26. [Area / Volume]

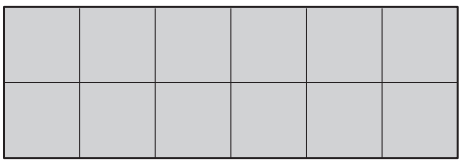
Skill 26.1 Calculating the area of polygons by counting squares and triangles on a square grid (1).

MM4.2 **1** 1 2 2 3 3 4 4
MM5.1 1 1 2 2 3 3 4 4

- Count the number of fully shaded squares on the grid.
- If necessary add on the number of half shaded squares (or triangles).
- Look for shortcuts in your counting.

Hint: To calculate the area of a rectangular shape it is possible to count the number of squares in a row and then multiply by the number of squares in a column.

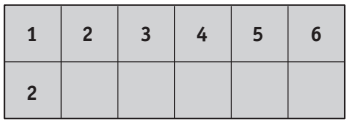
Q. Find the area of the rectangle.



Area = 1 cm²

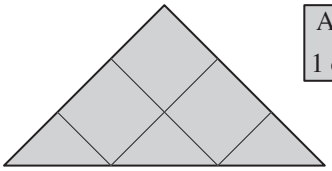
A. 6×2
$= 12\ cm^2$

There are 6 squares in a row and 2 squares in a column.

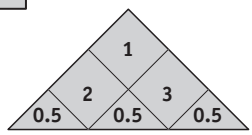


Area = 1 cm²

a) Find the area of the triangle.



Area = 1 cm²



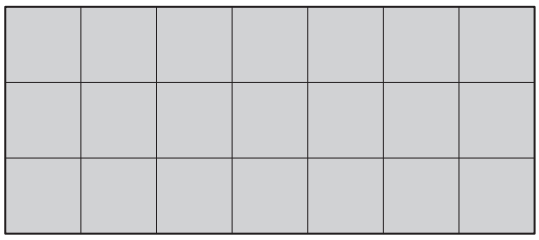
$3 + 0.5 + 0.5 + 0.5 =$ ..... cm²

b) Find the area of the rectangle.

Area = 1 cm²

1×6 = ... cm²

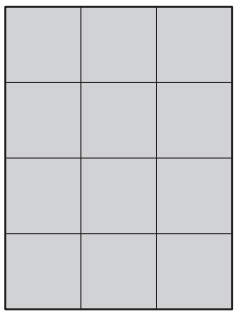
c) Find the area of the rectangle.



Area = 1 cm²

= ..... cm²

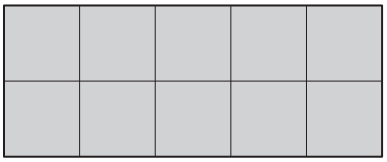
d) Find the area of the rectangle.



Area = 1 cm²

= ..... cm²

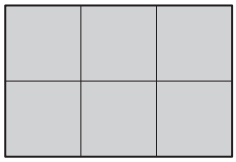
e) Find the area of the rectangle.



Area = 1 cm²

= ..... cm²

f) Find the area of the rectangle.

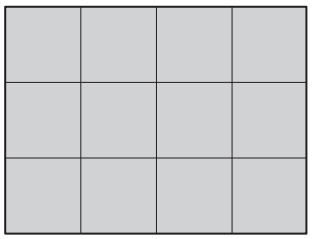


Area = 1 cm²

= ..... cm²

Skill 26.1 Calculating the area of polygons by counting squares and triangles on a square grid (2).

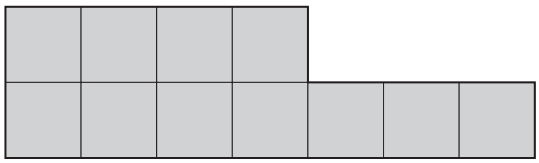
g) Find the area of the rectangle.



