TOPIC 17
Views of 3-D shapes

17.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the concepts covered in this topic.

17.1.1 Why learn this?

Knowledge of geometry and mathematics is essential for understanding how 3-dimensional (3-D) spaces work. Three-dimensional shapes exist all around us — from a cylindrical water bottle to prism shaped boxes, rectangular playing fields, and spherical and oval shaped balls. Drawing a 3-dimensional shape depends on the view you wish to show. Designs and ideas about 3-dimensional shapes can be communicated using 2-dimensional drawings.

LEARNING SEQUENCE

17.1 Overview
17.2 Scales and house plans
17.3 Plans and views
17.4 Isometric drawing
17.5 Review

17.1.2 What do you know?

1. **THINK** List what you know about reading scales. Use a thinking tool such as a concept map to show your list.
2. **PAIR** Share what you know with a partner and then with a small group.
3. **SHARE** As a class, create a thinking tool such as a large concept map that shows your class's knowledge of scales.

17.2 Scales and house plans

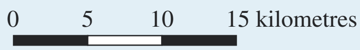
17.2.1 Understanding scales

- A scale on a map or plan describes the ratio between the distance on the map or plan and the actual distance on the Earth's surface.
- A scale may be written several ways.
  – A ratio such as 1 : 100 000 means that 1 cm on a map or plan represents a distance of 100 000 cm on the Earth, or 1 mm on the map or plan represents 100 000 mm on the Earth, etc.
  – A statement such as 1 cm ⇔ 500 km means that 1 cm on the map or plan represents a distance of 500 km on the Earth.

– A graphical bar scale, such as the one shown in Worked example 1, can be used. In this case, we need to measure the length of the bar to determine the scale ratio.

WORKED EXAMPLE 1

a **The scale on a house plan is 1 : 2000. How many metres does a length of 1 cm on the map represent?**
b **Write the scale 1 cm ⇔ 5000 m as a ratio scale.**
c **A map shows a scale of 1 cm ⇔ 1500 m. What distance is represented by 18 mm on the map?**
d **Use the following graphical scale to determine the distance that 1 cm on the map represents.**



THINK	WRITE
a 1 Use the ratio to add the same units to both sides. Since the answer asks for cm, use this unit.	**a** 1 : 2000 is the same as: 1 cm ⇔ 2000 cm
2 Bring the length to an appropriate unit. In this case, the answer is required in metres.	2000 cm = (2000 ÷ 100) m = 20 m So, 1 cm ⇔ 20 m.
3 Write the answer.	1 cm on the map represents a length of 20 m in reality.
b 1 Convert the ground units to the same as those of the map.	**b** 5000 m = (5000 × 100) cm = 500 000 cm
2 Write the scale as a ratio.	So, 1 cm ⇔ 5000 m is the same as 1 cm ⇔ 500 000 cm. Expressed as a ratio, this is 1 : 500 000.
c 1 Write a statement explaining this scale.	**c** 1 cm ⇔ 1500 m means that 1 cm on the map represents a distance of 1500 m.
2 Change the question distance to the same units as those for the map.	18 mm = (18 ÷ 10) cm = 1.8 cm
3 Multiply by this scale factor.	1.8 cm represents (1.8 × 1500) m, which is 2700 m or 2.7 km.
d 1 Measure the length of the bars with a ruler.	**d** The bars measure 3.5 cm.
2 Relate this measurement to the length shown in the scale.	This represents a length of 15 km.
3 Write as a scale.	3.5 cm ⇔ 15 km
4 Calculate a 1 cm map distance and write the answer.	So, 1 cm ⇔ $\frac{15}{35}$ km 1 cm on the map represents a distance of 4.3 km.

- Sometimes it is necessary to do the reverse, and convert from a real length to a plan measurement.

WORKED EXAMPLE 2

The length of a wall for a particular house is 12 m. If the scale of a house plan is 1 : 200, what length, on the plan, would represent the actual length of the wall?

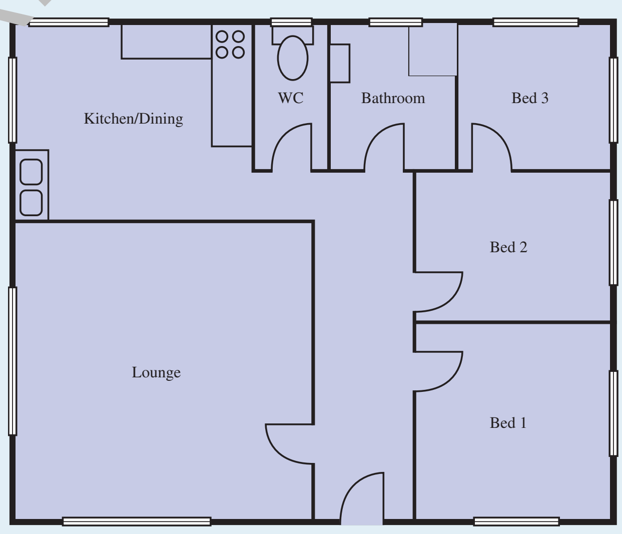
THINK	WRITE
1 Write the scale as a ratio using units of cm.	1 : 200 means that 1 cm on the plan represents an actual length of 200 cm. 1 cm ⇔ 200 cm
2 Convert the actual length from cm to m units.	$200 \text{ cm} = (200 \div 100) \text{ m}$ $= 2 \text{ m}$ So 1 cm on the plan represents an actual length of 2 m. 1 cm ⇔ 2 m
3 Divide the actual length by 2 to find how many lots of 2 m there are in 12 m.	$\frac{12 \text{ m}}{2 \text{ m}} = 6$
4 Multiply both sides of the scale by this scale factor then simplify.	1 cm × 6 ⇔ 2 m × 6 6 cm ⇔ 12 m
5 Answer the question.	The length of the wall on the house plan would be 6 cm.

17.2.2 House plans

- Whenever a house is being constructed, floor plans are supplied to the builder so that the footings, walls, roof etc. are all placed in the correct positions and are the correct length. The scale of the plan is generally given as a ratio. This enables us to calculate all dimensions within the house.

WORKED EXAMPLE 3

Below is a plan for a house.



Scale 1 : 100

a **Calculate the dimensions of the house.**

b **Calculate the area of the lounge room.**

THINK	WRITE
a **1** Measure the length and width of the house on the plan.	**a** Length of house on plan = 12 cm Width of house on plan = 10 cm
2 Multiply each of these measurements by 100.	Actual length of house = 12 cm × 100 = 1200 cm = 12 cm Actual width = 10 cm × 100 = 1000 cm = 10 cm
3 Write your answer.	The dimensions of the house are 12 m by 10 m.
b **1** Measure the length and width of the lounge room on the plan.	**b** Length of lounge room on plan = 6 cm Width of lounge room on plan = 6 cm
2 Multiply each of these measurements by 100.	Actual length of lounge room = 6 cm × 100 = 600 cm = 6 m Actual width of lounge room is also 6 m.
3 Calculate the area of the lounge room.	$A = 6^2$ $= 36\text{ m}^2$
4 Write your answer.	The area of the lounge room is 36 m^2.

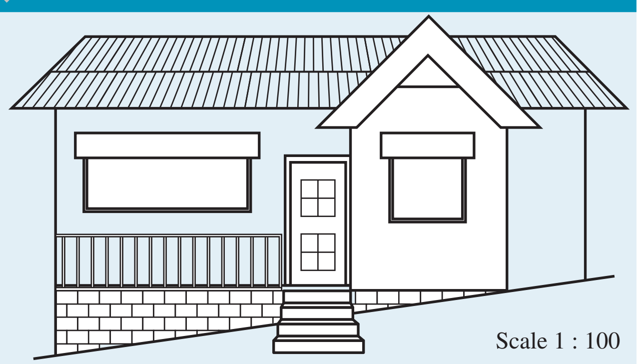
- In addition to a floor plan, a builder needs to know what the house will look like if it is viewed from the front, back and sides. These plans are called *elevations*. These are also drawn to scale.

WORKED EXAMPLE 4

The diagram at right shows the front elevation of a house.

a Calculate the height of the eaves on the lower side of the house.

b Measure the angle of the pitch of the roof.



Scale 1 : 100

THINK	WRITE
a **1** Measure the height on the plan for the lower side of the house.	**a** Height on the plan = 3.5 cm
2 Multiply the plan measurement by 100.	Actual height = 3.5 cm × 100 = 350 cm = 3.5 m
3 Write your answer.	The height of the eaves is 3.5 m.
b **1** Measure the angle that the slope of the roof makes with the horizontal.	**b** Angle to horizontal = 45°
2 Write your answer.	The angle of the pitch of the roof is 45°.

