STRAND E: Measurement

Unit 12 *Solids*

Student Text

Contents

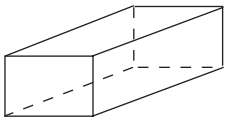
denotes that the topic is not on the current CXC/CSEC Mathematics syllabus and therefore not examined, but is of relevance to the content of the Unit.

12 Solids

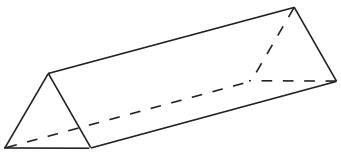
12.1 Making Solids Using Nets

A net can be cut out, folded and glued to make a hollow shape.

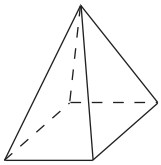
In this unit, you will be dealing with 3-dimensional shapes such as



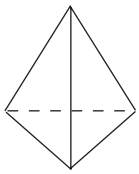
cuboid



prism



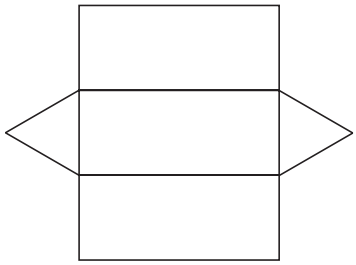
pyramid



tetrahedron

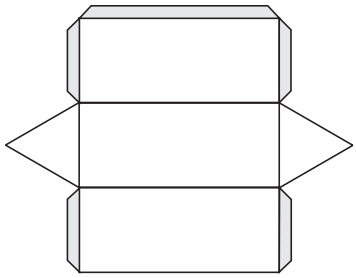
Worked Example 1

What solid is made when the net shown is folded and glued?



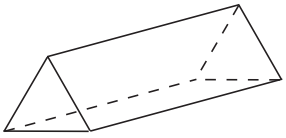
Solution

It is important to add tabs to the net so that it can be glued. You could put tabs on every edge, but this would mean gluing tabs to tabs. The diagram opposite shows one possible position of the tabs.



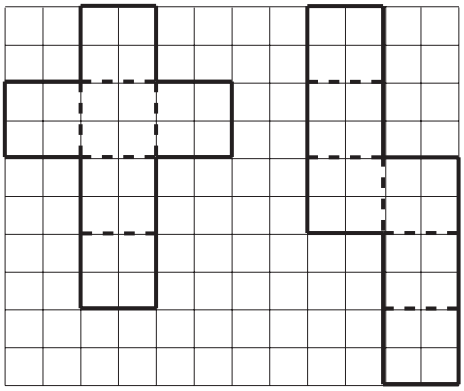
Before gluing, crease all the folds.

The final solid is a triangular prism.



Exercises

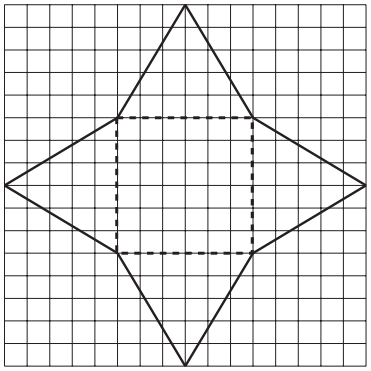
1. Copy and cut out larger versions of the following nets. Fold and glue them to obtain cubes. Do not forget to add tabs to the nets.



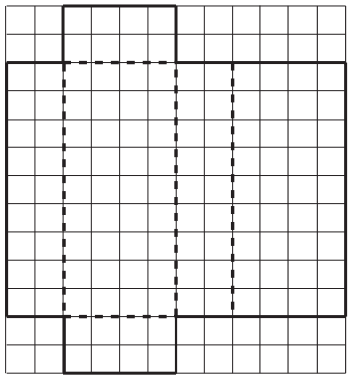
Shading denotes that the topic is not on the current CXC/CSEC Mathematics syllabus and therefore not examined, but is of relevance to the content of the Unit.

2. Copy each net shown below and make it into a solid, without overlapping the sides. State the name of the solid that you make, if it has one.

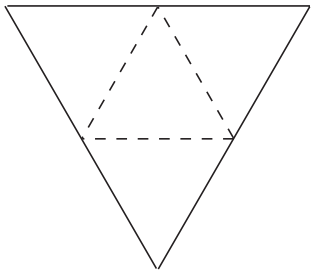
(a)



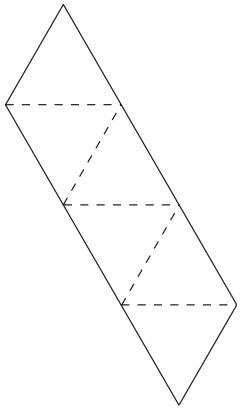
(b)



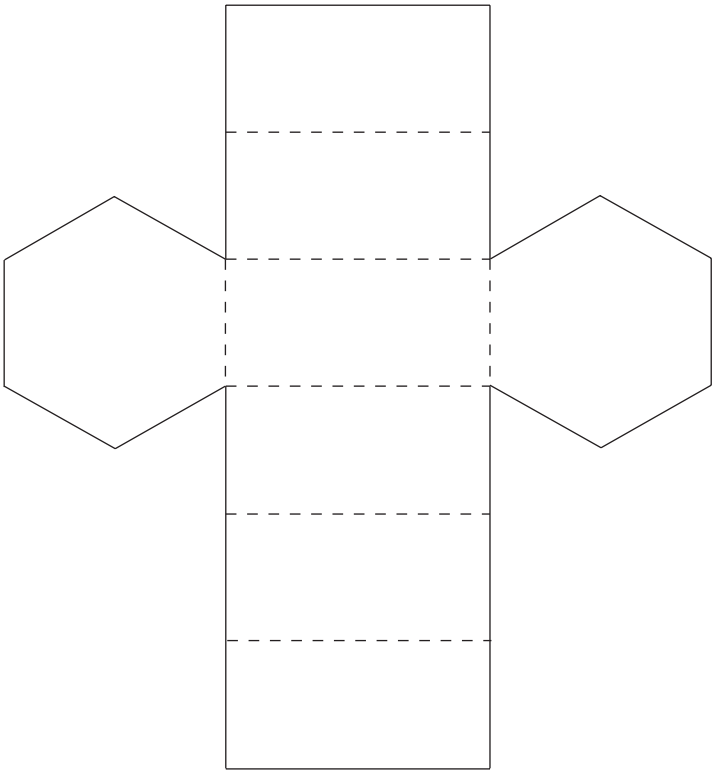
(c)