Area = 1 cm²

..... = cm²

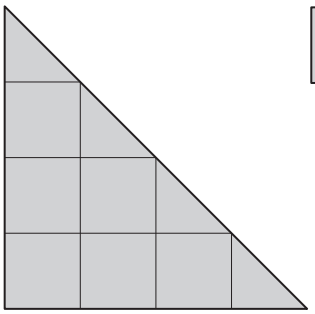
h) Find the area of the polygon.



Area = 1 cm²

..... = cm²

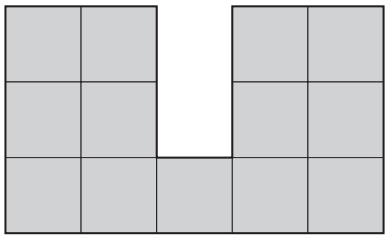
i) Find the area of the triangle.



Area = 1 cm²

..... = cm²

j) Find the area of the polygon.



Area = 1 cm²

..... = cm²

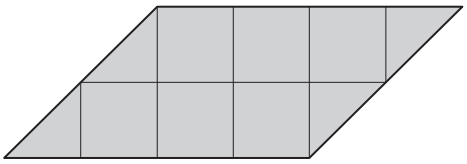
k) Find the area of the trapezium.

Area = 1 cm²

..... = cm²

l) Find the area of the parallelogram.

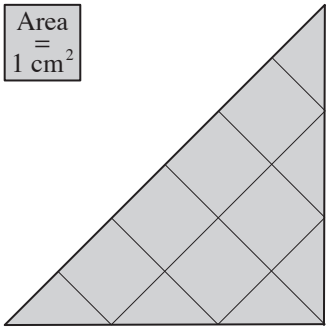
Area = 1 cm²



..... = cm²

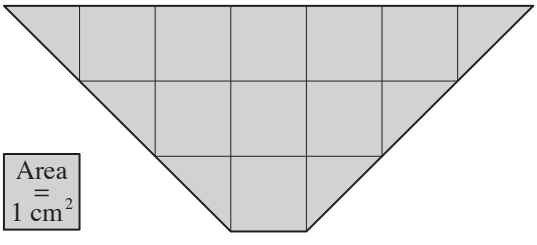
m) Find the area of the triangle.

Area = 1 cm²



..... = cm²

n) Find the area of the trapezium.



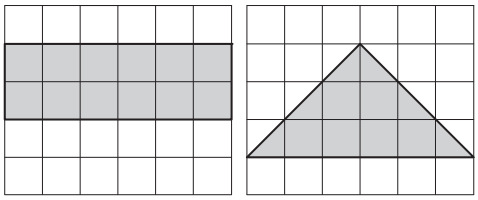
Area = 1 cm²

..... = cm²

Skill 26.2 Comparing the area of polygons on a square grid (1).

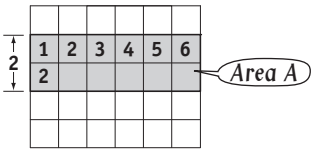
- Break the shape up into rectangles and triangles if necessary.
- Calculate the area of any rectangle by:
  Counting the squares
  OR
  Multiplying the number of squares in a row by the number of squares in a column.
- Calculate the area of any triangle by halving the area of the rectangle that would enclose it.
- Compare your results.

Q. Do the rectangle and the triangle have the same area?

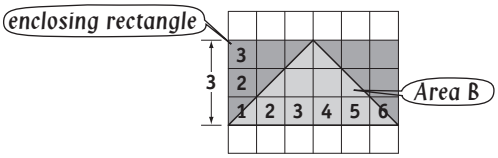


A. *Area A ≠ Area B* ⇒ ***No***

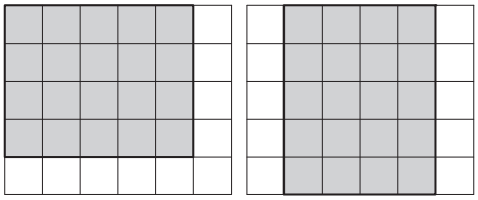
Area A $= 6 \times 2 = 12$ sq. units

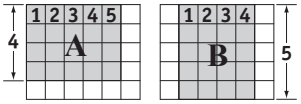


Area B $= \frac{1}{2} \times 6 \times 3$
$= \frac{1}{2} \times 18$
$= 9$ sq. units



a) Do these rectangles have the same area?