- With an understanding of house plans, you should now be able to draw plans of objects familiar to you, such as your home, bedroom or classroom. It is important to include a scale with each plan. Sometimes a legend is also appropriate.

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Complete this digital doc: SkillSHEET: Metric units of length
Searchlight ID: doc-6546

Complete this digital doc: SkillSHEET: Reading scales
Searchlight ID: doc-6547

Exercise 17.2 Scales and house plans

assesson

Individual pathways

PRACTISE	CONSOLIDATE	MASTER
Questions: 1, 2, 3, 4, 5, 6, 7, 8, 14	Questions: 1, 2, 3, 4, 5, 6, 7a, c, e, g, 8, 10a, c, 12, 14, 15	Questions: 1, 2, 3, 4, 5, 6, 7a, d, h, 8, 9, 10, 11, 12, 13, 14, 15

Individual pathway interactivity: int-4391

assesson ONLINE ONLY

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note*: Question numbers may vary slightly.

Fluency

1. WE1 Rewrite the following ratio scales in the form 1 cm ⇔ _______ using the most appropriate units.

a. 1 : 10
b. 1 : 100
c. 1 : 1000
d. 1 : 10 000
e. 1 : 100 000
f. 1 : 5000
g. 1 : 60 000
h. 1 : 400
i. 1 : 750 000
j. 1 : 2 000 000

2. Write the following as ratio scales.

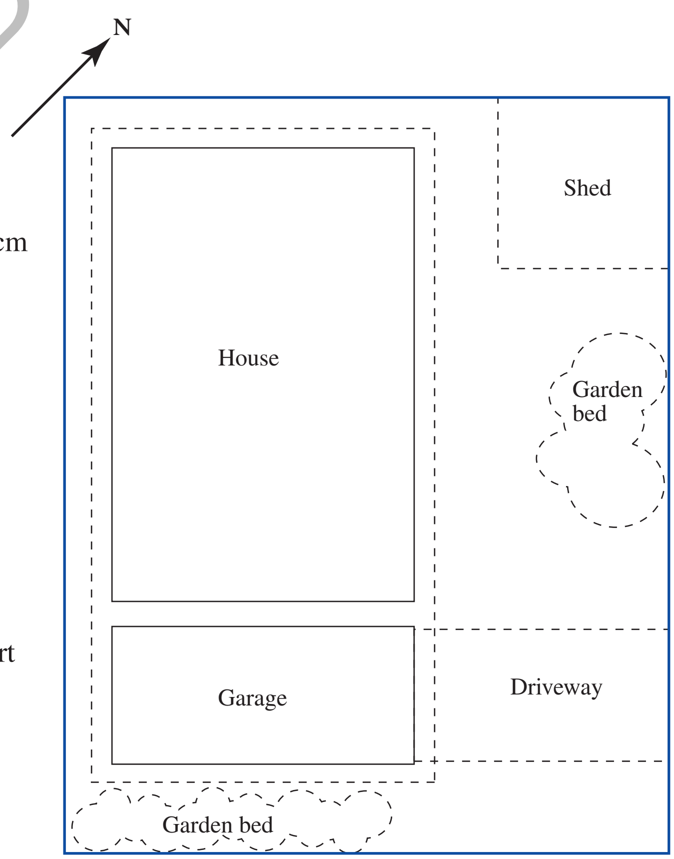
a. 1 cm ⇔ 20 cm
b. 1 cm ⇔ 50 000 cm
c. 1 cm ⇔ 10 m
d. 1 cm ⇔ 200 m
e. 1 cm ⇔ 5 km
f. 1 cm ⇔ 50 km
g. 1 cm ⇔ 5.5 km
h. 2 cm ⇔ 2 km
i. 2 cm ⇔ 25 km
j. 3 cm ⇔ 6 km

3. WE2 The scale of a town plan is given as 1 : 100 000. Use this to find the distances on the plan between:

a. two intersections that are 1 km apart
b. two department stores that are 200 m apart
c. an airport and a motel that are 15 km apart
d. a service station and a bank that are 2.5 km apart
e. the northern and southern extremities, which are 22 km apart
f. two shops that are 500 m apart.

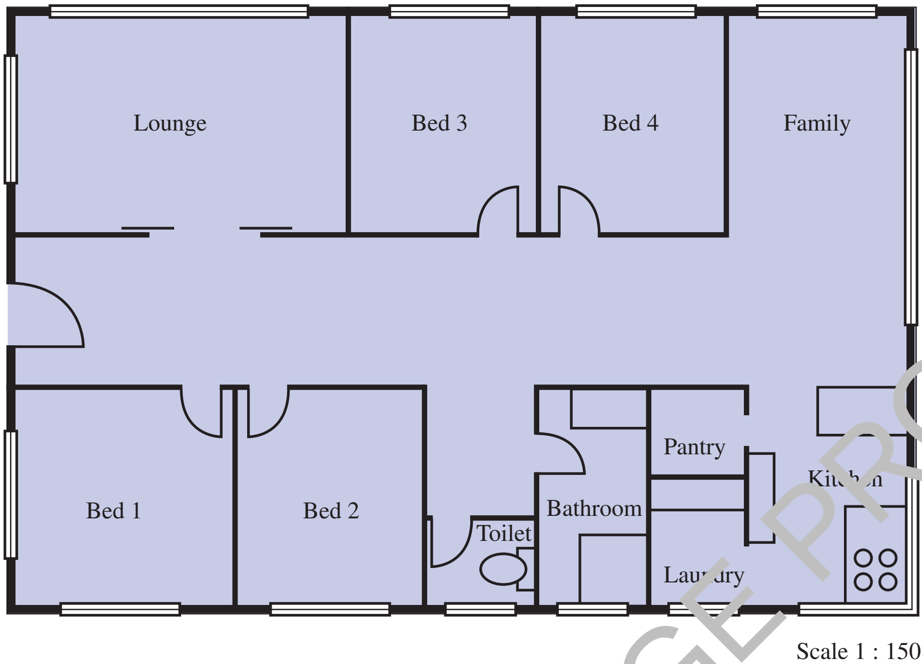
4. WE3 Below is the site plan for a block of land.

a. What are the dimensions of the block of land?
b. What are the dimensions of the house?



Scale 1 : 250

5. A house plan is shown below.



a. Calculate the dimensions of the house.
b. What are the dimensions of the lounge room?
c. Which bedroom is the largest? What are its dimensions?

6. WE4 Below is the front elevation of a house, drawn to scale.

a. Calculate the height of the peak of the roof.
b. Calculate the height of the eaves.
c. Measure the angle of the pitch of the roof.

Understanding

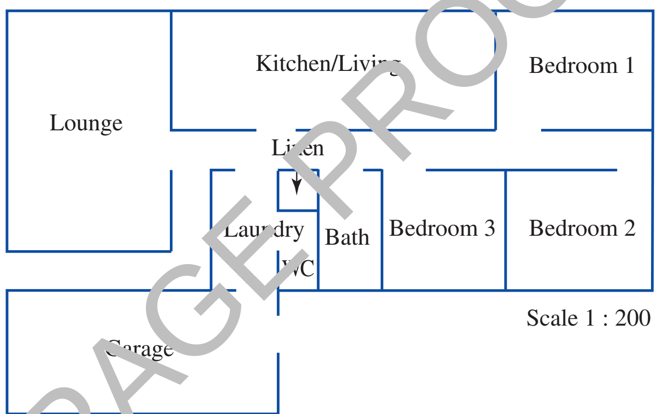
7. If a scale of 1 : 50 is used to make each of the following drawings:

a. what would be the width of the drawing of a house which is 25 m wide
b. what would be the height of the drawing of a man who is 2 m tall
c. what would be the dimensions of the drawing of a rectangular pool 50 m by 20 m
d. what would be the dimensions of the drawing of a table 4 m by 1.5 m
e. what is the actual height of a tree whose height in the drawing is 10 cm
f. what is the actual length of a truck whose length in the drawing is 25 cm
g. what are the dimensions of a television set whose dimensions on the drawing are 10 mm by 8 mm
h. what are the dimensions of a bed whose dimensions on the drawing are 4.5 cm long by 3 cm wide by 1.2 cm high?

