b = 128^\circ$, $c = 52^\circ$, $d = 128^\circ$
 (d) $a = 75^\circ$, $b = 105^\circ$, $c = 75^\circ$, $d = 105^\circ$
 (e) $a = 60^\circ$, $b = 80^\circ$, $c = 80^\circ$
 (f) $a = 70^\circ$, $b = 50^\circ$, $c = 60^\circ$, $d = 70^\circ$, $e = 70^\circ$
 (g) $a = 74^\circ$, $b = 100^\circ$, $c = 41^\circ$, $d = 115^\circ$
 (h) $a = 48^\circ$, $b = 48^\circ$, $c = 132^\circ$, $d = 138^\circ$, $e = 42^\circ$, $f = 48^\circ$
 (i) $a = 64^\circ$, $b = 52^\circ$, $c = 64^\circ$
 (j) $a = 38^\circ$, $b = 52^\circ$, $c = 52^\circ$
3. (a) $4x = 180^\circ$, $x = 45^\circ$ (b) $10x = 360^\circ$, $x = 36^\circ$
 (c) $8x = 180^\circ$, $x = 22.5^\circ$ (d) $9x = 180^\circ$, $x = 20^\circ$
 (e) $6x = 180^\circ$, $x = 30^\circ$ (f) $8x = 180^\circ$, $x = 22.5^\circ$
4. AB is parallel to EF, GH is parallel to IJ
5. $a = 80^\circ$, $b = 50^\circ$, $c = 80^\circ$, $d = 50^\circ$
6. (a) AC and BD are parallel (b) $\angle BAC = 50^\circ$ because AEC is isosceles
7. (a) Square, Rectangle, Rhombus and Parallelogram
 (b) Rectangle, Parallelogram, Kite, Rhombus and Square
8. (a) 36° ; alternate angles (b) 54° ; angle POQ is 90°
9. (a) $p = 48^\circ$ (b) $q = 84^\circ$ (c) Alternate angles
10. (a) $x + 80^\circ + 57^\circ = 180^\circ$
 $\Rightarrow x = 43^\circ$
 (b) $y + 90^\circ + 51^\circ + 57^\circ = 360^\circ$
 $\Rightarrow y = 162^\circ$

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31.5 Angle Symmetry in Regular Polygons

1. (a) 108° (b) 120° (c) 135° (d) 144°
2. (a) 1260° (b) 1620°
3. (a) Square (b) Hexagon (c) Pentagon (d) Nonagon
(e) Triangle (f) Decagon
4. Many possible solutions
6. (a) (i) No (ii) No (iii) No (b) (i) Yes (ii) No (iii) No
7. (a) 1260° (b) $180^\circ, 360^\circ, 540^\circ, 720^\circ, 900^\circ, 1080^\circ$
(c) $180n - 360$ (d) 2160° (e) 9
8. (a) $\frac{360}{n}$ (b) $180 - \frac{360}{n}$ (c) 162°
9. (a) 2 (c) (i) 5 (ii) 72°
- 10.



11. (a) 45° (b) 135°
12. (b) (ii) 120° (c) (i) 2 (ii) 6 (d) Cube