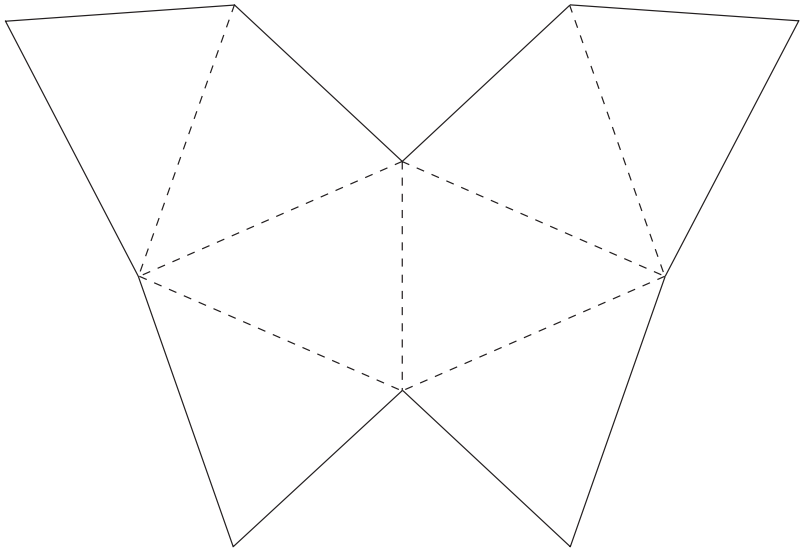
(d)



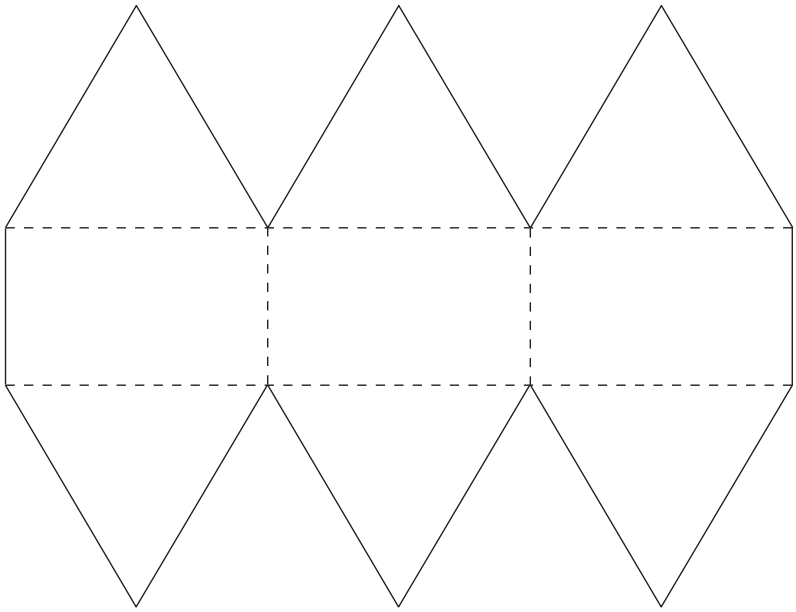
(e)



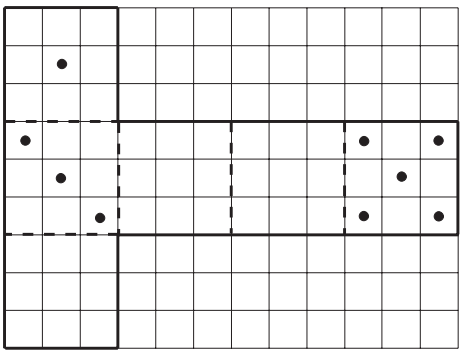
(f)



(g)



3. The diagram shows the net for a dice with some of the spots in place. Fill in the missing spots so that the opposite faces add up to 7. Then make the dice.

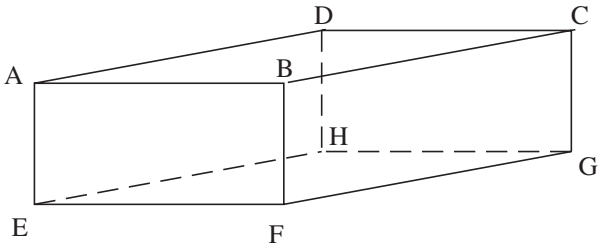


12.2 Constructing Nets

A net for a solid can be visualised by imagining that the shape is cut along its edges until it can be laid flat.

Worked Example 1

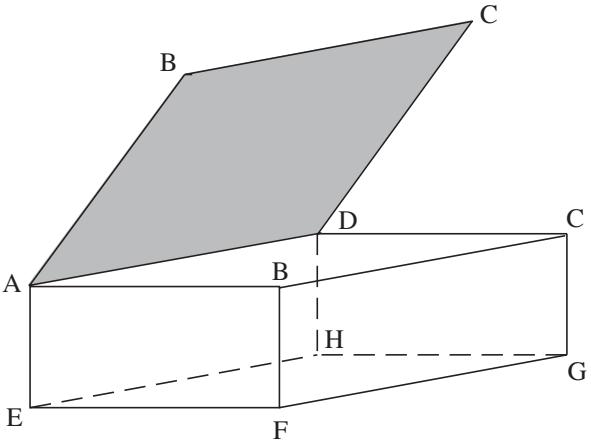
Draw the net for the cuboid shown in the diagram.

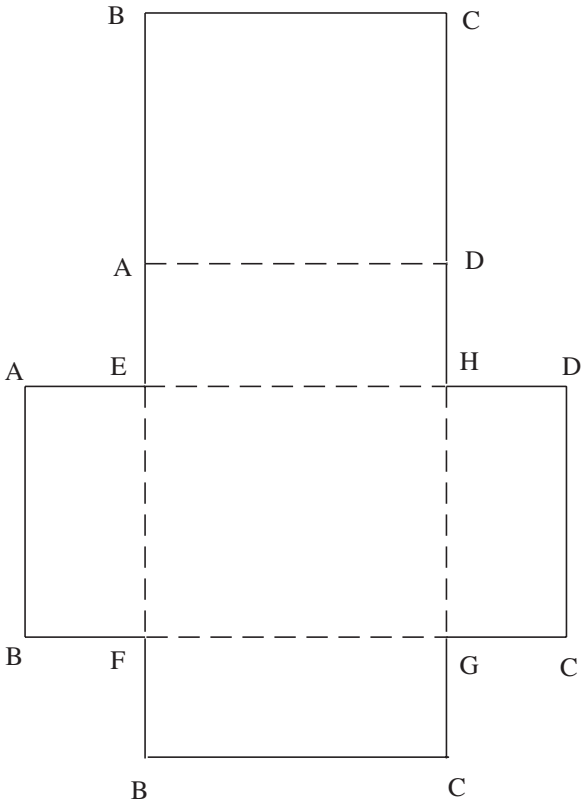


Solution

Imagine making cuts as below:

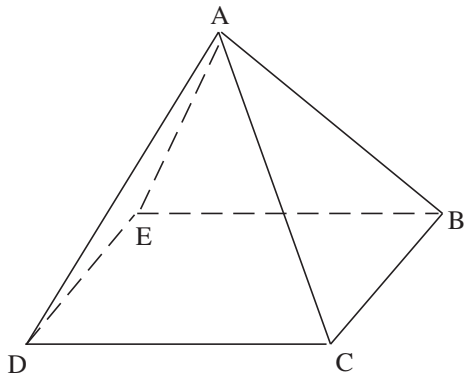
- cut along the edges AB, BC and CD to open the top like a flap.
- then cut down AE, BF, CG and DH, and press flat to give the net below.