8. Referring to the following plan of the house, find:

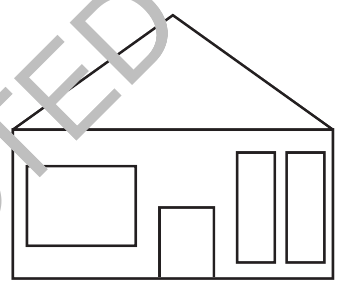
a. the dimensions of the lounge
b. the width of the hallway
c. the length of the garage
d. the floor area of the kitchen/living room
e. the total floor area of the largest bedroom.

(*Hint:* Use a ruler to find the required lengths on the plan first.)



Scale 1 : 200

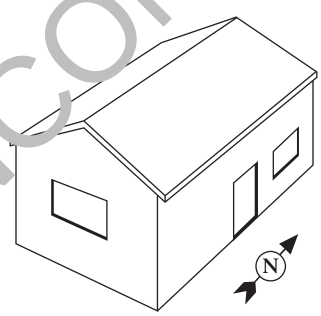
9. Trace the front elevation of the following house into your book. On your diagram write all lengths and angles necessary for the construction of the house.



Scale 1 : 200

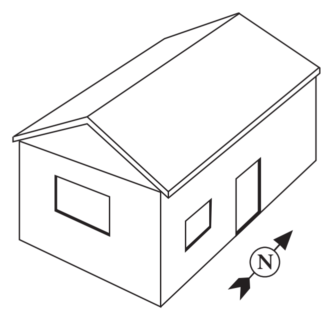
10. The following diagrams are representations of houses with a variety of roof types. Draw a plan of the south and east elevations of these houses. The direction of north is given.

a.



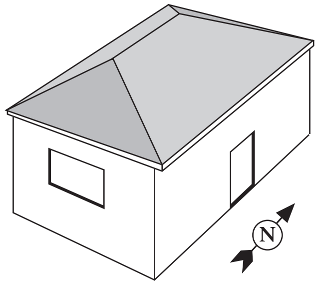
Gable roof

b.



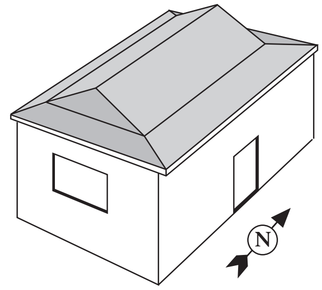
Boxed gable roof

c.



Hip roof

d.



Gambrel
(a roof combining the addition
of small gables to a hip roof)

11. Choose an area which is familiar to you, such as your home, bedroom, classroom or school grounds. Draw a plan of your area. Include a scale and a legend. Don't forget to show the northerly direction.

Reasoning

12. A rectangular room has width 3 m and length 5 m.

a. What are the dimensions of the diagram on a scale of 1 : 100?

b. What is the area of the rectangle on the diagram?

c. The diagram has been enlarged so that the dimensions of the new diagram are double the dimensions of the first diagram. What is the area of the rectangle on the new diagram?

d. Calculate the area of a rectangle with dimensions three times bigger than the original diagram.

e. How does enlargement affect the area of a shape?

13. What would happen to the value of an area of a surface if its dimensions were reduced by a factor n?

Problem solving

14. Athena the artist paints portraits. For her present subject, Seth, she uses the following measurement relationships.

- Seth's arm span is the same length as his height.
- The length of Seth's hand is one-tenth of his height.
- The distance across Seth's shoulders is one-quarter his height.

What is the relationship between Seth's arm span, the length of his hand and the distance across his shoulders?

15. Mikaela wants to buy a new fridge that is 800 mm deep and 1 m wide. She is restricted, though, by the kitchen space. The place for the fridge, on the diagram, has dimensions 1.5 cm depth and 2 cm width. If the scale of the drawing is 1:50, will this fridge fit in the space given? State the actual dimensions of the fridge space.

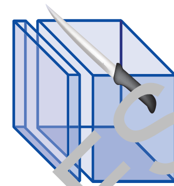
Reflection

Why is it important to show the position of north on a plan?

> **CHALLENGE 17.1**
>
> A map is photocopied and reduced to 70 per cent of its original size. After the reduction, two towns are 3.5 cm apart and the scale ruler shows that 1.4 cm represents 150 km. Find the actual distance between these two towns and how far apart they were on the original map.

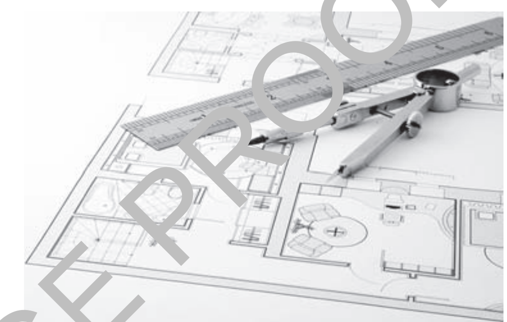
17.3 Plans and views

17.3.1 Prisms



- A prism is a 3-dimensional figure that can be cut into parallel slices or cross-sections that are identical in size and shape.
- Objects or buildings are often constructed by combining prisms.

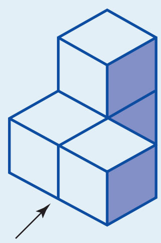
17.3.2 Plans and views

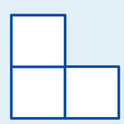
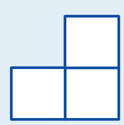
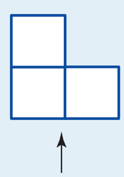


- An object can be viewed from different angles.
- Architects and draftspersons often draw plans of building sites and various objects when viewed from the front, the side or the top.
- The **front view**, or **front elevation**, is what you see if you are standing directly in front of an object.
- The **side view**, or **side elevation**, is what you see if you are standing directly to one side of the object. You can draw the left view or the right view of an object.
- The **top view**, or **bird's eye view**, is what you see if you are hovering directly over the top of the object looking down on it.

WORKED EXAMPLE 5

The following object is made from 4 cubes.
Draw plans of it showing:
a the front view
b the right view
c the top view.

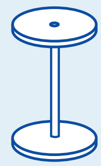


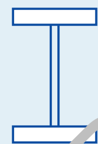
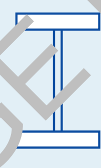
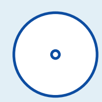
THINK	DRAW
a Make this shape using cubes. Place the shape at a considerable distance and look at it from the front (this way you can see only the front face of each cube). Draw what you see. (Or simply imagine looking at the shape from the front and draw what you see.)	**a**  Front view
b Look at your model from the right, or imagine that you can see only the right face of each cube and draw what you see.	**b**  Right view
c Look at your model from the top, or imagine that you can see only the top face of each cube. Draw what you see.	**c**  Top view Front

- Figures such as the one in Worked example 5 can be drawn using isometric dot paper. This will help to give the 3-dimensional perspective of the object.

WORKED EXAMPLE 6

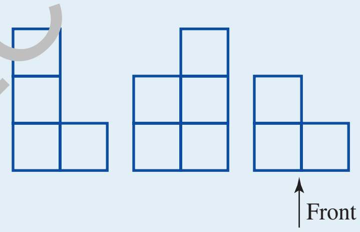
Draw:
i the front view
ii the right view
iii the top view of this solid.

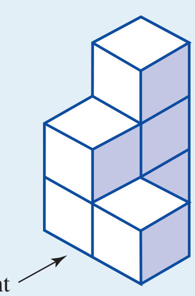


THINK	DRAW
1 Find an object of similar shape, or visualise the object in your head.	 Front view
2 Whether viewed from the front, or from the right of the object, the cylindrical shaft will appear as a long thin rectangle. The circular discs will also be seen as a pair of identical rectangles. So the front view and the right view are the same.	 Right view
3 When the object is viewed from above, all we can see is the flat surface of the top disc; that is, a large and a small circle with the same centre. (Note that such circles are called concentric.)	 Top view

WORKED EXAMPLE 7

The front, right and top views of a solid are shown. Use cubes to construct the solid.


Front
Front view
Right view
Top view

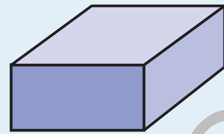
THINK	CONSTRUCT
1 Use cubes to construct the solid.	
2 Check carefully that your solid matches each of the 3 views you are given. Make adjustments if necessary.	Front

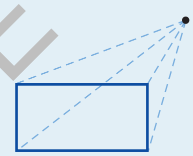
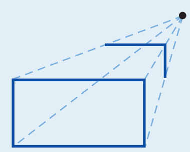
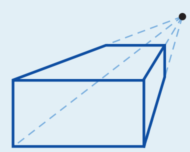
17.3.3 Perspective drawing

- A 2-**dimensional representation** of a 3-**dimensional object** can be made using a single-point perspective. This shows the object as it appears to the eye in reality. When we look at a picture of a scene, the objects seem to converge or move towards a point in the distance. This point is called a vanishing point.

