# 7

# Scale drawing

## Syllabus topic — M5 Scale drawing

This topic focuses on the use of ratios to solve problems in practical contexts, including the interpretation of scale drawings.

## Outcomes

- Express a ratio in simplest terms.
- Find the ratio of two quantities.
- Divide a quantity in a given ratio.
- Solve practical problems involving ratios.
- Use ratio to describe map scales.
- Use the scale factor of two similar figures to solve linear scaling problems.
- Obtain measurements from scale drawings.
- Interpret symbols and abbreviations on building plans and elevation views.
- Estimate and compare quantities using a scale drawing.

## Digital Resources for this chapter

In the Interactive Textbook:

- Videos
- Desmos widgets
- Literacy worksheet
- Spreadsheets
- Quick Quiz
- Study guide
- Solutions (enabled by teacher)

In the Online Teaching Suite:

- Teaching Program
- Tests
- Review Quiz
- Teaching Notes

## Knowledge check

The Interactive Textbook provides a test of prior knowledge for this chapter, and may direct you to revision from the previous years' work.

## 7A  Ratios

A ratio is used to compare amounts of the same units in a definite order. For example, the ratio 3 : 4 represents 3 parts to 4 parts or $\frac{3}{4}$ or 0.75 or 75%.

A ratio is a fraction and can be simplified in the same way as a fraction. For example, the ratio 15 : 20 can be simplified to 3 : 4 by dividing each number by 5. Equivalent ratios are obtained by multiplying or dividing each amount in the ratio by the same number.

$$\overset{\div 3 \quad \div 3}{15 : 12 = 5 : 4} \qquad \overset{\times 3 \quad \times 3}{5 : 4 = 15 : 12}$$

15 : 12 and 5 : 4 are equivalent ratios.

When simplifying a ratio with fractions, multiply each of the amounts by the lowest common denominator. For example, to simplify $\frac{1}{8} : \frac{3}{4}$ multiply both sides by 8. This results in the equivalent ratio of 1 : 6.

### RATIO

A ratio is used to compare amounts of the same units in a definite order.
Equivalent ratios are obtained by multiplying or dividing by the same number.

### Example 1: Simplifying a ratio      7A

Write the ratios in simplest form.

a   20 : 4

b   $3 : \frac{1}{2}$

c   1.5 : 3.5

**SOLUTION:**

| | | |
|---|---|---|
| **1** | Divide both sides of the ratio by 4. | **a**   $20 : 4 = 20 \div 4 : 4 \div 4$ |
| **2** | Evaluate. | $= 5 : 1$ |
| **3** | Multiply both sides of the ratio by 2. | **b**   $3 : \frac{1}{2} = 3 \times 2 : \frac{1}{2} \times 2$ |
| **4** | Evaluate. | $= 6 : 1$ |
| **5** | Multiply both sides of the ratio by 10. | $1.5 : 3.5 = 1.5 \times 10 : 3.5 \times 10$ |
| **6** | Divide both sides of the ratio by 5 (highest common factor). | **c**   $= 15 : 35 = \frac{15}{5} : \frac{35}{5}$ |
| **7** | Evaluate. | $= 3 : 7$ |

## Exercise 7A

**1** Complete each pair of equivalent ratios.

a  $1 : 3 = 4 : \square$
b  $1 : 7 = 2 : \square$
c  $2 : 5 = \square : 10$
d  $3 : 7 = \square : 21$
e  $5 : 10 = 1 : \square$
f  $12 : 16 = 3 : \square$
g  $12 : 18 = \square : 3$
h  $20 : 50 = \square : 25$
i  $4 : 7 = 44 : \square$

**2** Complete each pair of equivalent ratios.

a  $1 : 2 : 3 = 4 : \square : \square$
b  $4 : 12 : 16 = \square : 6 : \square$
c  $1 : 7 : 9 = \square : \square : 63$

**Example 1a**  **3** Write three equivalent ratios for each of the following ratios.

a  $1 : 2$
b  $2 : 5$
c  $8 : 6$

**4** Express each ratio in simplest form.

a  $15 : 3$
b  $10 : 40$
c  $24 : 16$
d  $14 : 30$
e  $8 : 12$
f  $49 : 14$
g  $81 : 27$
h  $48 : 32$
i  $17 : 51$
j  $9 : 18 : 9$
k  $5 : 10 : 20$
l  $27 : 9 : 3$

**5** Express each ratio in simplest form.

a  $\$24 : \$18$
b  3 kg to 12 kg
c  $56t : 16t$
d  40 c to 72 c
e  3 h to 1 day
f  2 mm to 1 cm
g  $1 km : 250 m$
h  $3 m : 50 cm$
i  $6 km : 300 m$
j  $7 cm : 21 mm$
k  8 months : 4 years
l  $2 L : 450 mL$

**6** There are 14 boys and 10 girls in a class. What is the ratio of:

a  boys to girls?
b  girls to boys?
c  boys to the total number?

**7** A clothing store has a discount sale. A dress marked at $250 is sold for $200. What is the ratio of the discount to the marked price?

**8** Madeleine and Nathan invest $4500 and $2500 into a managed fund. What is the ratio of Madeleine's share to Nathan's share?

**9** There were 80 blocks of land available for sale in a new land release. After one month 32 blocks have been sold. What is the ratio of sold blocks to the total number of blocks?

**10** A 5 kg bag of potatoes costs $12.80. Find the cost of:
  **a** 1 kg                              **b** 10 kg
  **c** 14 kg                             **d** 6 kg.

**11** The cost of 3 pens is $42.60. Find the cost of:
  **a** 1 pen                             **b** 4 pens
  **c** 6 pens                           **d** 10 pens.

**12** During a recent dry spell, it rained on only 3 days during the month of November.
  **a** What was the ratio of wet days to total days for the month of November?
  **b** What was the ratio of wet days to dry days for the month of November?

Example 1b **13** Express each ratio in simplest form.

  **a** $\dfrac{1}{2} : \dfrac{1}{5}$            **b** $\dfrac{2}{3} : \dfrac{3}{7}$            **c** $\dfrac{3}{4} : 1$

  **d** $\dfrac{1}{2} : \dfrac{1}{10}$           **e** $\dfrac{1}{10} : \dfrac{1}{5}$           **f** $\dfrac{2}{3} : \dfrac{3}{5}$

  **g** $1 : \dfrac{3}{4}$             **h** $\dfrac{2}{3} : 1$              **i** $\dfrac{9}{10} : 1$

**14** Express each ratio in simplest form.
  **a** $2x : x$                         **b** $3y : 9y$
  **c** $4a : 2$                        **d** $4a : 8a$
  **e** $3xy : 12x$                   **f** $7m^2 : m$

**15** A bag contains 10 green marbles, 14 blue marbles and 6 yellow marbles. What is the ratio of green to yellow to blue marbles in simplest form?

**16** In an election, Aiden scored 250 votes, Billie 175 votes and Chelsea 125 votes. Find the ratio of Aiden's votes : Billie's votes : Chelsea's votes.

**17** Samantha and Mathilde own a restaurant. Samantha gets $\dfrac{3}{5}$ of the profits and Mathilde receives the remainder.
  **a** What is the ratio of profits?
  **b** Last week the profit was $2250. How much does Mathilde receive?
  **c** This week the profit is $2900. How much does Samantha receive?

## 7B Dividing a quantity in a given ratio

Ratio problems may be solved by dividing a quantity in a given ratio. This method divides each amount in the ratio by the total number of parts.

### DIVIDING A QUANTITY IN A GIVEN RATIO

1.  Calculate the total number of parts by adding each amount in the ratio.
2.  Divide the quantity by the total number of parts to determine the value of one part.
3.  Multiply each amount of the ratio by the result in step 2.
4.  Check by adding the answers for each part. The result should be the original quantity.

### Example 2: Dividing a quantity in a given ratio    7B

Mikhail and Ilya were given $450 to share in the ratio 4:5. How much did each get?

**SOLUTION:**

1.  Calculate the total number of parts by adding each amount in the ratio (4 parts to 5 parts).

    $\text{Total parts} = 4 + 5 = 9$

    9 parts = $450

2.  Divide the quantity ($450) by the total number of parts (9 parts) to determine the value of one part.

    $1 \text{ part} = \dfrac{\$450}{9} = \$50$

3.  Multiply each amount of the ratio by the result in step 2 or $50.

    4 parts = 4 × $50 = $200

    5 parts = 5 × $50 = $250

4.  Check by adding the answers for each part. The result should be the original quantity or $450.

    ($200 + $250 = $450)

5.  Write the answer in words.

    Mikhail got $200, Ilya got $250.