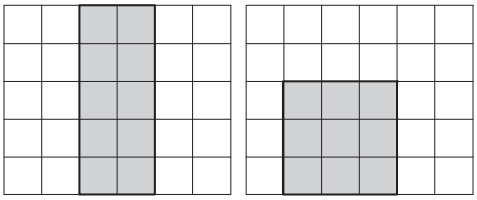




Area A $= 5 \times 4 = 20$

Area B $= 4 \times 5 = 20$ ⇒ yes

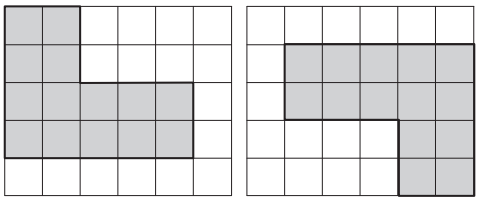
b) Do these rectangles have the same area?



Area A =

Area B = ⇒

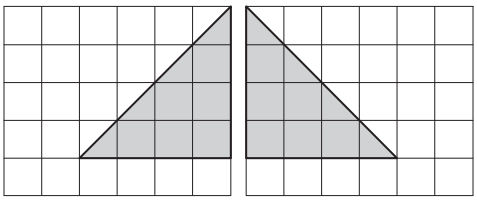
c) Do these polygons have the same area?



Area A =

Area B = ⇒

d) Do these triangles have the same area?

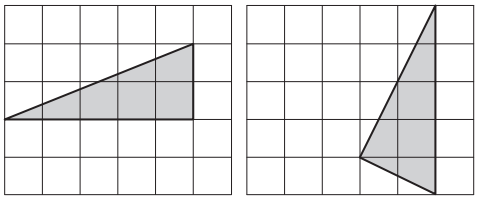


Area A =

Area B = ⇒

Skill 26.2 Comparing the area of polygons on a square grid (2).

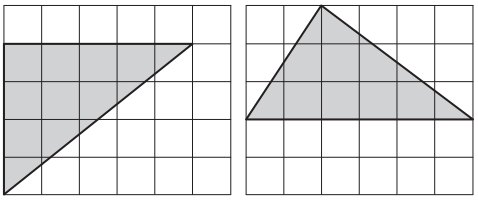
e) Do these triangles have the same area?



Area A = ...

Area B = ... ⇒ ☐

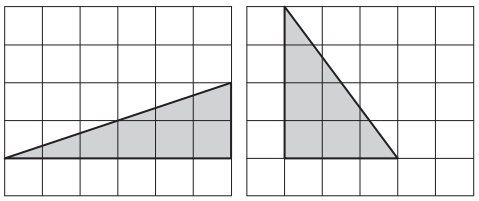
f) Do these triangles have the same area?



Area A = ...

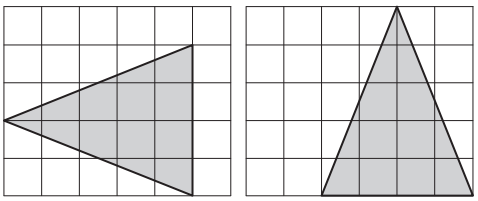
Area B = ... ⇒ ☐

g) Do these triangles have the same area?



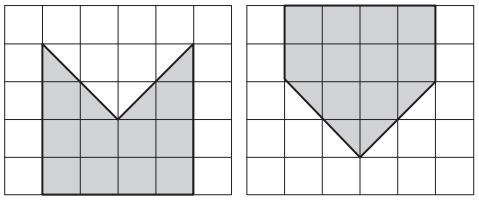
..... ⇒ ☐

h) Do these triangles have the same area?