WORKED EXAMPLE 8

Construct a perspective drawing of the rectangular prism shown.



THINK	DRAW
1 Draw the front face of the prism as a rectangle.	
2 Take a vanishing point in the distance behind the object and slightly to the right. Draw dotted lines from this point to the corners of the front face of the prism.	
3 On these dotted lines, make the following markings. Draw the top edge of the back face parallel to the top edge of the front face. Also draw the right edge of the back face parallel to the right edge of the front face.	
4 Join the top and right-side vertices of the front face to the corresponding vertices of the back face.	

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Exercise 17.3 Plans and views

assesson

Individual pathways

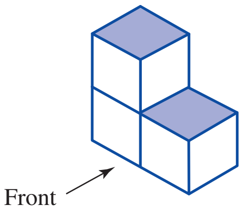
PRACTISE	CONSOLIDATE	MASTER
Questions: 1, 2, 3, 4, 5, 6, 11, 12	Questions: 1, 2, 3, 4, 5, 6, 9, 11, 12	Questions: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

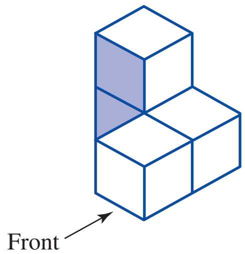
Individual pathway interactivity: int-4392 — **learnon** ONLINE ONLY

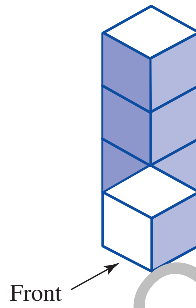
To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note*: Question numbers may vary slightly.

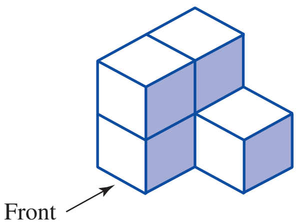
Fluency

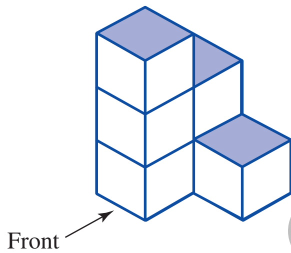
1. WE5 The following objects are made from cubes. For every object draw the plans, showing the front view, the right view and the top view. (You may wish to use a set of cubes or building blocks to help you.)

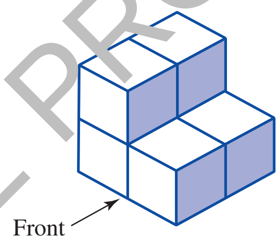
a. 

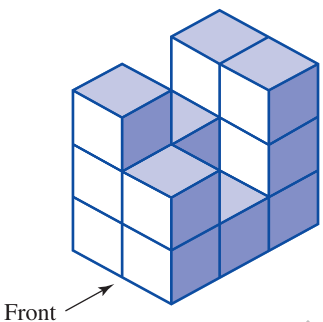
b. 

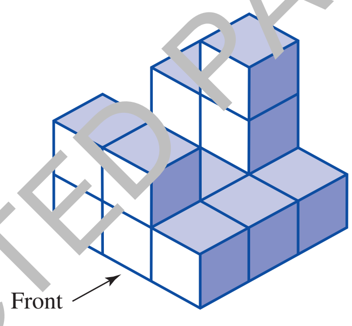
c. 

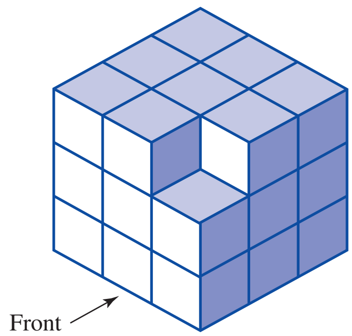
d. 

e. 

f. 

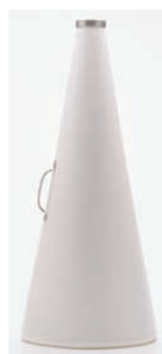
g. 

h. 

i. 

2. WE6 Draw the front, right and top views of each solid shown.

a. 

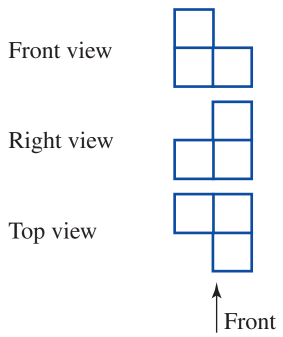
b. 

c. 

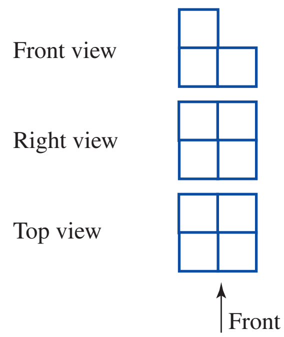
d. 

3. **WE7** The front, right and top views of a solid are shown. In each case, use cubes to construct the solid.

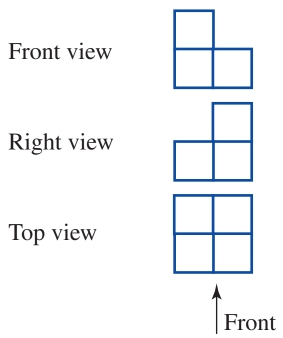
a.



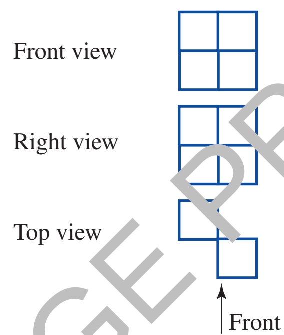
b.



c.



d.

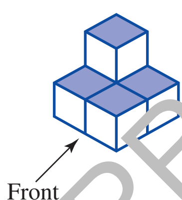


4. **WE8** Construct a perspective drawing of a cube.

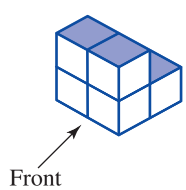
Understanding

5. **MC** The front, right and top views of a solid are shown. Which of the given drawings could represent the solid?

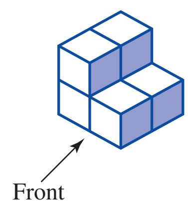
A.



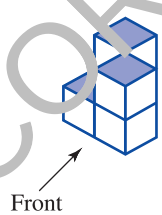
B.



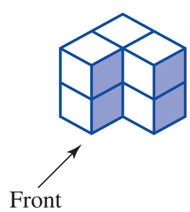
C.



D.



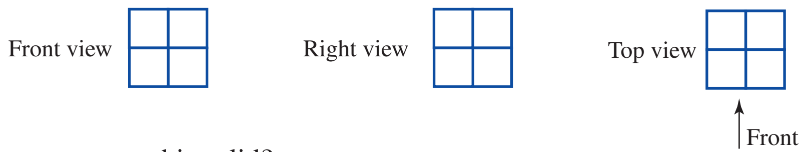
E.



6. a. What shape is the top view of a telephone pole?
   b. What shape is the top view of the Melbourne Cricket Ground?
   c. What shape is the side view of a bucket?
   d. What shape is the top view of a car?

7. a. Draw the side view of this pool table.
   b. Draw the front view of your house (seen from the street).
   c. Draw the side view of an electric kettle.
   d. Draw the top view of your television set.

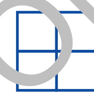
8. A shape is made using only 4 cubes. Its front view, right view and top view are shown.



a. Is it possible to construct this solid?
b. Describe or draw what this solid would look like.

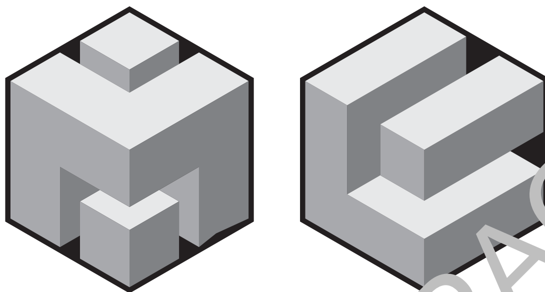
Reasoning

9. Explain why a 3-D object requires three to six diagrams to clearly represent its views.
10. How many objects can you construct using the top view shown? Explain your answer with the use of diagrams.