### Example 3 Dividing a quantity in a given ratio    7B

A man left $6000 to be divided among his three children, Xia, Yui and Zi, in the ratio 5:8:7, in that order. How much did each get?

**SOLUTION:**

1.  Calculate the total number of parts in the ratio by adding 5 parts to 8 parts to 7 parts.

    $\text{Total parts} = 5 + 8 + 7 = 20$

    20 parts = $6000

2.  Divide the quantity ($6000) by the total number of parts (20 parts) to determine the value of one part.

    $1 \text{ part} = \dfrac{\$6000}{20} = \$300$

3.  Multiply each amount of the ratio by the result in step 2 or $300.

    5 parts = 5 × $300 = $1500

    8 parts = 8 × $300 = $2400

    7 parts = 7 × $300 = $2100

4.  Write the answer in words.

    Xia got $1500, Yui got $2400, Zi got $2100.

## Exercise 7B

**Example 2** **1** Find the total number of parts in the following ratios.

    **a** $2:9$         **b** $1:5$         **c** $11:3$         **d** $2:3:4$

**2** The ratio of girls to boys in a class is $2:7$.

    **a** What fraction of the class is girls?

    **b** What fraction of the class is boys?

**3** Calculate how much each person receives if $100 is shared in the following ratios.

    **a** $7:3$         **b** $2:3$         **c** $11:9$         **d** $7:8:10$

**4** Divide 240 into the following ratios.

    **a** $2:1$         **b** $3:2$         **c** $1:5$         **d** $7:5$

**5** Share each amount in the ratio given.

    **a** $20 in the ratio $4:1$         **b** $20 in the ratio $7:3$

    **c** $15 in the ratio $1:2$         **d** 77 drinks in the ratio $3:4$

    **e** 100 lollies in the ratio $7:13$         **f** 45 kg in the ratio $4:5$

    **g** 160 books in the ratio $5:3$         **h** 360 pencils in the ratio $2:7$

    **i** 50 g in the ratio $1:3$         **j** 60 km in the ratio $8:7$

**6** A bag of 500 grams of chocolates is divided into the ratio $7:3$. What is the mass of the smaller amount?

**7** At a concert there were 7 girls for every 5 boys. How many girls were in the audience of 8616?

**8** Divide:

    **a** $200 in the ratio $1:2:2$         **b** $400 in the ratio $1:3:4$

    **c** 12 kg in the ratio $1:2:3$         **d** 88 kg in the ratio $2:1:5$

    **e** 440 kg in the ratio $12:13:15$         **f** $63 000 in the ratio $1:2:4$.

**9** Share $600 in the ratio:

    **a** $1:9$         **b** $2:1:3$

    **c** $2:5:5$         **d** $13:8:9$.

**Example 3** **10** Molly, Patrick and Andrew invest in a business in the ratio $6:5:1$. The total amount invested is $240 000. How much was invested by the following people?

    **a** Molly         **b** Patrick         **c** Andrew

11 The ratio of residential area to parks in a local community is 17 : 3. The total area of the local community is 40 km². What is the area of parks?

12 Hayley is 15 years old and her brother is 5 years younger. If $200 is shared between them in the ratio of their ages, how much will Hayley receive?

13 In a country town, a census showed that there were 5 adults to every 7 children. If the population of the town was 7200, how many children lived there?

14 A punch is made from pineapple juice, lemonade and orange juice in the ratio 5 : 3 : 2.
   a How much lemonade is needed if one litre of pineapple juice is used?
   b How much pineapple juice is required to make 15 litres of punch?

15 Angus, Ruby and Lily share an inheritance of $500 000 in the ratio of 7 : 5 : 4. How much will be received by the following people?
   a Angus
   b Ruby
   c Lily

16 In a boiled fruit cake recipe the ratio of mixed fruit to flour to sugar is 5 : 3 : 2. A 250 g packet of mixed fruit is used to make the cake. How much sugar and flour are required?

17 A delivery load of 8.5 tonnes is to be divided between two stores in the ratio 11 : 6. How much will each store receive?

18 The load on a bridge is applied in three positions, A, B and C, in the ratio 5 : 7 : 5. If the total load on the bridge is 782 tonnes, what is the load taken at each point?

19 A jam is made by adding 5 parts fruit to 4 parts of sugar. How much fruit should be added to $2\frac{1}{2}$ kilograms of sugar in making the jam?

## 7C  Similarity and scale factors

The pictures of the three pieces of cake are similar. Similar figures are exactly the same shape but they are different sizes.

When we enlarge or reduce a shape by a scale factor, the original and the image are similar. Similar shapes have:

- corresponding angles of equal size
- corresponding sides of different size, but in the same ratio or proportion.
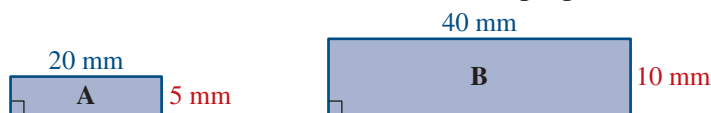
For example, the above rectangles are similar. All the angles are 90°. The corresponding sides are in the same ratio $\left(\dfrac{10}{5} = \dfrac{40}{20} = 2\right)$. The measurements in rectangle B are twice the measurements in rectangle A. Rectangle B has been enlarged by a scale factor of 2.

### SIMILAR FIGURES

- Similar figures are exactly the same shape but are a different size.
- Corresponding (or matching) angles of similar figures are equal.
- Corresponding (or matching) sides of similar figures are in the same ratio.
- Scale factor is the amount the first shape is enlarged or reduced to get the second shape.

We can also compare the ratio of the area of the rectangles.

Area rectangle A $= 100\,\text{mm}^2$

Area rectangle B $= 400\,\text{mm}^2$

Ratio of areas $= \dfrac{400}{100} = 4$

The area of rectangle A has been enlarged by a scale factor of 4.

We notice that, as the length dimensions are enlarged by a scale factor of 2, the area is enlarged by a scale factor of $2^2 = 4$.

### USING SCALE FACTOR FOR AREA

When all the dimensions are multiplied by a scale factor of $k$, the area is multiplied by a scale factor of $k^2$.

## Example 4: Calculating the scale factor     7C

What is the scale factor for these two similar rectangles?
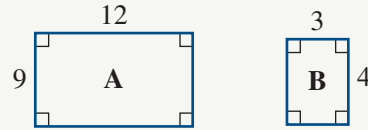


**SOLUTION:**

**1**   Look carefully at the similar figures.

Rectangle B is smaller than rectangle A and is rotated.

**2**   Match the corresponding sides.

9 matches with 3 and 12 matches with 4.

**3**   Write the matching sides as a fraction (measurement in rectangle B divided by the matching measurement in rectangle A).

Scale factor $= \dfrac{3}{9}$ or $\dfrac{4}{12}$

**4**   Simplify

$= \dfrac{1}{3}$ (or $1 : 3$)

## Example 5: Using a scale factor for length     7C

What is the length of the unknown side in the pair of similar triangles?



**SOLUTION:**

**1**   Match the corresponding sides.

8 matches with 48

**2**   Write the matching sides as a fraction (second shape to the first shape). This fraction is the scale factor.

Scale factor $= \dfrac{48}{8}$

**3**   Simplify

$= 6$ (or $6 : 1$)

**4**   Match the corresponding side for $x$.

$x = 10 \times 6$    $x$ matchs side marked

$= 60$      with a 10.