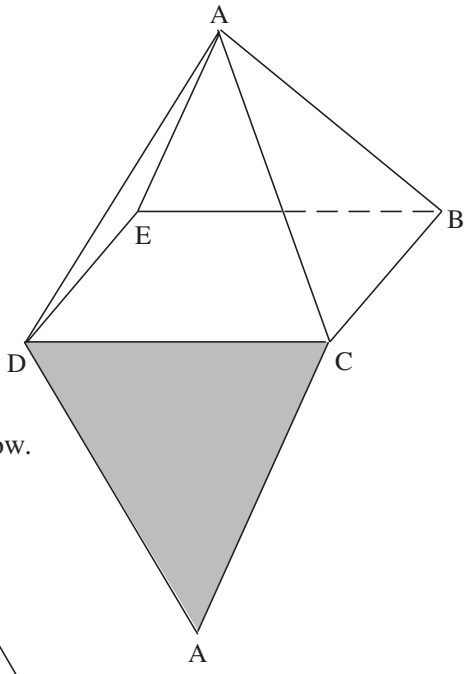
Worked Example 2

Draw the net for this square-based pyramid.

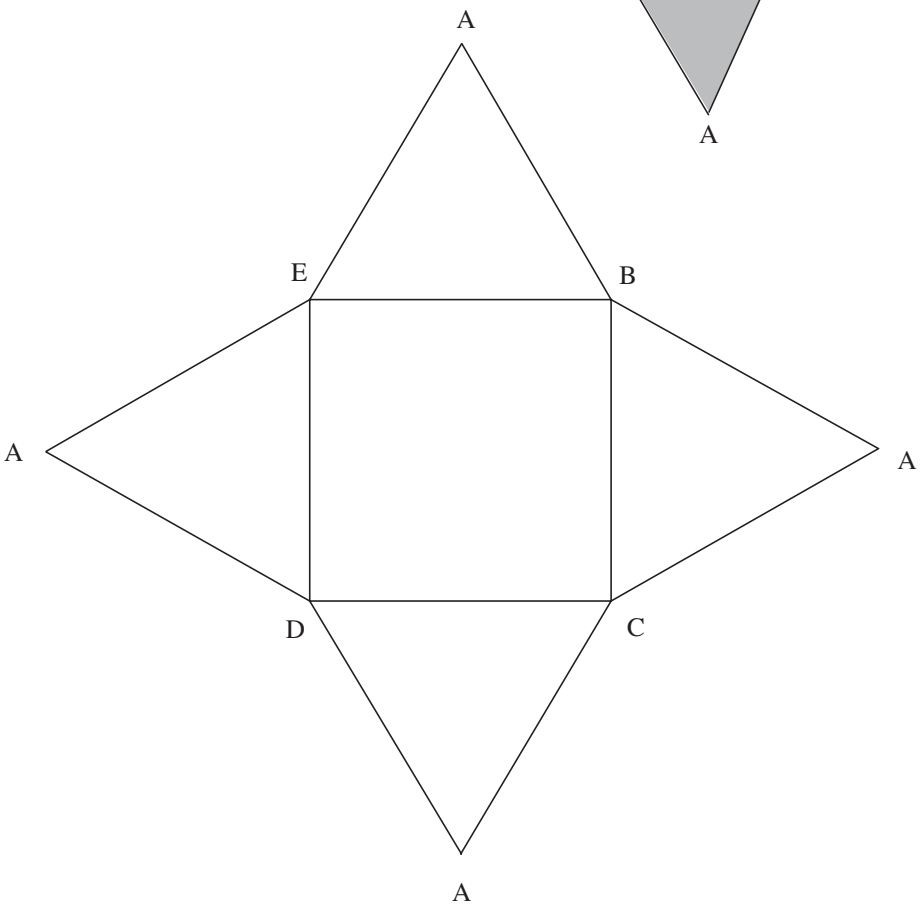


Solution

First imagine cutting down the edges AD and AC and opening out a triangle.



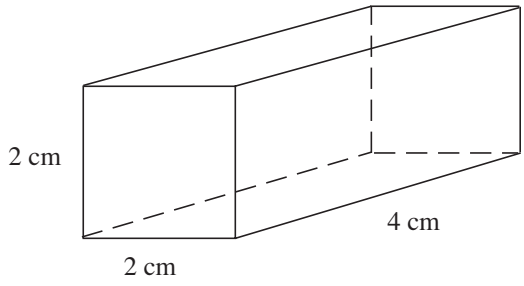
Then cutting down AB and AE gives the net below.



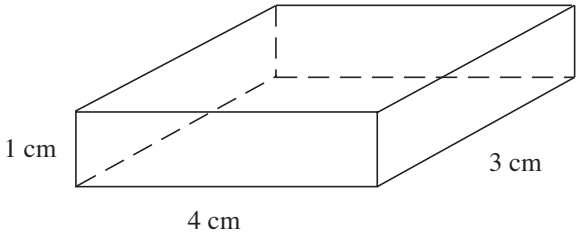
Exercises

1. Draw an accurate net for each cuboid below.

(a)



(b)



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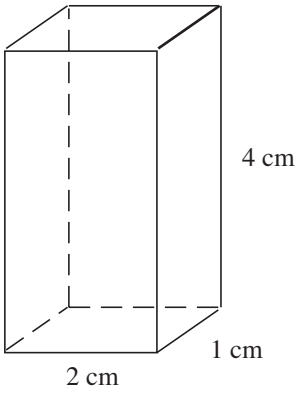
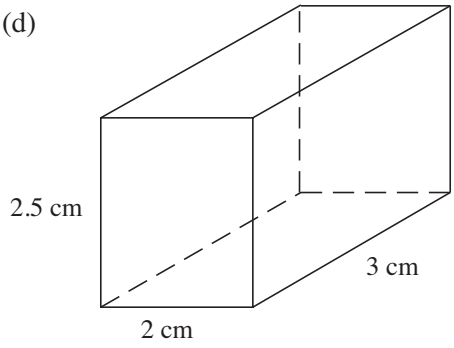
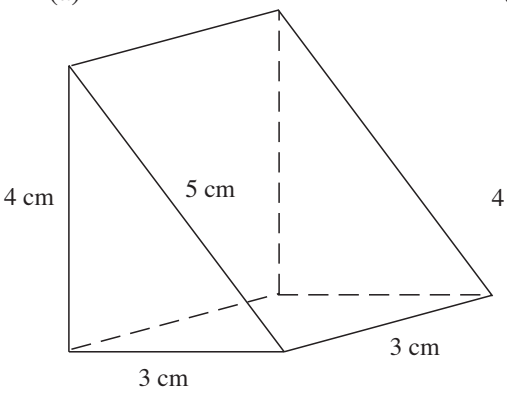