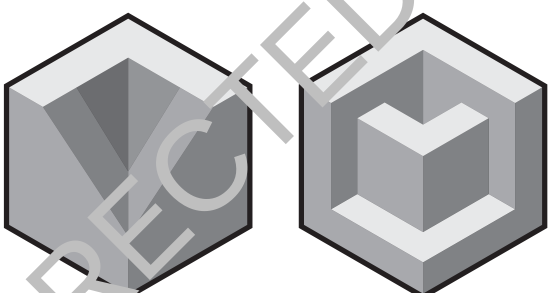


Problem solving

11. Draw top, front and side views for the 3-D objects given.



12. Draw top, front and side views for the 3-D objects given.

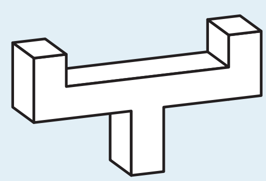


Reflection

Why is the technique of perspective drawing frequently used in artistic paintings?

CHALLENGE 17.2

Using the following diagram, draw its plan, showing the front view, right view and top view.



17.4 Isometric drawing

- When working with 3-dimensional models and designs, it is often useful to have the design or model drawn on paper (that is, in 2 dimensions).
- An **isometric drawing** is a 2-dimensional drawing of a 3-dimensional object.
- This picture shows an architect's drawing of a beach hut and environs in isometric view superimposed on the actual hut. Architects and draftspersons often use isometric drawings to give their clients a clear picture of the proposed design.

WORKED EXAMPLE 9

First copy the incomplete figure (Figure 1) onto isometric dot paper. Complete the isometric drawing of the object (Figure 2).

FIGURE 1

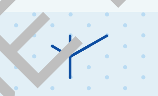
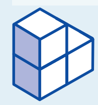


FIGURE 2



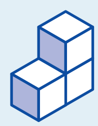
THINK

Study the object and identify the lines that have already been drawn. Fill in the missing lines on your isometric drawing to match the object.

DRAW

WORKED EXAMPLE 10

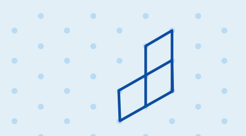
Draw the following object on isometric dot paper. (You could construct it first from a set of cubes.)



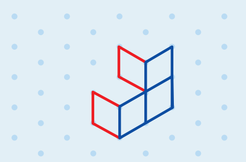
THINK

1 Use cubes to make the object shown (optional). Draw the front face of the object. The vertical edges of the 3-dimensional object are shown with vertical lines on the isometric drawing; the horizontal edges are shown with the lines at an angle (by following the dots on the grid paper).

DRAW



2 Draw the left face of the object.



3 Add the top face to complete the isometric drawing of the object.

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Searchlight ID: doc-6561

Exercise 17.4 Isometric drawing

assessON

Individual pathways

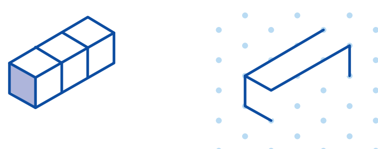
PRACTISE	CONSOLIDATE	MASTER
Questions: 1, 2, 3, 4, 5, 8, 11	Questions: 1, 2, 3a, c, 4, 5, 6, 8, 9, 11	Questions: 1, 2, 3b, d, 4, 5, 6, 7, 8, 9, 10, 11

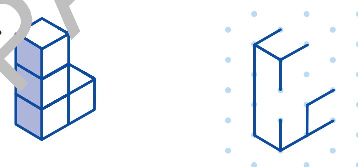
Individual pathway interactivity: int-4393 learnON ONLINE ONLY

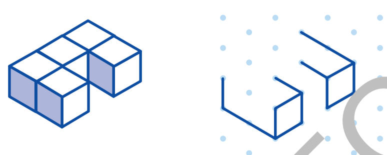
To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note*: Question numbers may vary slightly.

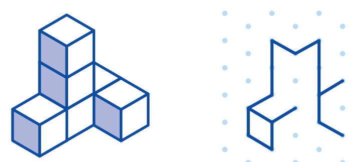
Fluency

1. WE9 Copy the following figures onto isometric dot paper and complete the isometric drawing of the objects shown.

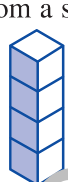
a.


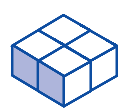
b.


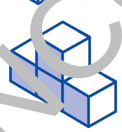
c.


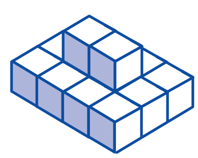
d.


2. WE10 Draw each of the following objects on isometric dot paper. (You might wish to make them first from a set of cubes.)

a.


b.


c.


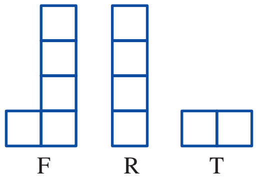
d.


Understanding

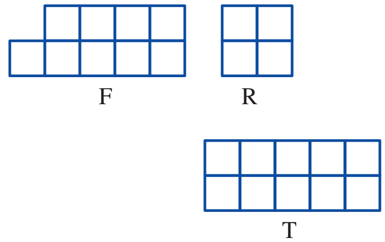
3. Construct the following letters using cubes, and then draw the solids on isometric dot paper:
  a. the letter T with 5 cubes
  b. the letter L with 7 cubes
  c. the letter E with 10 cubes
  d. the letter H with 7 cubes.

4. Draw these objects, whose front (F), right (R) and top (T) views are given, on isometric dot paper.

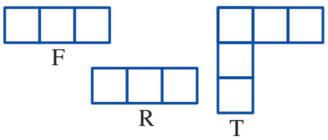
a.



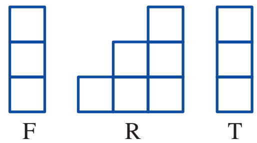
b.



c.

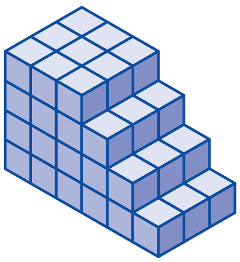


d.

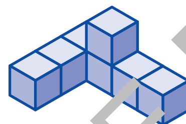


5. Draw the front, right and top views of these objects.

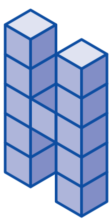
a.



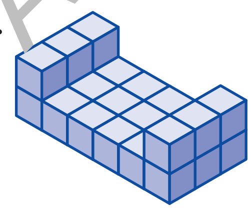
b.



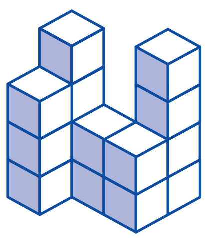
c.



d.



6. Draw the following figure on isometric dot paper.

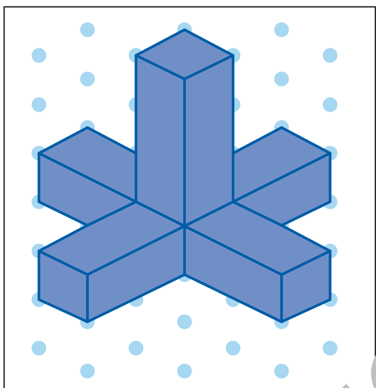


7. Draw a selection of buildings from this photograph of a city skyline on isometric dot paper.

Reasoning

8. On the same isometric dot paper draw the two wooden boxes shown.

9. Draw top, front and side views of the object shown in the following isometric drawing.



Problem solving

10. Sam has a set of wooden cube blocks he uses to build different shapes. His sister Chris challenged him to see how many different ways he could stack 4 cubes. He can only stack them on top of each other or side by side — not one behind the other. The arrangements must be different and not simply a mirror image or rotation of another shape. Draw the different arrangements possible.

11. Jonah is building a brick wall as shown in the following photograph. Draw this part of the wall on isometric dot paper.

Reflection

How does isometric dot paper turn two-dimensional lines into a three-dimensional image?

17.5 Review

A concept map summary of this topic is available as a digital document.