**5**   Calculate $x$ by multiplying 10 by 6 (scale factor is 6).

## Example 6: Using a scale factor for area     7C

The two given triangles are similar.
The area of the small triangle is $3 \, cm^2$.
What is the area of the larger triangle?
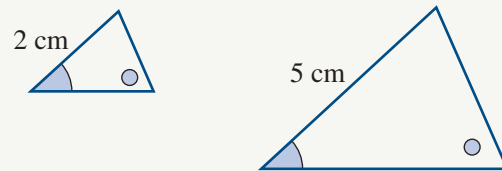


**SOLUTION:**

**1**   Match the corresponding sides.

2 matches with 5

**2**   Write the matching sides as a fraction (second shape to the first shape). This fraction is the scale factor.

Scale factor $= \dfrac{5}{2}$

**3**   Calculate the area by multiplying 3 cm$^2$ by the square of the scale factor.

Area $= 3 \times \left(\dfrac{5}{2}\right)^2 = 18.75 \, cm^2$

## Exercise 7C

**1** Match the each shape A to I with its similar shape 1 to 8.
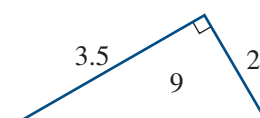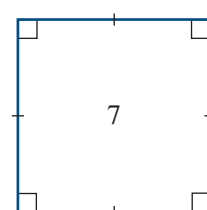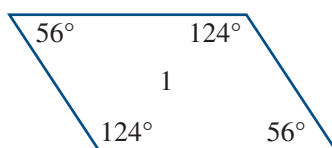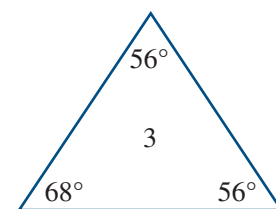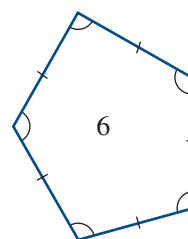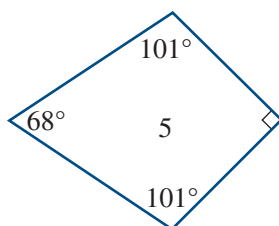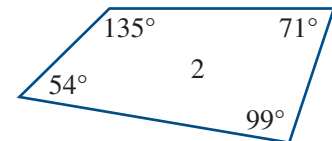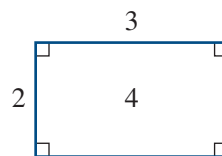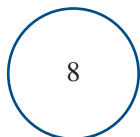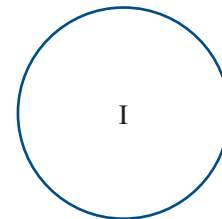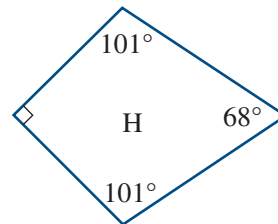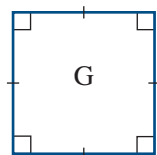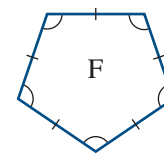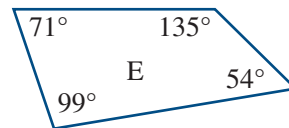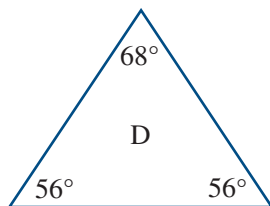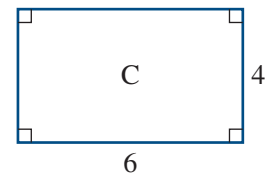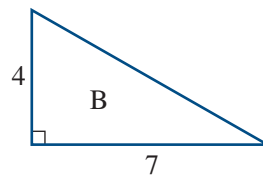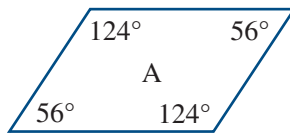
**Example 4**   **2**   What is the scale factor for the following pairs of similar figures?

**a**

4

8

**b**

12

3

**c**

1

2

4

8

**d**

15

12

5

4

**e**

2

124°

56°

56°

4

6

124°    56°

56°

3

**f**

72°

45°    63°

12

9

4

63°

3    72°

45°
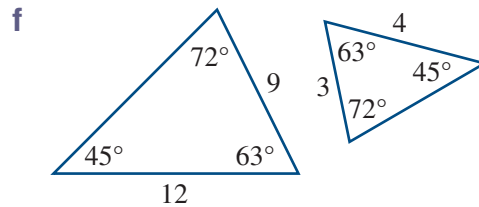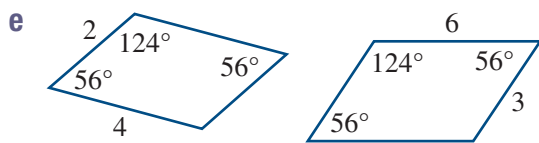
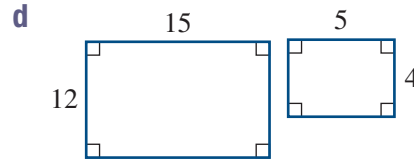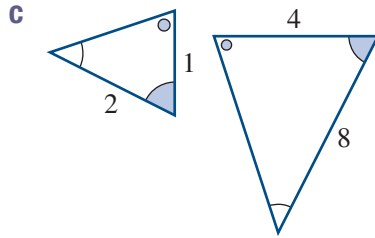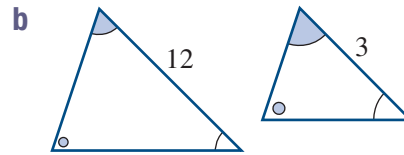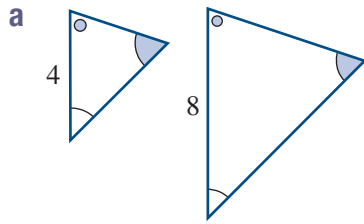**Example 5**   **3**   Use the scale factor to find the length of the unknown side in the following pairs of similar figures.

**a**

6

$a$

3

1

**b**

2

$b$

6

9

**c**

101°    10

68°

101°    10

101°    $c$

68°

101°    15

**d**

68°

$d$

56°    56°

45

6    56°

68°    9

56°
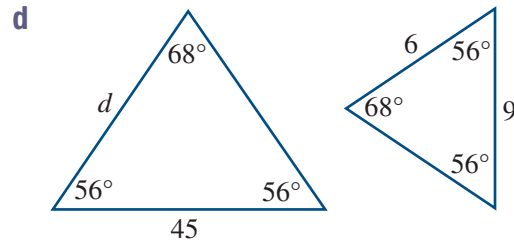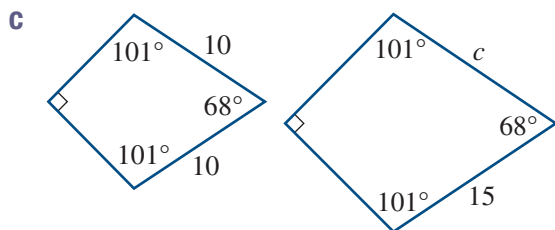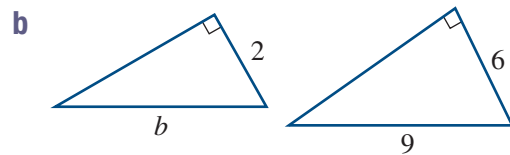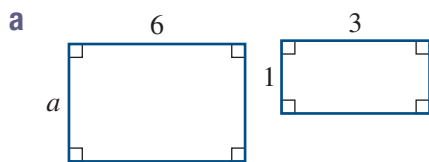
**4** A data projector is used to display a computer image measuring 12 cm by 15 cm onto a screen. The scale factor used by the data projector is 1 : 9. What are the dimensions of the screen?

**5** A toy yacht consists of two sails with measurements and angles as shown opposite.
   **a** In what way are the two sails similar in shape?
   **b** Find the scale factor for the side lengths of the sails.
   **c** Find the length of the longest side of the large sail.



15 cm
10 cm
20 cm
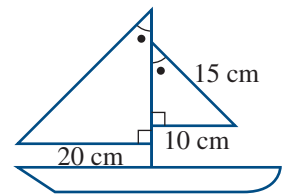
**6** A tall palm tree is held in place with two cables of length 6 m and 4 m as shown.
   **a** In what way are the two triangles created by the cables similar in shape?
   **b** Find the scale factor for the side lengths of the cables.
   **c** Find the height of the point above the ground where the longer cable is attached to the palm tree.



6 m
4 m
3 m
60°   60°
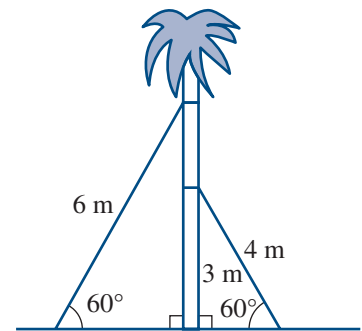
**Example 6** **7** The two given triangles are known to be similar. Find the area of the larger triangle.