(d)



2. Draw a net for each of the following solids.

(a)



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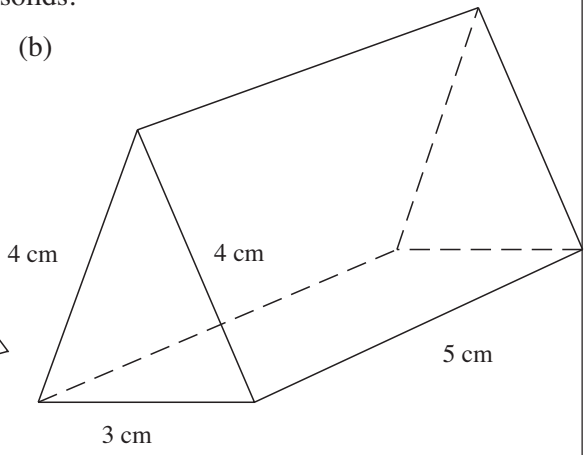
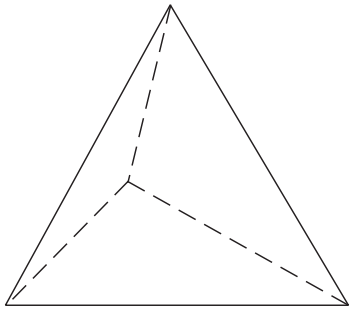
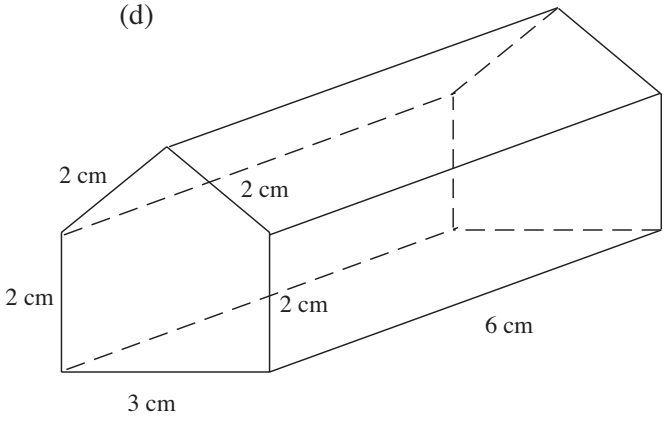


(c)

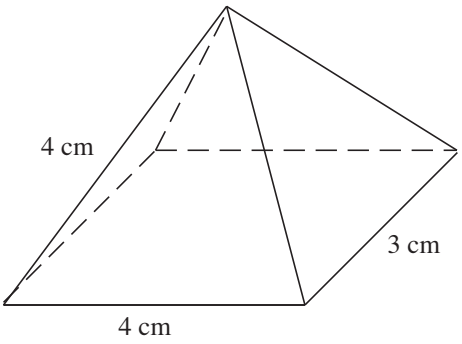


All edges 5 cm

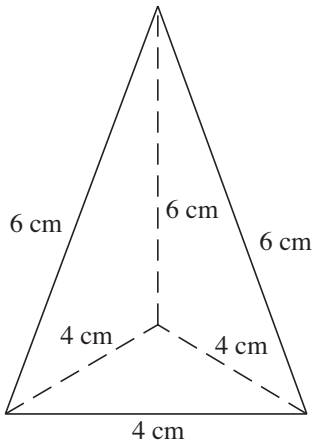
(d)



(e)



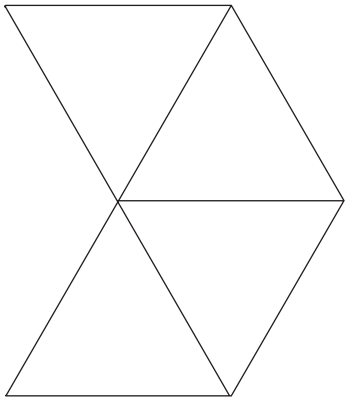
(f)



3. (a) Draw and cut out four equally sized equilateral triangles.

(b) How many different ways can they be arranged with sides joined together?

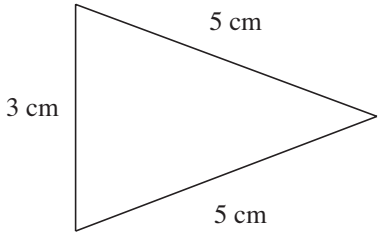
One example is shown.



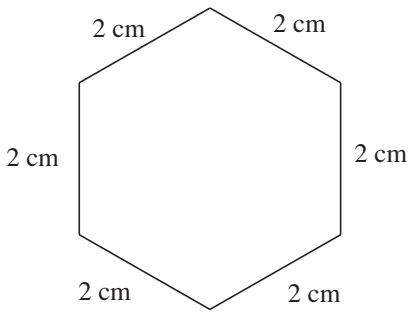
(c) Which of your arrangements of triangles form a net for a tetrahedron?

4. The diagrams below show the ends of two of prisms that each have length of 8 cm. Draw a net for each prism.

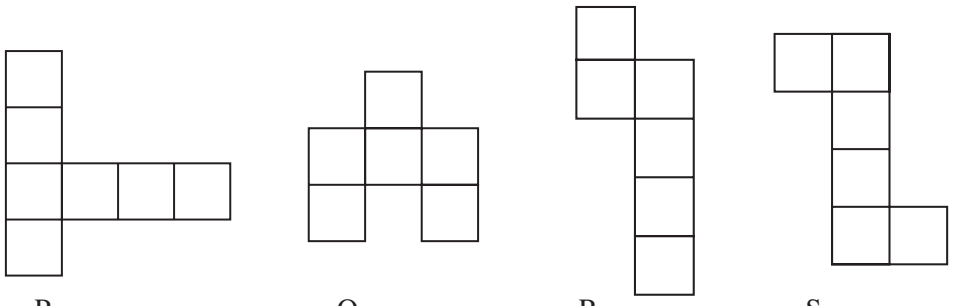
(a)



(b)

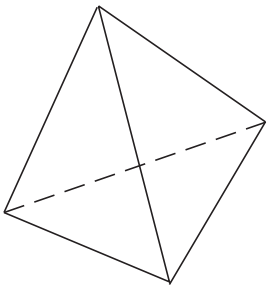


5. Which one of these nets can be folded without any of the sides overlapping to make a cube?



P Q R S

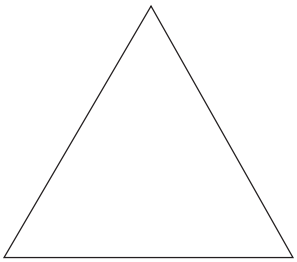
6.