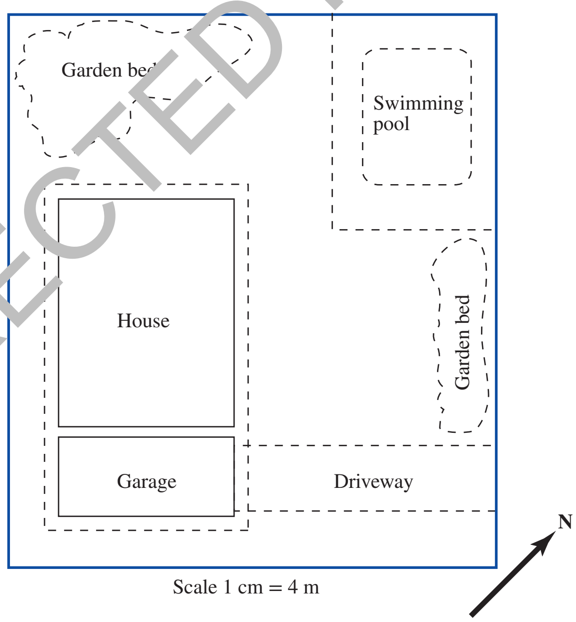
17.5.1 Review questions

Fluency

1. The scale on a map is given as 1 : 100 000. Find the actual distances between:
   a. two schools that are 5 cm apart on the map
   b. two parks that are 2.5 cm apart on the map
   c. two farms that are 4 cm apart on the map.
2. A scale of 1 : 200 is used to make models of a tree and a car.
   a. What would be the length of the model car if the car is actually 2.5 metres long?
   b. What would be the height of the model tree if the tree is actually 6.5 metres tall?

Problem solving

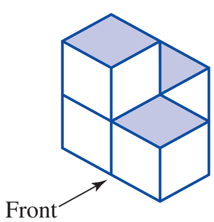
1. On a town plan, the scale is given as 1 : 200 000.
   a. Find the actual distances between two schools that are 4.5 cm apart on the plan.
   b. Find the distance on the plan between two parks that are 2.5 km apart.
2. The scale diagram below is a site plan for a block of land on which a house is to be built. Use this diagram to answer the following questions.
   a. Calculate the dimensions of the block of land.
   b. Calculate the dimensions of the house.
   c. Calculate the area of the house in square metres.
   d. In which direction would you be travelling as you drive into the garage?



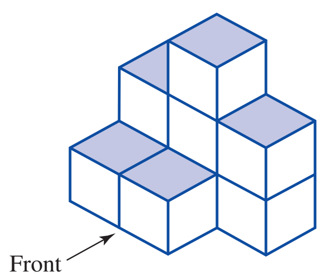
Scale 1 cm = 4 m

3. Draw the front, side and top views of each of these solids.

a.

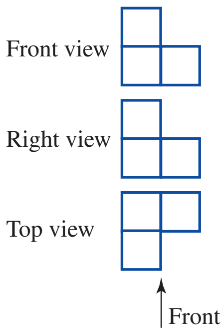


b.

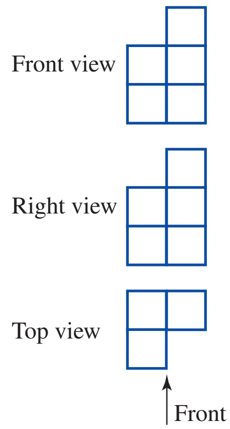


4. The front, side and top view of a solid are shown. Construct this solid, using blocks.

a.

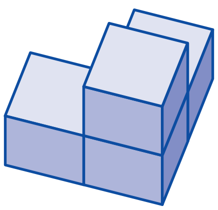


b.

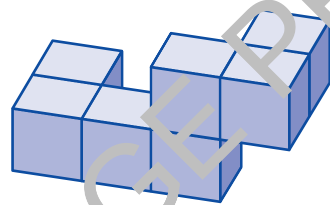


5. Draw the front, right and top views of these objects.

a.

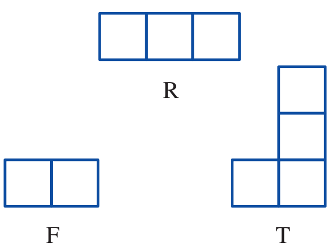


b.

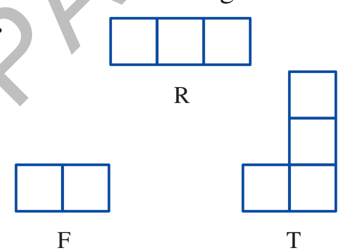


6. Draw isometric views of the objects, whose front, right and top views are given below.

a.



b.



7. A rectangular prism, constructed from the set of cubes, is 3 cubes long, 2 cubes wide and 4 cubes high. Draw an isometric view of the prism.

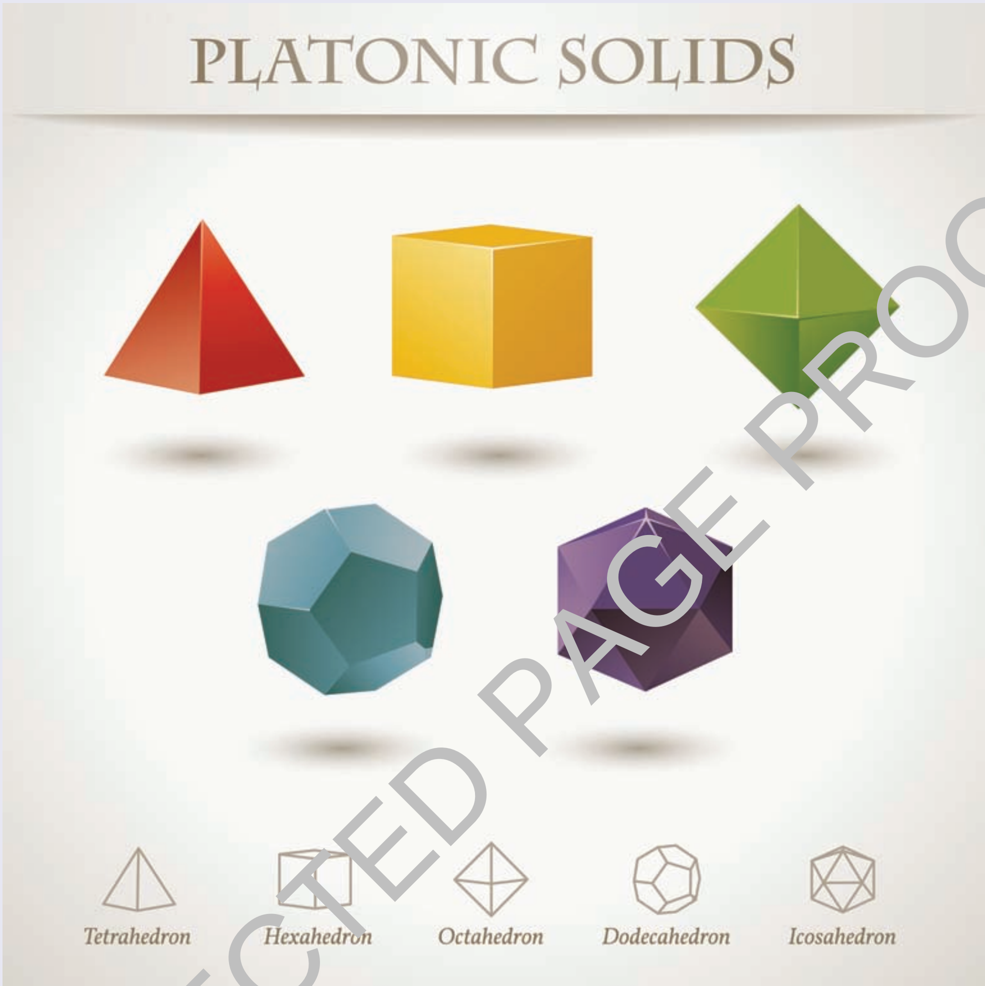
Language

It is important to learn and be able to use correct mathematical language in order to communicate effectively. Create a summary of the topic using the key terms below. You can present your summary in writing or using a concept map, a poster or technology.

converge
dimensions
elevation
front view
isometric drawing
legend
map scale
perspective
plan
ratio
scale factor
side view
top view
vanishing point