**a**
1
2
$x$
area = 4 cm²
$x$

**b**
10 m
$x$
$x$
area = 20 m²
15 m
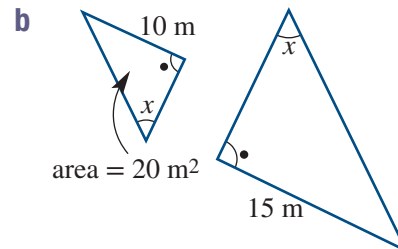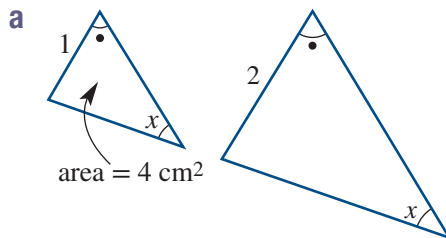
**8** The two given triangles are known to be similar. Find the area of the smaller triangle.

**a**
3 mm
9 mm
$x$
area = 27 mm²
$x$

**b**
2 cm
$x$
area = 6.75 cm²
$x$
3 cm

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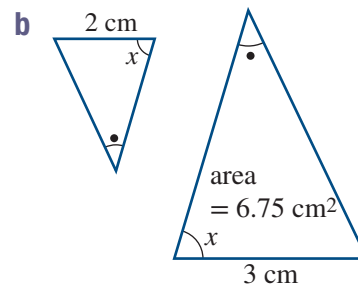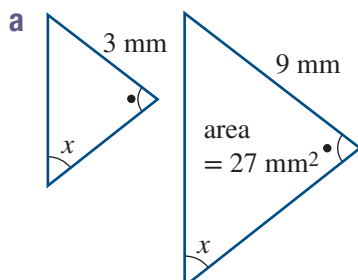
# 7D Scale drawing

A scale drawing is a drawing that represents the actual object. The scale factor of a scale drawing is the ratio of the size of the drawing to the actual size of the object. For example, a map is a scale drawing. It is not the same size as the area it represents. The measurements have been reduced to make the map a convenient size. The scale of a drawing may be expressed with or without units. For example, a scale of 1 cm to 1 m means 1 cm on the scale drawing represents 1 m on the actual object. Alternatively, a scale of 1:100 means the actual distance is 100 times the length of 1 unit on the scale drawing.



## SCALE DRAWING

Scale of a drawing =  Drawing length:Actual length
Scale is expressed in two ways:
- Using units such as 1 cm to 1 m (or 1 cm = 1 m).
- No units using a ratio such as 1:100.

### Example 7: Using a scale                                              7D

A scale drawing has a scale of 1:50.
a   Find the actual length if the drawing length is 30 mm. Answer to the nearest centimetre.
b   Find the drawing length if the actual length is 4.5 m. Answer to the nearest millimetre.

**SOLUTION:**

1   Multiply the drawing length by 50 to determine the actual length.

2   Divide by 10 to change millimetres to centimetres.

a   Actual length $= 30 \times 50$ mm
$= 1500$ mm
$= 150$ cm

3   Divide the actual length by 50 to determine the drawing length.

4   Multiply by 1000 to change metres to millimetres.

b   Drawing length $= 4.5 \div 50$ m
$= 0.09$ m
$= 90$ mm

## Exercise 7D

**Example 7** **1** A scale drawing has a scale of 1 : 100. What is the actual length of these drawing lengths?
Express your answer in metres.
    **a** 2cm                   **b** 10mm                   **c** 3.4cm
    **d** 28mm                 **e** 8.5cm                 **f** 49mm

**2** A scale drawing has a scale of 1 : 25 000. What is the drawing length of these actual lengths?
Express your answer in millimetres.
    **a** 2km                    **b** 750m                  **c** 4000cm
    **d** 3.5km                 **e** 50000mm          **f** 1375m

**3** Express each of the following scales as a ratio in the form 1 : $x$.
    **a** 1cm to 2cm            **b** 1mm to 5cm           **c** 1cm to 3km

**4** The scale on a map is 1 : 1000. Calculate the actual distances if these are the distances on the
map. Express your answer in metres.
    **a** Road 20cm          **b** Shops 10cm          **c** Pathway 5cm
    **d** Parking area 10mm   **e** Bridge 34mm      **f** Park 80mm

**5** The scale on a map is given as
1cm = 15 km. What is the actual distance
if the distance on the map is:
    **a** 2.5cm?
    **b** 45cm?



**6** The scale on a map is 1 : 5000. Calculate the map distances if these are actual distances.
Express your answer in millimetres.
    **a** 50m                         **b** 80m
    **c** 100m                      **d** 120m
    **e** 150m                      **f** 240m

**7** The scale on a map is given as 1mm = 50m. If the distance between two points is 350m, what
is the map distance between these points?

**8** A scale drawing has a scale of 1 : 75. Find the:
    **a** actual length if the drawing length is 15mm
    **b** drawing length if the actual length is 3m.

**9** The Parkes radio telescope dish has a diameter of 64 metres.
The image opposite uses a photograph of the dish.

   **a** Determine a scale for the image.

   **b** Estimate the height of the top of the antenna above
the ground.

**10** The scale of a model is 2 : 150. Calculate the model lengths if these are actual lengths. Express
your answer in millimetres.

   **a** 75 cm             **b** 180 cm             **c** 300 cm

   **d** 45 m              **e** 6 m              **f** 36 m

**11** A scale drawing of the space shuttle is shown opposite.
The actual length of the space shuttle is 56 metres.

   **a** What is the scale factor?

   **b** Calculate the length of the wing span to the nearest metre.

   **c** Calculate the width of the shuttle to the nearest metre.

   **d** What is the length of the nose of the shuttle to the nearest
metre?
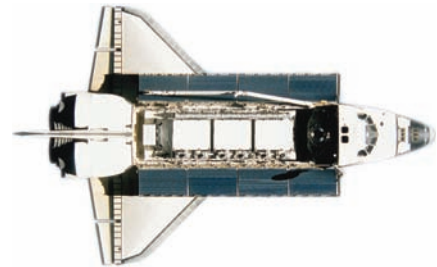
**12** The total length of the Sydney Harbour Bridge is 1150 metres. A scale model is built for a
coffee table of length 1.2 metres using the picture below.

   **a** What scale would be suitable?

   **b** What is the maximum height of the bridge if the scale model has a height of 20 cm?

   **c** Estimate the height of the bridge pillars.

**13** The length of the Olympic swimming pool shown opposite is 50 metres.



   **a** Calculate a scale for the aerial photograph.
   **b** What are the dimensions of the aerial photograph? (Answer to the nearest metre.)
   **c** What is the length from *A* to *B*?
   **d** What is the length from *B* to *C*?
   **e** What is the length from *C* to *A*?
   **f** What is the perimeter of *ABC*?
   **g** Calculate the area of the land marked *ABC*. Assume a right angle at *C*.
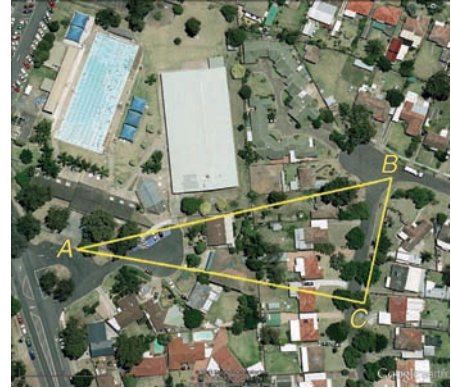
**14** A football field is shown opposite. The scale is marked by the red bar, which represents 50 m on the ground. Answer the following questions, correct to the nearest metre or square metre.



   **a** What is the length of the grandstand highlighted by the yellow bar?
   **b** Calculate the length of the field.
   **c** Calculate the width of the field.
   **d** What is the perimeter of the field?
   **e** What is the area of the field?
   **f** What is the length of the diagonal of the field?

**15** Two circular buildings, *A* and *B*, at Sydney airport are shown. The red scale represents 25 m on the ground. Answer the following questions, correct to the nearest metre or square metre.



   **a** What is the radius of building *A*?
   **b** What is the diameter of building *B*?
   **c** What is the circumference of building *A*?
   **d** What is the area of building *A*?
   **e** What is the radius of the building *B*?
   **f** What is the circumference of building *B*?