The diagram above shows a pyramid with four equal triangular faces.

Each edge is 4 cm long.

Below is one of the faces.

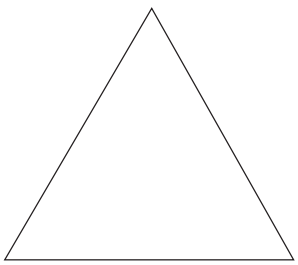


(a) What is the special name given to this kind of triangle?

(b) What is the size of each angle of this triangle?

(c) Construct an accurate net for the pyramid.

One face has been drawn for you.



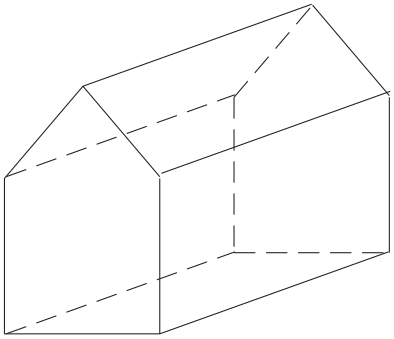
12.3 Plans and Elevations

The *plan* of a solid is the view from *above*.

The *elevation* of a solid is the view from a *side*. We often use the terms *front elevation* and *side elevation*.

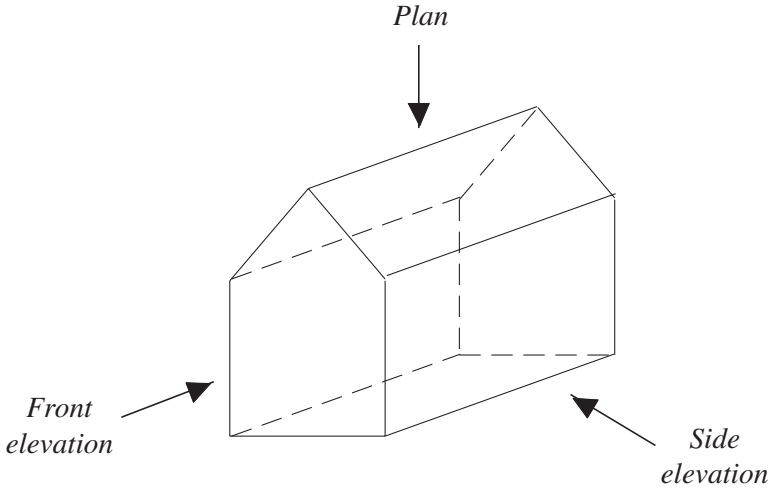
Worked Example 1

Draw the plan, front elevation and side elevation of the shed in the diagram.



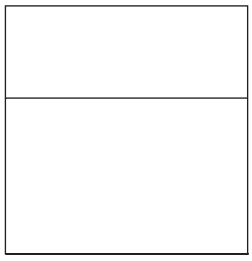
Solution

To draw the plan and elevation, look at the shed as shown below.



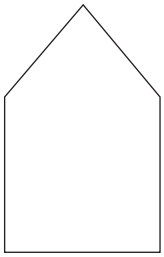
Looking from the side gives the

Side elevation



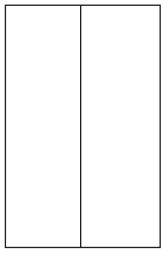
Looking from the front gives the

Front elevation



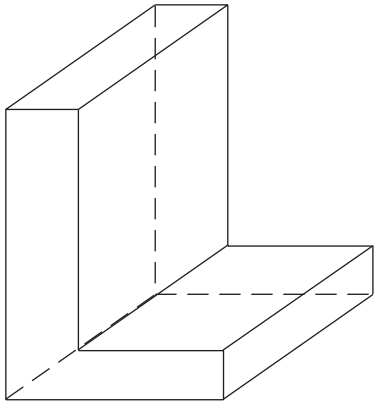
Looking from above gives the

Plan



Worked Example 2

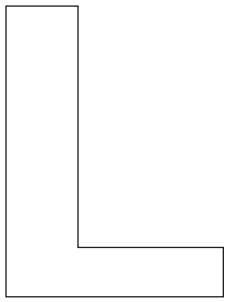
Draw the front elevation, side elevation and plan of this shape.



Solution

Looking from the front side gives the

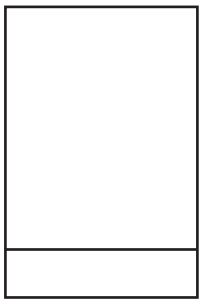
Front elevation



Looking from the

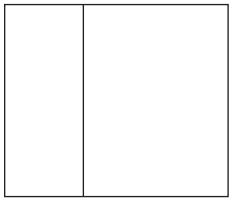
gives the

Side elevation



Looking from above gives the

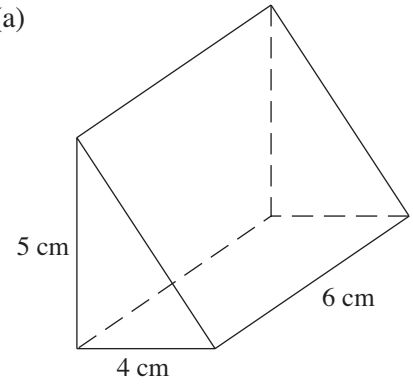
Plan



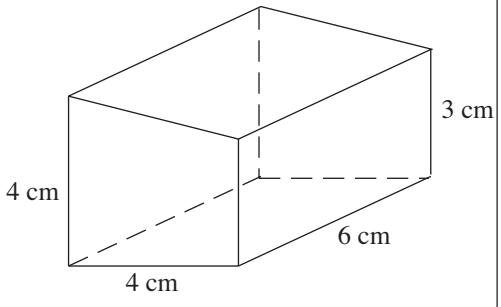
Exercises

1. Draw the front elevation, plan and side elevation for each solid shown below.

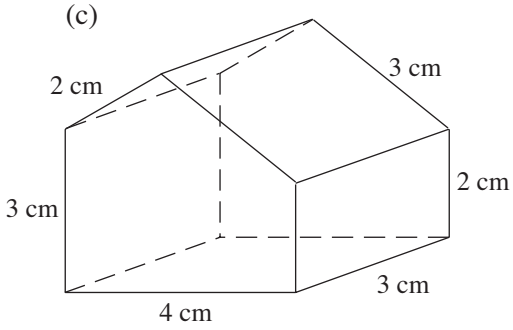
(a)