Investigation | Rich task

Making a truncated octahedron



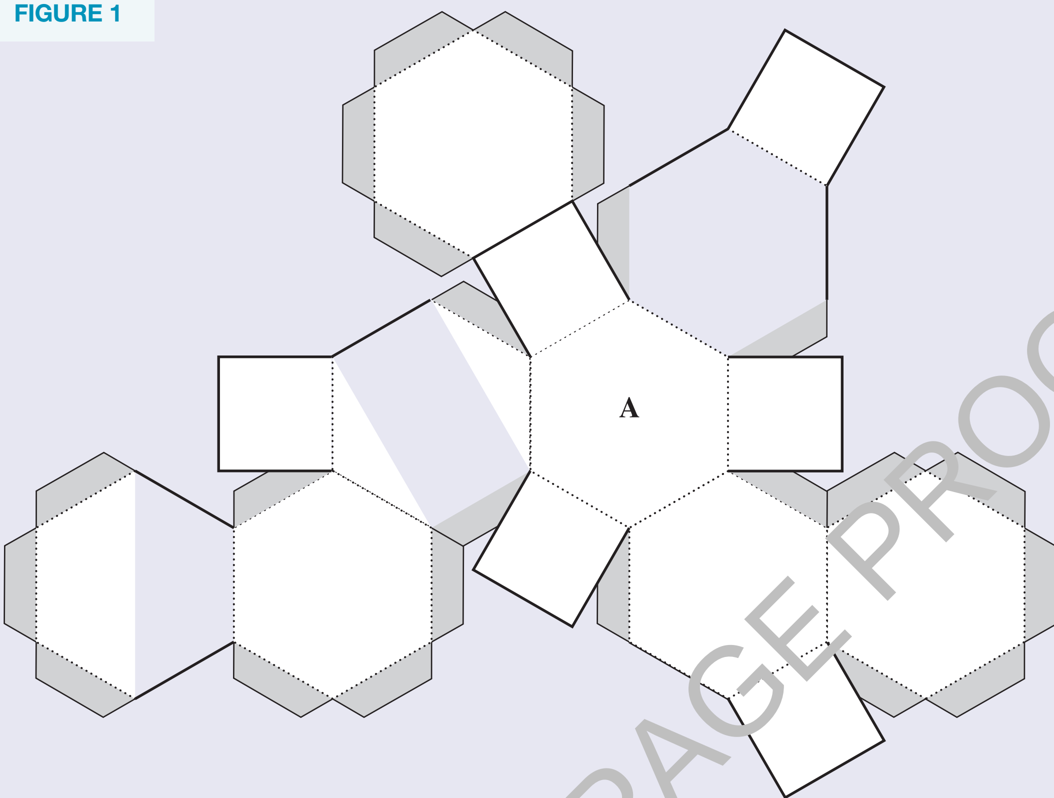
A truncated octahedron is formed when the vertices of an octahedron are cut off. *Truncate* means to cut off. New square faces form when the vertices are cut off, producing the truncated octahedron as shown in figure 3.

Copy the net that appears in figure 1 onto stiff cardboard. Cut along the solid outer lines, taking care not to cut the tabs off. Fold upwards along the dotted lines. The best way to fold is to rule a pen along the dotted lines first and then fold upwards. Starting at the central hexagon (labelled *A*), fold each of the surrounding shapes upwards. The 3-dimensional shape will begin to take shape. Glue or sticky-tape the tabs to the inside of each adjoining face.

Carefully examine the net of the truncated octahedron shown in figure 1.

1. What shapes does it contain?
2. How many of each shape are there?
3. When you have constructed your solid, state the number of faces, vertices and edges associated with the shape.

FIGURE 1



A smaller version of your net is shown in figure 2, along with the solid form (figure 3).

FIGURE 2

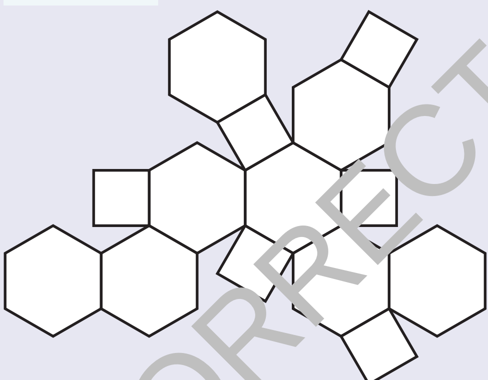
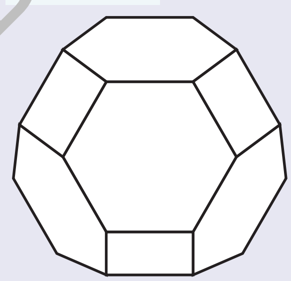


FIGURE 3



4. Choose a colour pattern, using at least three different colours for your net. Show how it will appear on the three-dimensional solid.

5. Investigate other basic three-dimensional shapes and try to construct them using straws. Provide a name and a plan of your shapes' nets.

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Try out this interactivity: Crossword
Searchlight ID: int-2743

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Searchlight ID: int-3177

Answers

Topic 17 Views of 3-D shapes

Exercise 17.2 Scales and house plans

1. a. 1 cm ⇔ 10 cm **b.** 1 cm ⇔ 1 m **c.** 1 cm ⇔ 10 m **d.** 1 cm ⇔ 100 m **e.** 1 cm ⇔ 1 km
f. 1 cm ⇔ 50 km **g.** 1 cm ⇔ 600 m **h.** 1 cm ⇔ 4 km **i.** 1 cm ⇔ 7.5 km **j.** 1 cm ⇔ 22 km

2. a. 1 : 20 **b.** 1 : 50 000 **c.** 1 : 1000 **d.** 1 : 20 000 **e.** 1 : 500 000
f. 1 : 5 000 000 **g.** 1 : 550 000 **h.** 1 : 100 000 **i.** 1 : 125 000 **j.** 1 : 200 000

3. a. 1 cm **b.** 2 mm **c.** 15 cm
d. 2.5 cm **e.** 22 cm **f.** 5 mm

4. a. 20 m × 25 m **b.** 10 m × 15 m

5. a. 18 m × 12 m **b.** 6.75 m × 4.5 m **c.** Bed 1 — 4.5 m × 4.5 m

6. a. 8.5 m **b.** 3.5 m **c.** 40°

7. a. 50 cm **b.** 4 cm **c.** 100 cm × 40 cm **d.** 8 cm × 3 cm
e. 5 m **f.** 12.5 m **g.** 50 cm × 40 cm **h.** 2.25 m × 1.5 m × 0.6 m

8. a. 6 m × 4 m **b.** 1 m **c.** 6.8 m **d.** 24 m^2 **e.** 12 m^2

9. Check with your teacher.

10. Check with your teacher.

11. Check with your teacher.

12. a. 3 cm and 5 cm **b.** 15 m^2 **c.** 60 m **d.** 135 m^2

e. If the dimensions double, the area becomes four times larger. If the dimensions are three times bigger, the area becomes nine times larger. If the dimensions are enlarged by a factor n, the area is enlarged by a factor n^2.

13. If the dimensions were reduced by a factor n, the area would be reduced by a factor n^2.

14. Seth's arm span is 10 times the length of his hand and 4 times the distance across his shoulders.

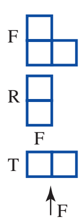
15. No. Depth is 750 cm, width is 1 m.

Challenge 17.1

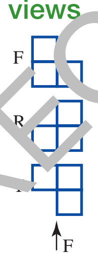
The towns were 5 cm apart on the original map. They are actually 375 km apart.

Exercise 17.3 Plans and views

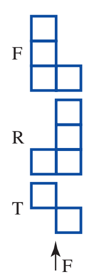
1. a.



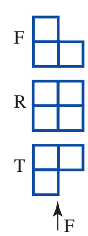
b.



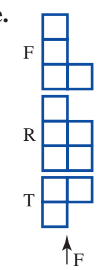
c.



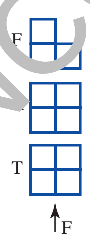
d.



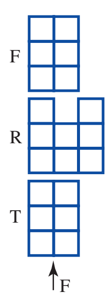
e.



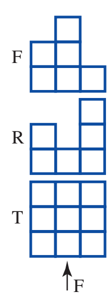
f.



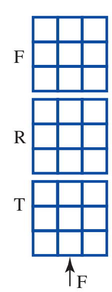
g.



h.



i.



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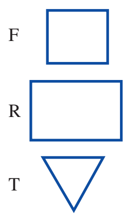
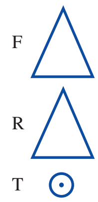
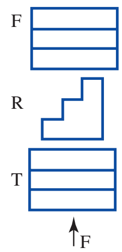


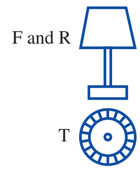
b.



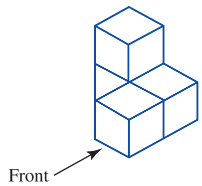
c.



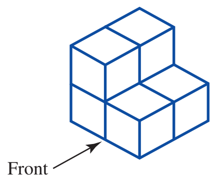
d.



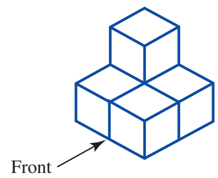
3. a.