# 7E  Plans and elevations

A plan is a view of an object from the top. It is looking down on the object. A house plan is a horizontal section cut through the building showing the walls, windows, door openings, fittings and appliances. An elevation is a view of an object from one side, such as a front elevation or side elevation. House elevations are rarely a simple rectangular shape but show all the parts of the building that are seen from a particular direction. House elevations are a vertical section parallel to one side of the building.
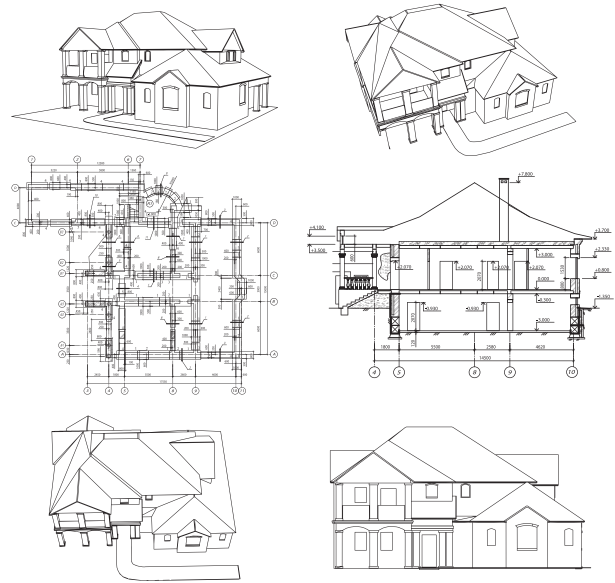


## PLANS AND ELEVATIONS

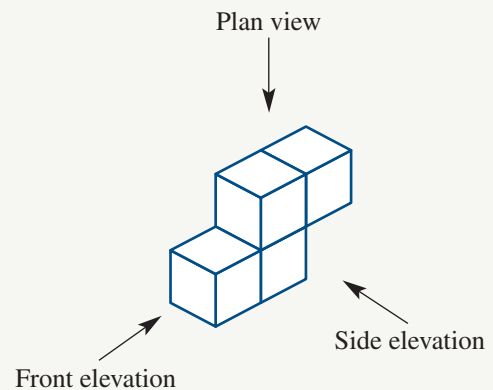A plan is a view of an object from the top.
An elevation is a view of an object from one side, such as a front elevation or side elevation.

## Example 8: Drawing a plan and elevation                7E

Draw the plan view, front elevation and side elevation of this object.



Plan view

Side elevation

Front elevation

**SOLUTION:**

1  Look down on the object for the plan.
2  Look from the front for the front elevation and from the side for the side elevation.
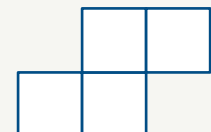
Plan          Front elevation          Side elevation

## Building plans

A floor plan for a Metricon home is shown below. Building plans are a very common application of similar figures. They are drawn using a scale factor such as 1:150. This allows the dimensions of a house to be determined by measurement and calculation.
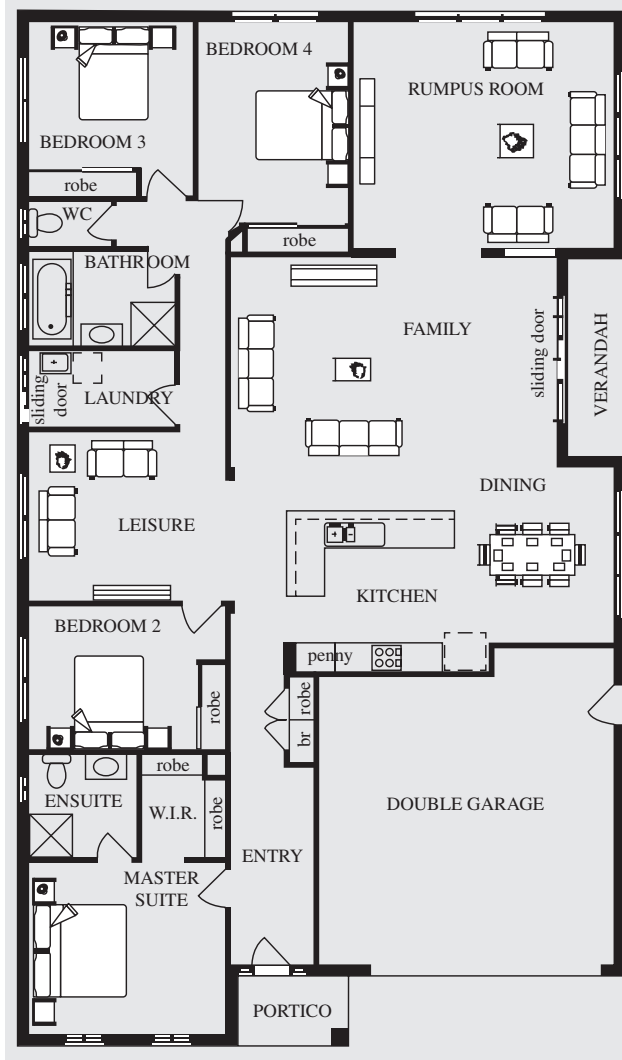


Scale 1:150

## Common floor plan symbols

 Door swing – indicates direction the door opens

 Window – glass window in a solid wall

 Kitchen sink – two-compartment kitchen sink

 Shower – shower without a bathtub

 Toilet – toilet located on wall

 Bathtub – bathtub showing location of drain

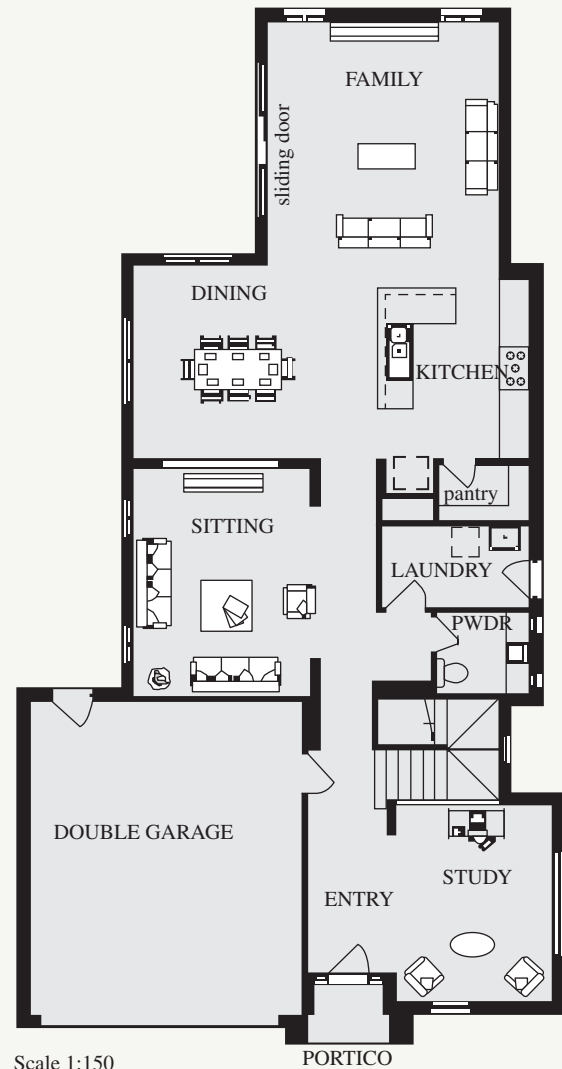## Example 9: Finding measurements from a house plan                    7E

A building plan is shown for the ground floor of
a Metricon home.

**a** How many internal doors are there?

**b** What is the meaning of PWDR?

**c** What is the length of the house?

**d** What are the dimensions of the double garage?







Scale 1:150

**SOLUTION:**

**1** Count the number of internal doors
(find the door symbol).

**a** 4 internal doors

**2** PWDR is an abbreviation for the powder
room.

**b** Powder room

**3** Use a ruler to measure the length of the
house on the floor plan.

**c** Drawing length is 12.6 cm

**4** Multiply the measurement by 150
(scale 1:150).

Actual length $= 12.6 \times 150$ cm
$= 1890$ cm or 18.9 m

**5** Use a ruler to measure the dimensions of
the double garage on the floor plan.

**d** Drawing length is $4.1 \times 3.5$ cm

**6** Multiply the measurements by 150
(scale 1:150).

Actual length $= 4.1 \times 150$ cm
$= 615$ cm or 6.2 m

Actual breath $= 3.5 \times 150$ cm
$= 525$ cm or 5.3 m

Dimensions are $6.2 \times 5.3$ m.