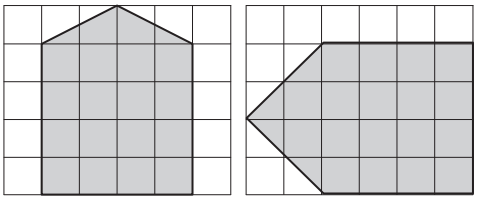
..... ⇒ ☐

i) Do these polygons have the same area?



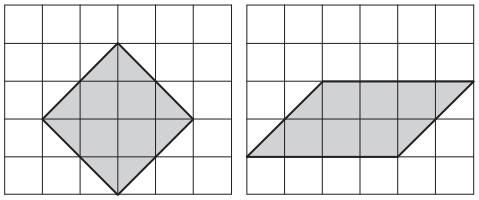
..... ☐

j) Do these polygons have the same area?



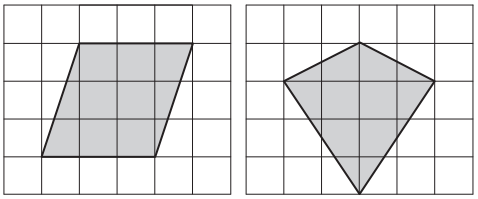
..... ☐

k) Do the square and the parallelogram have the same area?



..... ☐

l) Do the parallelogram and the kite have the same area?

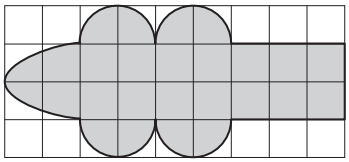


..... ☐

Skill 26.3 Estimating the area of irregular shapes on a square grid.

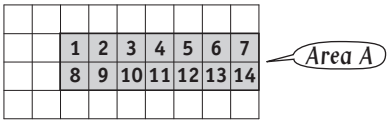
- Break the shape up into workable parts (rectangles/triangles/curved shapes).
- Calculate the area of any rectangle by:
  Counting the squares
  OR
  Multiplying the number of squares in a row by the number of squares in a column.
- Calculate the area of any triangle by halving the area of the rectangle that would enclose it.
- Estimate the area of any partly curved shape by making up whole squares from the shaded region.
- Add the results.

Q. Find the area of the shaded shape.
[Round to the nearest whole number.]

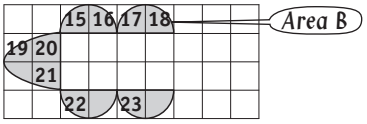


A. *Area A + Area B*
= 14 + 9
= 23 sq. units

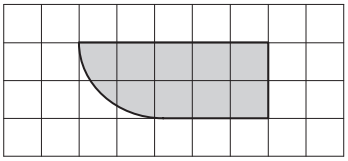
Area A = 14 whole units

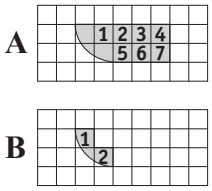


Area B = 9 units
(made up from 12 part units)



a) Find the area of the shaded shape.
[Round to the nearest whole number.]

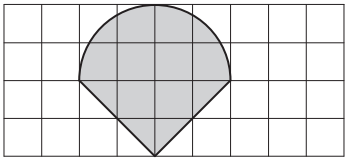




Area A = 7 and Area B = 2

Area A + B = 7 + 2 = sq. units

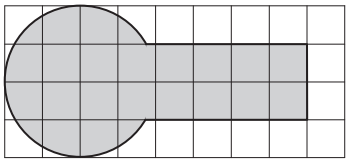
b) Find the area of the shaded shape.
[Round to the nearest whole number.]