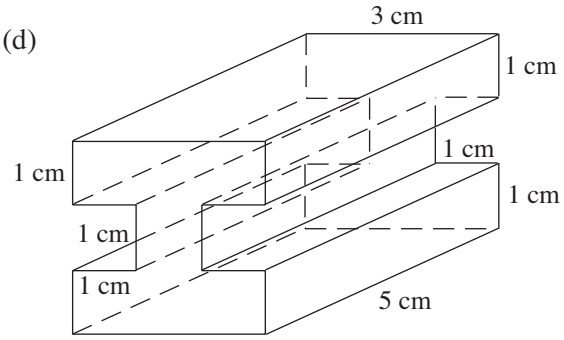
(b)



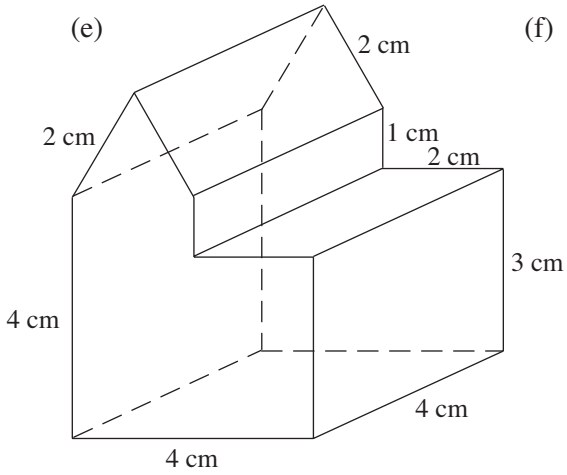
(c)



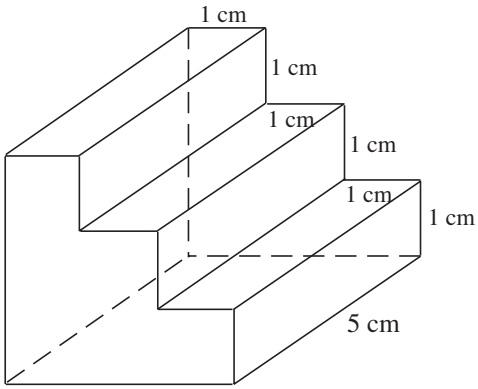
(d)



(e)



(f)



2. Draw the plan and front elevation of a square based pyramid that has a height of 6 cm and base with sides of 5 cm.

3. Draw a plan and front elevation for:

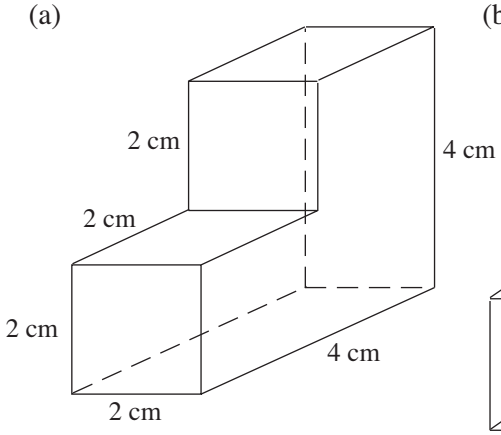
   (a) a tin of baked beans, (b) a DVD case,

   (c) a roll of sellotape, (d) a ball.

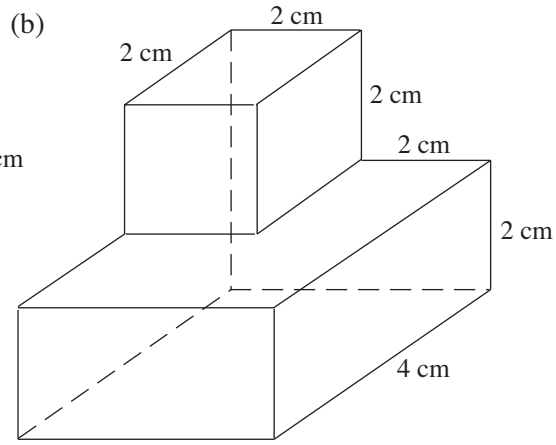
4. A pencil with a hexagonal cross section stands on one end with its point up. Draw a plan, front elevation and side elevation of the pencil.

5. Draw the front elevation, side elevation and plan of the solids below.

(a)



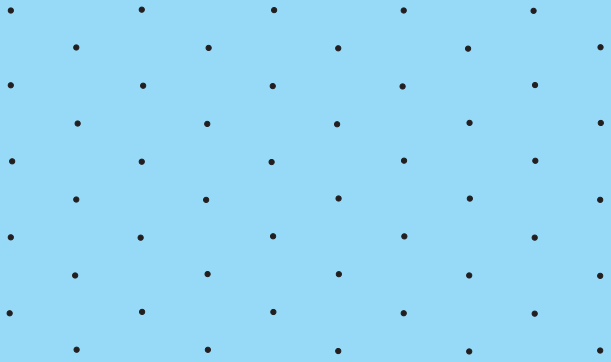
(b)



12.4 Using Isometric Paper

The spots on isometric paper are arranged at the corners of equilateral triangles.

Isometric paper



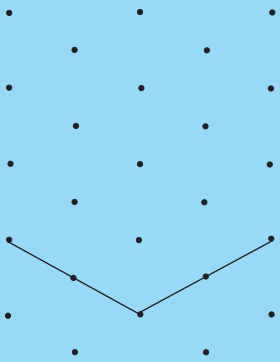
Worked Example 1

Draw a cube with sides of 2 cm on isometric paper.

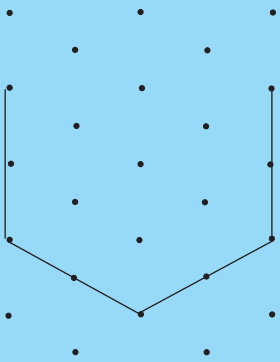
Solution

The diagrams show the three stages needed to draw the cube.

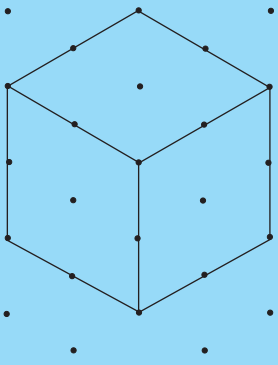
First draw the base.



Then add the upright edges.