## Exercise 7E

Example 8 | **1** Draw the plan, front elevation and side elevation for these objects.

**a**

Plan view

Front elevation          Side elevation

**b**

Plan view

Front elevation          Side elevation
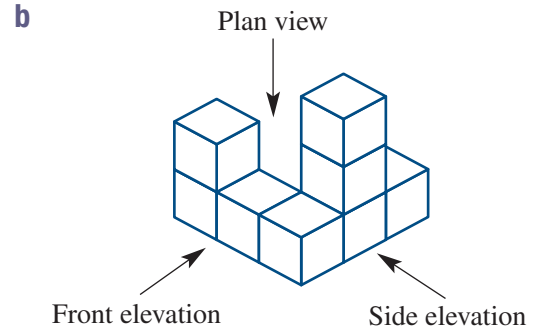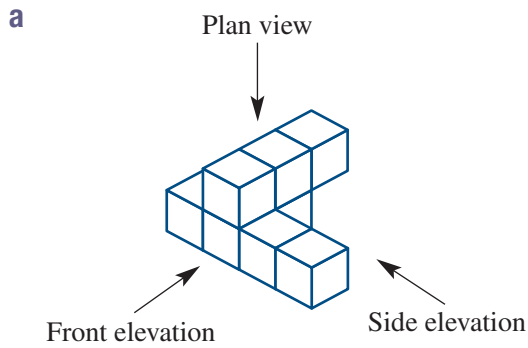
**2** What are these shapes?

| | Plan | Front elevation | Side elevation |
|---|---|---|---|
| **a** | rectangle | right triangle | rectangle |
| **b** | square with X | triangle | triangle |
| **c** | circle | rectangle | rectangle |
| **d** | square | rectangle | rectangle |
| **e** | circle with dot | triangle | triangle |

**3** Draw the plan, front elevation and side elevation for these objects.

**a**          **b**          **c**

**d**          **e**          **f**
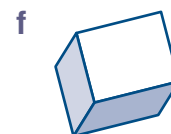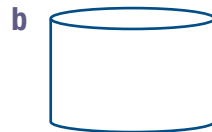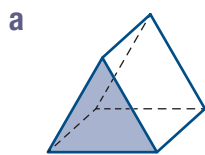
**4** A section of a floor plan is shown opposite.
  **a** What room is shown in the diagram?
  **b** What symbol is used for a shower?
  **c** What symbol is used for a door?
  **d** What does 'W.I.R.' represent on the plan?

**5** A section of a floor plan is shown opposite.
  **a** What are the dimensions of the kitchen?
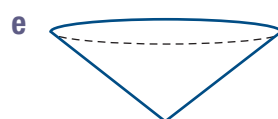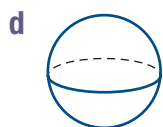  **b** What symbol is used for the sink?
  **c** What symbol is used for the cooktop?
  **d** What does 'Ref' represent on the plan?
  **e** What does 'P' represent on the plan?
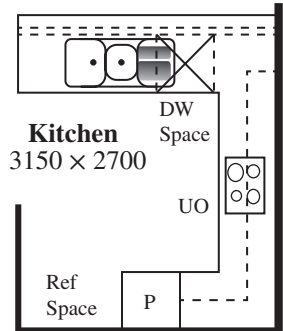
Example 9 **6** A section of a floor plan is shown opposite.
  **a** What are the dimensions of the bedroom?
  **b** What symbol is used for a window?
  **c** What does 'B.I.W.' represent on the plan?
  **d** What is the length of the bedroom on the plan?
  **e** Calculate a scale for the floor plan.
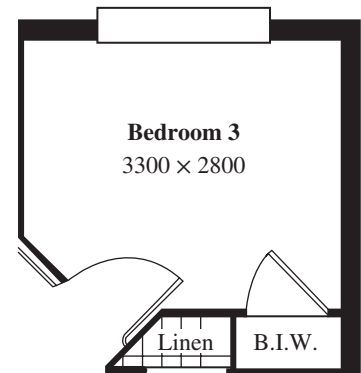
**7** A section of a floor plan is shown opposite.
  **a** What are the dimensions of the bedroom?
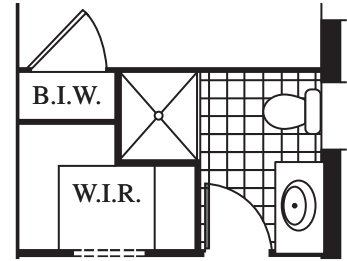  **b** What symbol is used for the toilet?
  **c** What is the length of the bedroom on the plan?
  **d** Calculate a scale for the floor plan.
  **e** What are the dimensions of the walk-in robe?
  **f** What is the area of the bedroom? Answer in square metres, correct to two decimal places.

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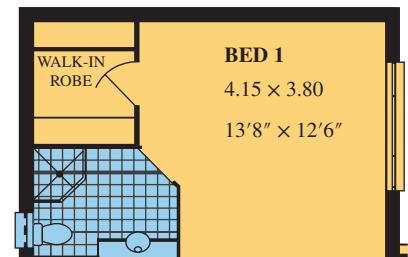
**Example 9** **8** A second-storey building plan is shown for a Masterton home.

   **a** What are the dimensions of the third bedroom? Answer in metres.

   **b** What are the dimensions of the master bedroom? Answer in metres.

   **c** By measurement, estimate a scale for this plan.

   **d** By measurement, find the width of the house. Answer in metres.

   **e** Calculate the area of the void. Answer to the nearest square metre.

   **f** Calculate the area of the ensuite. Answer to the nearest square metre.
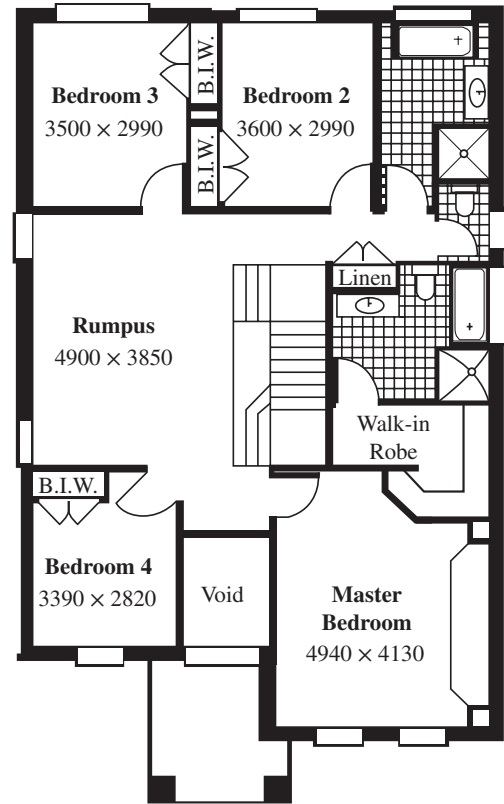


**9** A rumpus room is built measuring 5.5 m by 4.7 m. The floor plan uses a scale of 1 : 100. A concrete slab with a depth of 100 mm is used to build the rumpus room.