Area A = *and Area B =*

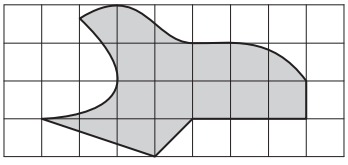
Area A + B = = sq. units

c) Find the area of the shaded shape.
[Round to the nearest whole number.]



= sq. units

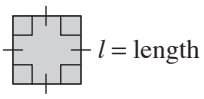
d) Find the area of the shaded shape.
[Round to the nearest whole number.]



= sq. units

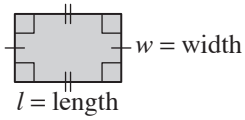
Skill 26.4 Calculating the area of squares, rectangles and parallelograms (1).

square



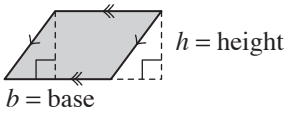
$A = l \times l$
$= l^2$

rectangle



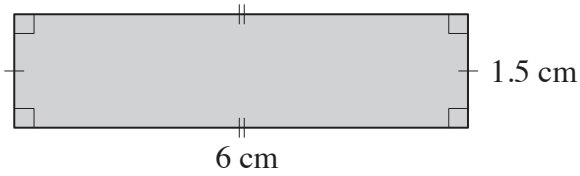
$A = l \times w$
$= lw$

parallelogram



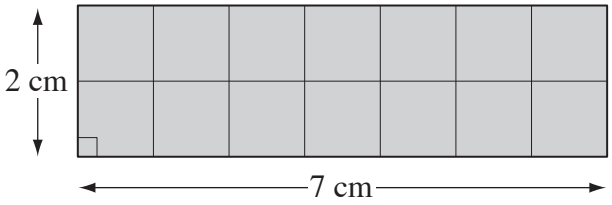
$A = b \times h$
$= bh$

Q. Using $A = lw$ find the area of the rectangle.



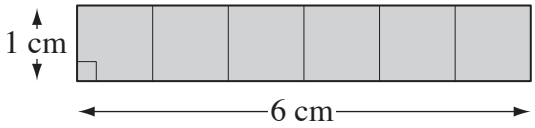
A. *$A = lw$ where $l = 6$ and $w = 1.5$*
$= 6 \times 1.5$
$= \mathbf{9\ cm^2}$

a) Using Area = length × width find the area of this rectangle.



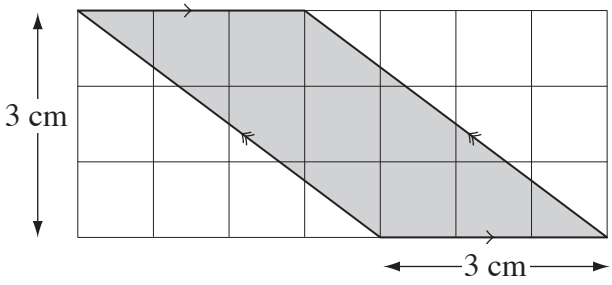
$A = 7 \times 2$ = ____ cm^2

b) Using Area = length × width find the area of this rectangle.



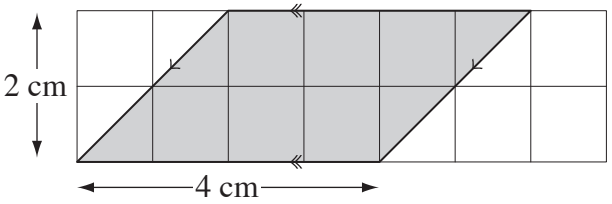
$A =$ ..... = ____ cm^2

c) Using Area = base × height find the area of this parallelogram.



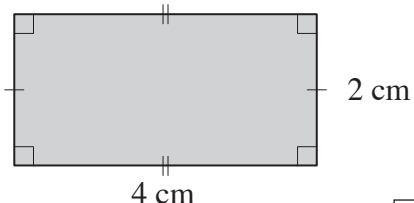
$A =$ ..... = ____ cm^2

d) Using Area = base × height find the area of this parallelogram.