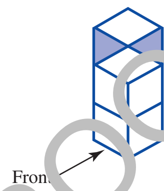
b.



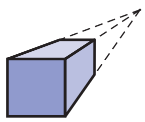
c.



d.



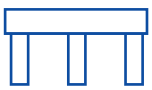
4.



5. D

6. a. Circle **b.** Oval **c.** Trapezium **d.** Rectangle

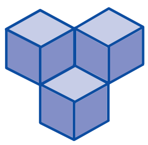
7. a.



b–d Various answers

8. a. It would be difficult to construct this solid.

b.

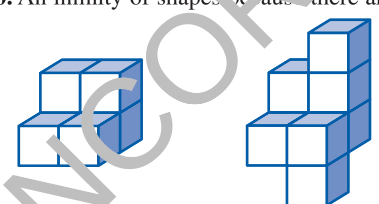


The solid would look like the one shown. The 4th cube is behind the front bottom cube, resting on the surface. The two top cubes have no cubes supporting them.

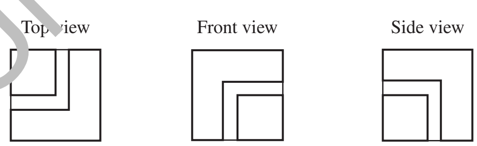
9. Usually a 3-D object will require only 3 views as normally the front and back faces are identical, the top and bottom faces are identical, and the left and right faces are identical.

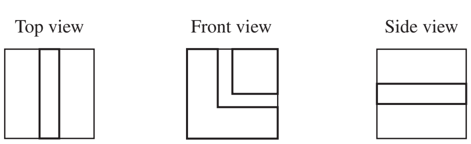
There are instances when an object has no identical faces. In these situations all views have to be drawn in order to show the details of each face.

10. An infinity of shapes because there are no restrictions on the other two views.

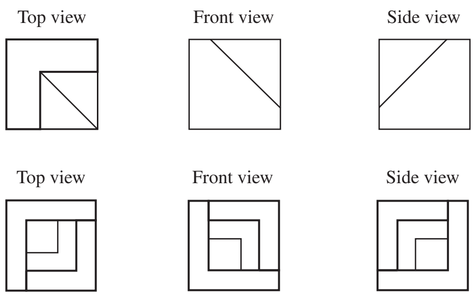


11.

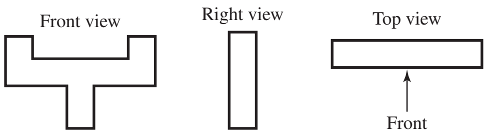




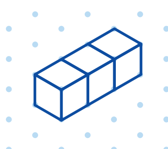
12.

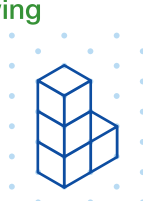


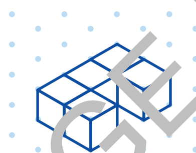
Challenge 17.2



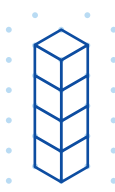
Exercise 17.4 Isometric drawing

1. a. 

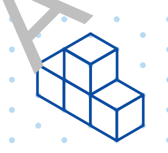
b. 

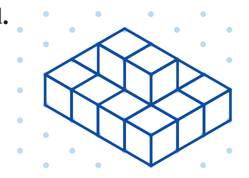
c. 

d. 

2. a. 

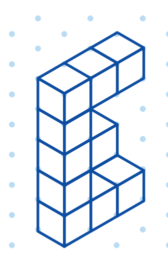
b. 

c. 

d. 

3. a. 

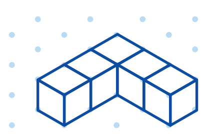
b. 

c. 

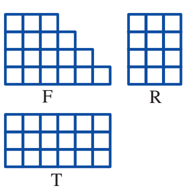
d. 

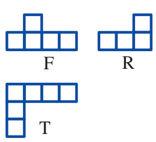
4. a. 

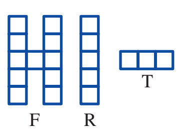
b. 

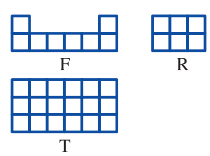
c. 

d. 

5. a. 

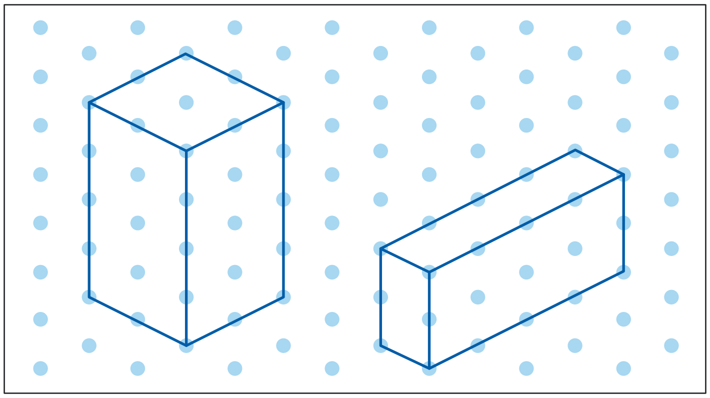
b. 

c. 

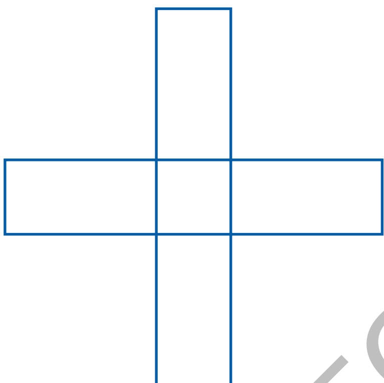
d. 

6. 

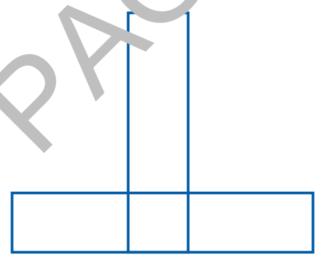
7. Check with your teacher.

8. 

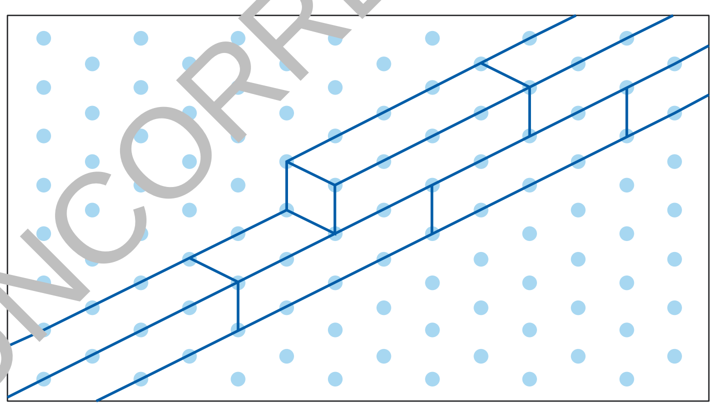
9. Top view



Front and side views



10. 4

11. 

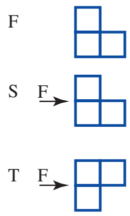
17.5 Review

1. **a.** 5 km **b.** 2.5 km **c.** 4 km
2. **a.** 1.25 cm **b.** 3.25 cm

3. a. 9 km **b.** 1.25 cm

4. a. 30 m 3 26 m **b.** 9.6 m 9 12 m **c.** 115.2 m^2 **d.** SW

5. a.



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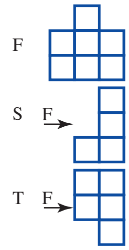
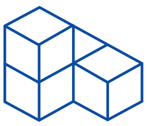


6. a.



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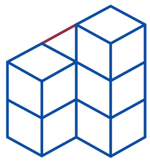
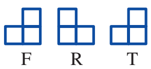


7. a.



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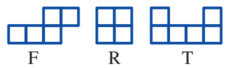
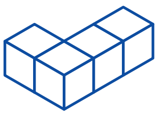


8. a.



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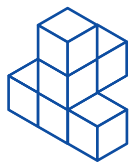
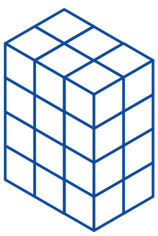


9.



Investigation — Rich task

1. Hexagons and squares

2. 8 hexagons and 6 squares

3. Faces = 14, vertices = 24, edges = 36

4. Teacher to check

5. Teacher to check