   **a** What is the area of the rumpus room on the plan? Answer in square millimetres.

   **b** What is the volume of concrete for the rumpus room? Answer in cubic millimetres.

   **c** What is the volume of concrete for the rumpus room if the slab depth is 200 mm? Answer in cubic millimetres.

**10** The front elevation of a house is shown opposite (scale 1 : 200).

   **a** What is the width of the house? Answer in metres.

   **b** What is the height of the chimney? Answer in metres.

   **c** What are the dimensions of the front door? Answer in metres.

   **d** What are the dimensions of the window on the right-hand side? Answer to the nearest centimetre.

   **e** What is the area of the window? Answer to the nearest square centimetre.

   **f** What is the area of the large triangular gable? Answer to the nearest square centimetre.

   **g** What is the area of the small triangular gable? Answer to the nearest square centimetre.



FRONT ELEVATION

**11** The front elevation of a house is shown below.
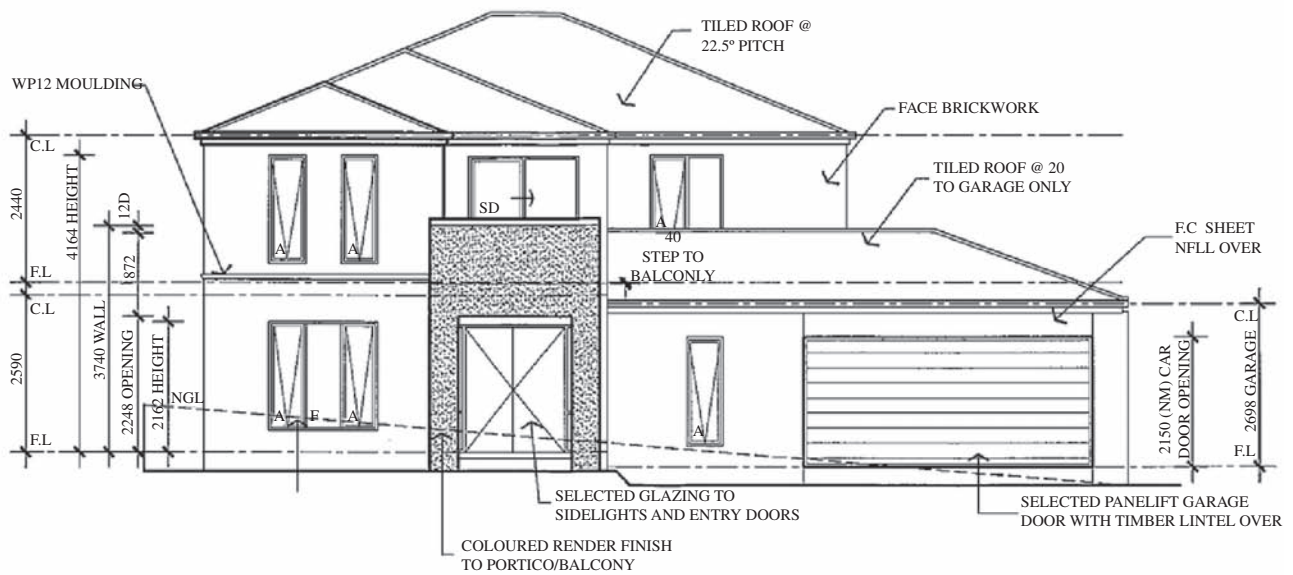


a What is the height of the first storey? Answer in metres.
b What is the height of the garage? Answer in metres.
c What is the angle of the pitch of the roof?
d How many windows are at the front of the house?

**12** A building plan is shown below. The house length is 20 m and the width is 18 m.
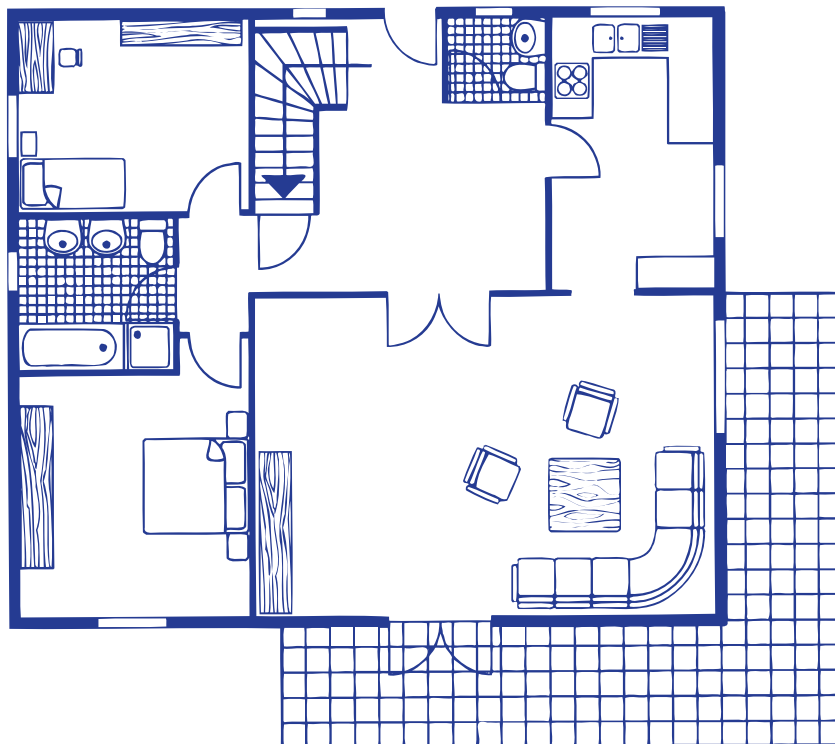


a What are the dimensions of the living room? Answer in metres.
b What is the area of the living room? Answer to the nearest square metre.
c Considering only the area of the living room, how much concrete was used in the concrete slab whose thickness is 200 mm? Answer to the nearest cubic metre.

**13** A building plan is shown for a Metricon home. The house length is 24 m (includes portico) and the width is 15 m (includes garage).

a What is a suitable scale for this plan?

b What are the dimensions of the verandah? Answer correct to the nearest tenth of a metre.

c What are the dimensions of the double garage? Answer correct to the nearest tenth of a metre.

d What are the dimensions of bedroom 3? Answer correct to the nearest tenth of a metre.

e Calculate the area of the sitting room. Answer correct to the nearest square metre.

f What is the cost of carpeting the sitting room if the cost of the carpet is $140 per square metre? Answer to the nearest dollar.
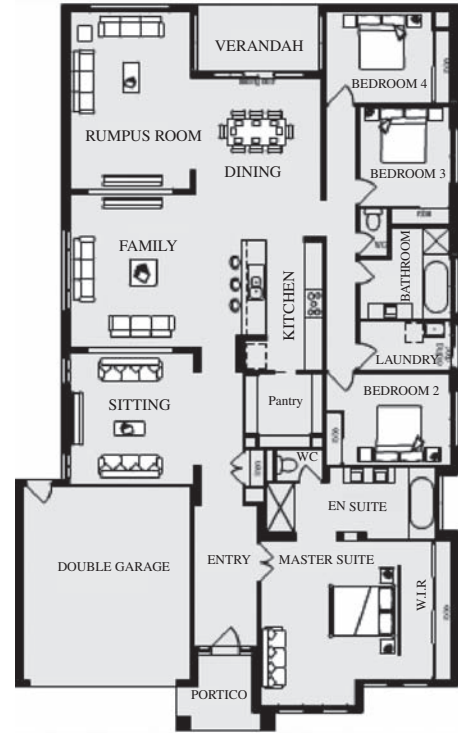


**14** A section of a building plan is shown opposite. The dimensions of the family room are 5.5 metres by 6.0 metres.

a Estimate a suitable scale for this building plan.

b What is the combined length of the family, kitchen and sitting rooms? Answer correct to the nearest tenth of a metre.

c The family, dining, kitchen and sitting rooms are to be tiled. Calculate the combined area of these rooms. Answer to nearest square metre.

d Ceramic tiles measuring $300 \times 300$ mm are to be laid in these rooms. How many tiles are required?

e What assumption has been made to the answer in part **d**?

f The family, dining, kitchen and sitting rooms are built on a concrete slab with a thickness of 0.15 m. What is the volume of concrete used for the slab?
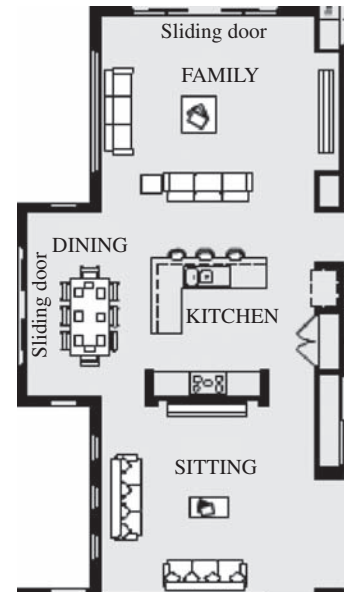
# Key ideas and chapter summary

**Ratio**   A ratio is used to compare amounts of the same units in a definite order.
Equivalent ratios are obtained by multiplying or dividing by the same number.

$$\overset{\div 3 \quad \div 3}{15 : 12 = 5 : 4} \qquad \overset{\times 3 \quad \times 3}{5 : 4 = 15 : 12}$$

15 : 12 and 5 : 4 are equivalent ratios.