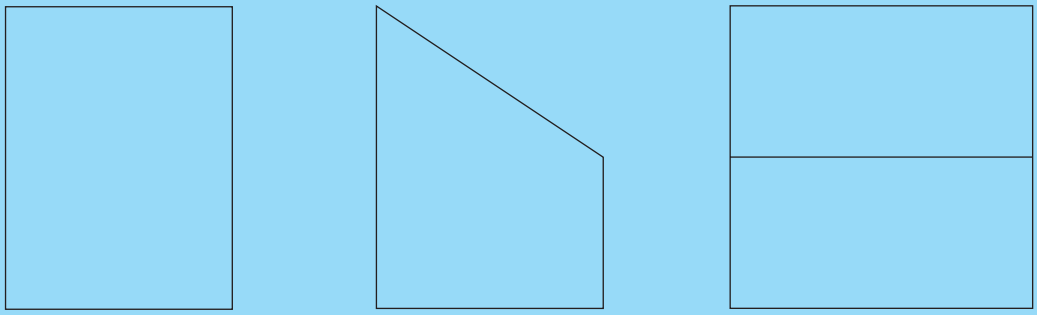


Finally add the top of the cube.



Worked Example 2

The diagrams below show the plan and elevations of a solid object.

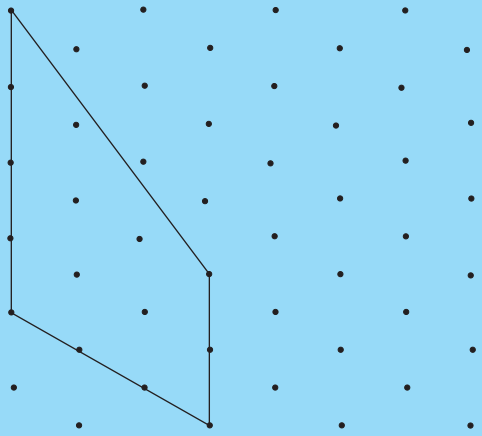


Plan *Front elevation* *Side elevation*

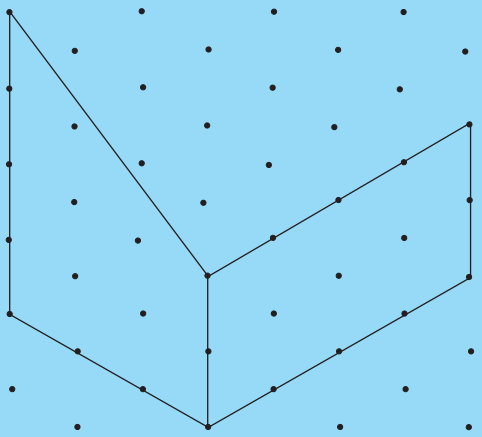
Draw the object on isometric paper.

Solution

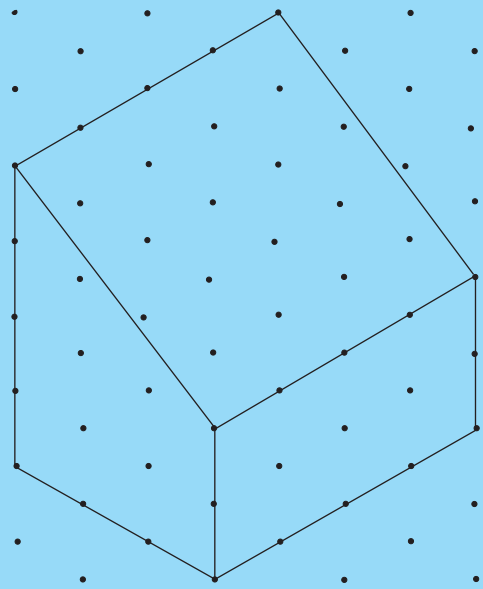
From the front elevation the front can be drawn.



Then using the side elevation the lower part of the side can be drawn.

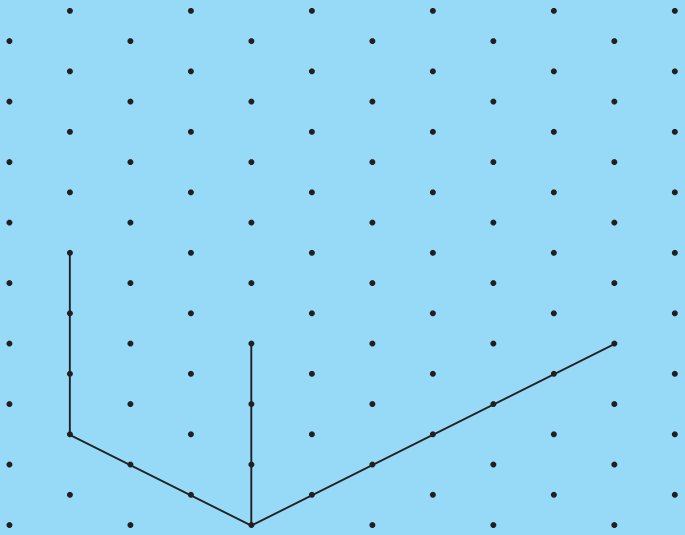


Finally the drawing can be completed.



Exercises

1. The diagram shows part of the drawing of a cuboid. Copy and complete the cuboid.

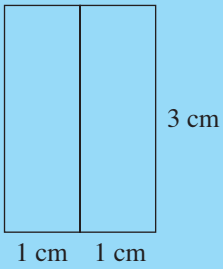


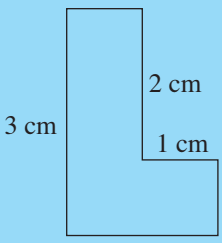
2. On isometric paper draw cubes with sides of lengths 1 cm and 3 cm.

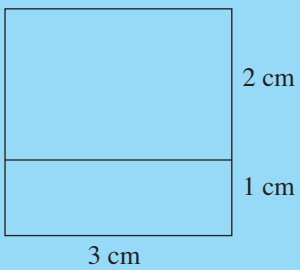
3. A cuboid has sides of length 3 cm, 4 cm and 5 cm. Draw the cuboid in three different ways on isometric paper.

4. In each case below the plan and two elevations of a solid are given. Draw an isometric drawing of each solid.

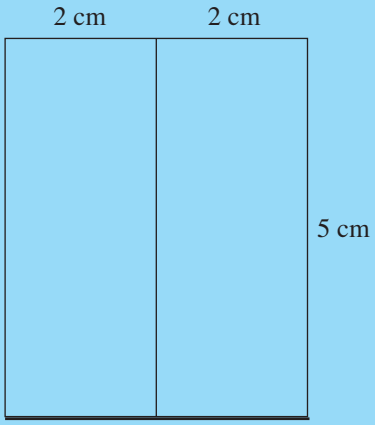
(a)