**Dividing a quantity in a given ratio**
1 Find the total number of parts by adding each amount in the ratio.
2 Divide the quantity by the total number of parts to find one part.
3 Multiply each amount of the ratio by the result in step 2.
4 Check by adding the answers for each part. The result should be the original quantity.

**Similarity and scale factors**   Similar figures are exactly the same shape but are a different size.
- Corresponding (or matching) angles of similar figures are equal.
- Corresponding (or matching) sides of similar figures are in the same ratio.
- Scale factor is the amount the first shape is enlarged or reduced to get the second shape.

**Using scale factor for area**   When all the dimensions are multiplied by a scale factor of $k$, the area is multiplied by a scale factor of $k^2$.

**Scale drawing**   Scale of a drawing = Drawing length : Actual length
Scale is expressed in two ways:
- Using units such as 1 cm to 1 m (or 1 cm = 1 m).
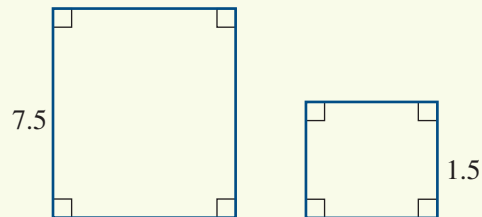- No units using a ratio such as 1 : 100.

**Plans and elevations**
- A plan is a view of an object from the top.
- An elevation is a view of an object from one side, such as a front elevation or side elevation.

Plan view

Side elevation

Front elevation

**Review**
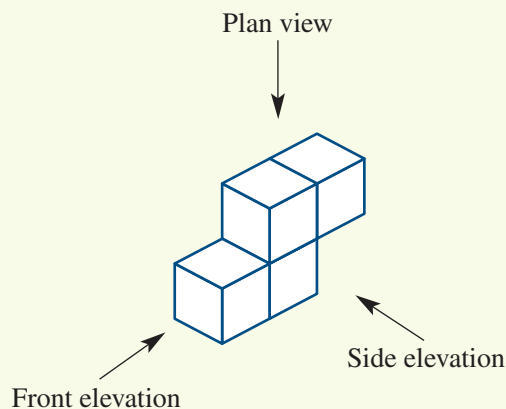
## Multiple-choice

**1** A school has 315 boys, 378 girls and 63 teachers. The ratio of students to teachers is:

    **A** 5 : 6         **B** 6 : 5         **C** 11 : 1         **D** 1 : 11.

**2** The ratio 500 mm to $\frac{1}{5}$ m is the same as:

    **A** 50 : 2         **B** 2500 : 1         **C** 5 : 2         **D** 2 : 5.

**3** The ratio of adults to child in a park is 5 : 9. How many adults are in the park if there are 630 children?

    **A** 70         **B** 126         **C** 280         **D** 350

**4** $750 is divided in the ratio 1 : 3 : 2. The smallest share is:

    **A** $250         **B** $125         **C** $375         **D** $750.

**5** A 360-gram bag of lollies is divided in the ratio 7 : 5. What is the mass of the smaller amount?

    **A** 150 g         **B** 168 g         **C** 192 g         **D** 210 g

**6** A scale drawing has a scale of 1 : 20. What is the actual length if the drawing length of an object is 20 mm?

    **A** 1 mm         **B** 20 mm         **C** 40 mm         **D** 400 mm

**7** The scale on a map is given as 1 mm = 150 m. If the distance between two points is 600 m, what is the map distance between these points?

    **A** 4 mm         **B** 0.25 mm         **C** 2.5 cm         **D** 40 cm

**8** What is the scale factor for these squares?

    **A** $\frac{1}{5}$         **B** 5

    **C** 6         **D** 7.5



7.5          1.5

**9** On a map, Sydney and Melbourne are 143.2 mm apart. If the cities are 716 km apart, what scale has been used?

    **A** 1 : 5         **B** 1 : 5000         **C** 1 : 50 000         **D** 1 : 5 000 000

## Short-answer

**1** Complete each pair of equivalent ratios.

**a** $4 : 30 = 2 : \square$　　　**b** $6 : 10 = \square : 20$　　　**c** $2 : 11 = 22 : \square$

**d** $13 : 3 = \square : 9$　　　**e** $2 : 5 = \square : 25$　　　**f** $4 : 9 = \square : 36$

**2** True or false?

**a** $1 : 3 = 5 : 9$

**b** The ratio $2 : 3$ is the same as $3 : 2$.

**c** The ratio $3 : 5$ is written in simplest form.

**d** $30\,cm : 1\,m$ is written as $30 : 1$ in simplest form.

**e** $\dfrac{2}{3} = 4 : 6$

**3** Simplify the following ratios.

**a** $10 : 40$　　　　**b** $36 : 24$　　　　**c** $75 : 100$

**d** $8 : 64$　　　　　**e** $27 : 9$　　　　　**f** $5 : 25$

**g** $6 : 4$　　　　　**h** $52 : 26$　　　　**i** $12 : 36$

**j** $500 : 100$　　　**k** $20 : 30$　　　　**l** $28 : 7$

**m** $10 : 15 : 30$　　**n** $12 : 9$　　　　**o** $56 : 88$

**p** $4.8 : 1.6$　　　　**q** $\dfrac{3}{4} : \dfrac{1}{2}$　　　　**r** $\dfrac{2}{7} : \dfrac{5}{7}$

**4** Divide:

**a** \$80 in the ratio $7 : 9$　　　　　**b** $200\,kg$ in the ratio $1 : 4$

**c** $40\,m$ in the ratio $6 : 2$　　　　**d** \$1445 in the ratio $4 : 7 : 6$.

**5** The ratio of the cost price of a TV to its retail price is $5 : 12$. If its cost price is \$480, calculate its retail price.

**6** Daniel and Eddie own a business and share the profits in the ratio $3 : 4$.
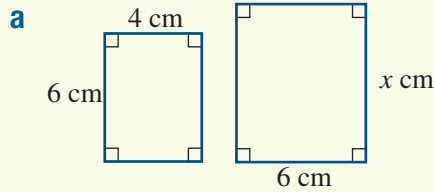
**a** The profit last week was \$3437. How much does Daniel receive?

**b** The profit this week is \$2464. How much does Eddie receive?

**7** Patrick mixes sand and cement in the ratio $5 : 2$ by volume. If he uses 5 buckets of cement, how much sand should he use?

**Review**

**8** Find the scale factor for the following pairs of similar figures, and find the value of $x$.

**a**



4 cm
6 cm
$x$ cm
6 cm

**b**



3 cm
5 cm
4 cm
9 cm
15 cm
$x$ cm
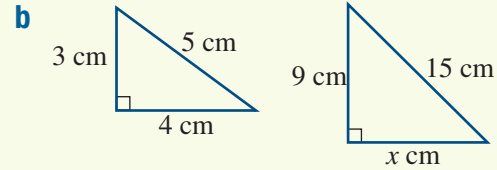
**9** The ratio of Victoria's height to Willow's is 8 : 7. If Victoria is 176 cm tall, how tall is Willow?

**10** Express each of the following scales as a ratio in the form 1 : a.
  **a** 1 cm to 3 m
  **b** 1 mm to 6 cm
  **c** 1 m to 2.5 km

**11** Two cities are 50 km apart. How many millimetres apart are they on a map that has a scale of 1 : 100 000?

**12** The scale on a map is given as 1 cm = 5 km. If the distance between two points on the map is 46 mm, what is the actual distance between these points? Answer in kilometres.

**13** A scale drawing has a scale of 1 : 50 000. What is the drawing length of these actual lengths? Express your answer in millimetres.
  **a** 4 km
  **b** 1250 m
  **c** 5000 cm
  **d** 6.5 km
  **e** 20 000 mm
  **f** 2 125 m

**14** The scale on a map is 1 : 400. Calculate the actual distances if these are the distances on the map. Express your answer in metres.
  **a** Bike path 180 cm
  **b** Town centre 20 cm
  **c** Street 5 cm
  **d** Beach 210 mm
  **e** River 62 cm
  **f** Park 60 mm

**15** A section of a floor plan is shown opposite.
The longer dimension of the laundry is 3 metres.
  **a** Estimate a suitable scale for the floor plan.
  **b** What symbol is used for the bath?
  **c** What does 'W.C.' represent on the plan?
  **d** What are the dimensions of the laundry?



Robe
W.C.
BATHROOM
LAUNDRY
Sliding door

PDF
LITERACY