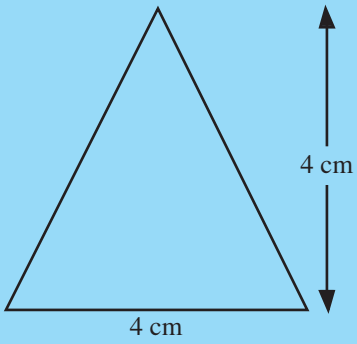


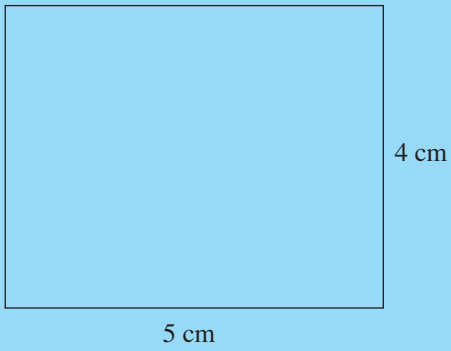




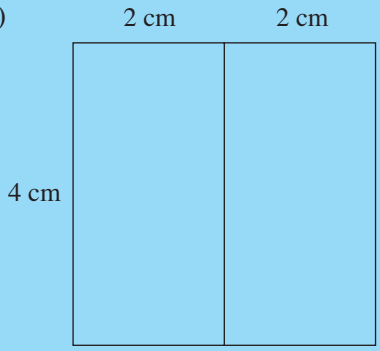
(b)

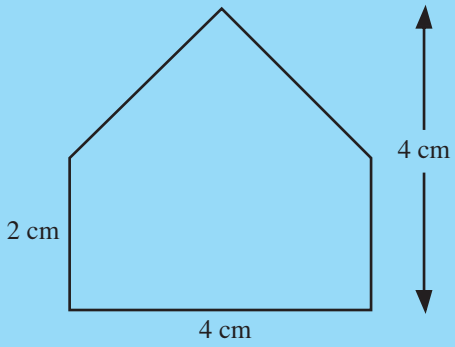


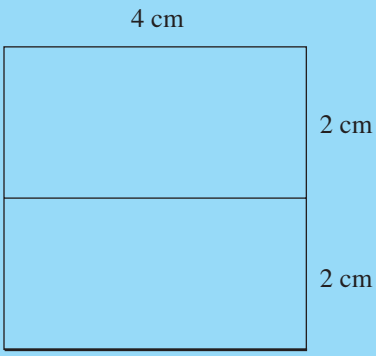




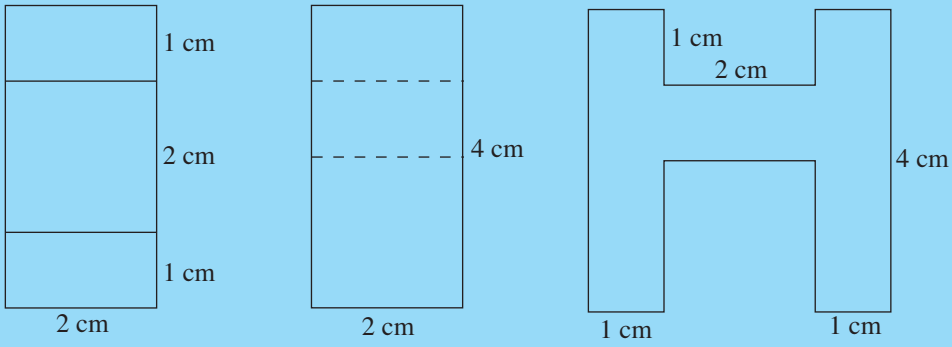
(c)



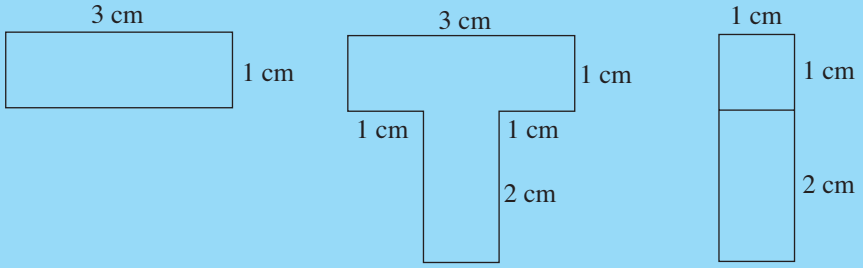




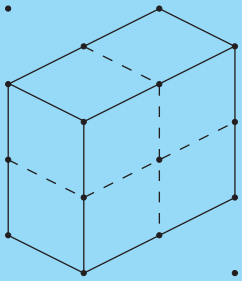
(d)



(e)

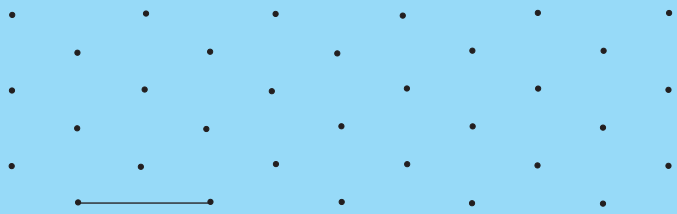


5. Four cubes with sides of length 1 cm can be joined together in different ways. One way is shown below.

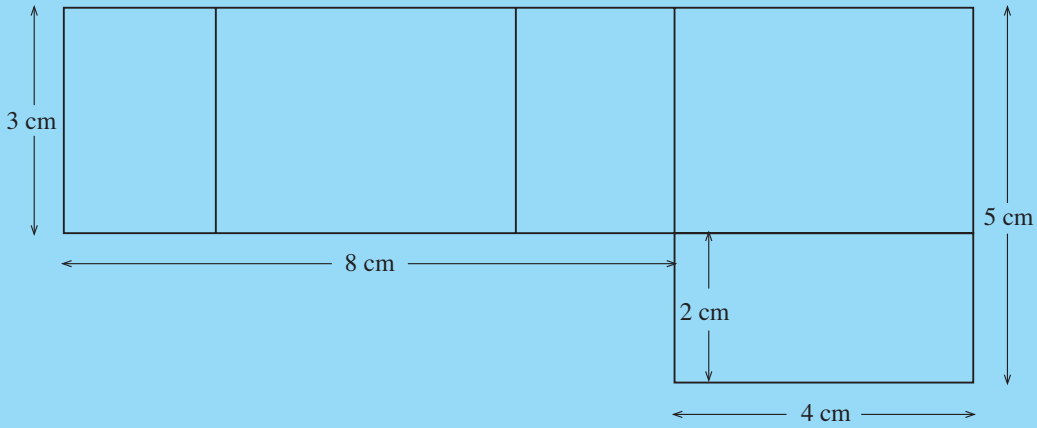


Find other ways in which the four cubes could be joined together.

6. Complete the drawing of a cuboid. One edge is drawn for you.



7. The diagram below is the net of a small open box, with no top face.



(a) Find the perimeter of the net.

(b) Calculate the area of the net.

(c) Copy the diagram, and add one more rectangle in a suitable position to change the diagram to the net of a closed box.

(d) Write down the length, width and height of the box (in any order).

(e) Calculate the volume of the box.

(f) Draw an isometric view of the closed box on a grid like the one below.