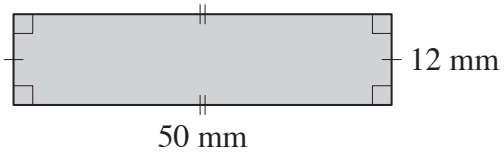
$A =$ ..... = ____ cm^2

e) Using Area = length × width find the area of this rectangle.



$A =$ ..... = ____ cm^2

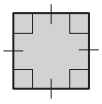
f) Using $A = lw$ find the area of the rectangle.



$A =$ ..... = ____ mm^2

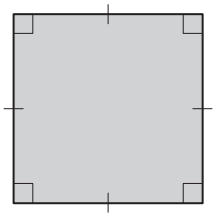
Skill 26.4 Calculating the area of squares, rectangles and parallelograms (2).

g) Using Area = length × length find the area of the square.



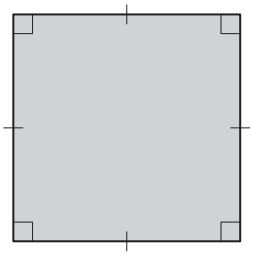
$A =$ ..... $=$ ____ mm^2

h) Using Area = l^2 find the area of the square.



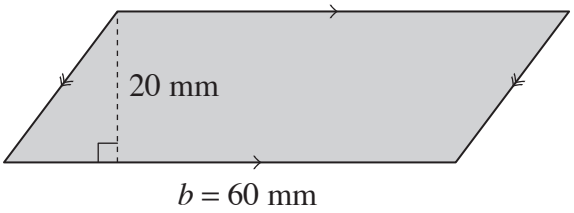
$A =$ ..... $=$ ____ cm^2

i) Find the area of the square.



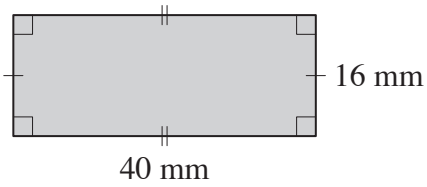
$A =$ ..... $=$ ____ cm^2

j) Using Area = base × height find the area of the parallelogram.



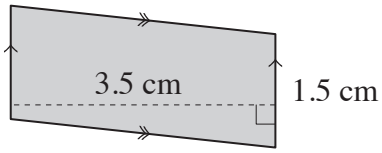
$A =$ ..... $=$ ____ mm^2

k) Using $A = lw$ find the area of the rectangle.



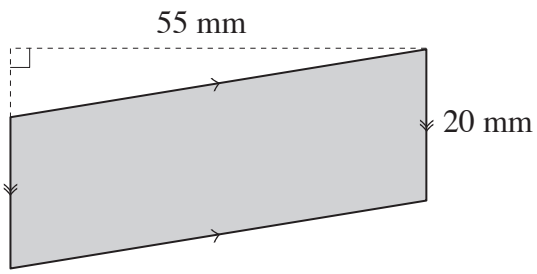
$A =$ ..... $=$ ____ mm^2

l) Using Area = base × height find the area of the parallelogram.



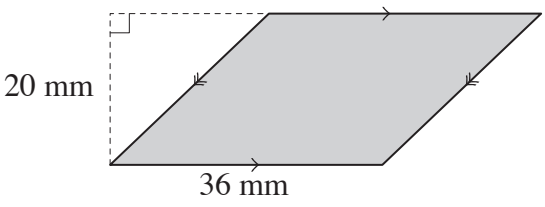
$A =$ ..... $=$ ____ cm^2

m) Using $A = bh$ find the area of the parallelogram.



$A =$ ..... $=$ ____ mm^2

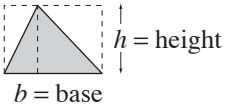
n) Find the area of the parallelogram.



$A =$ ..... $=$ ____ mm^2

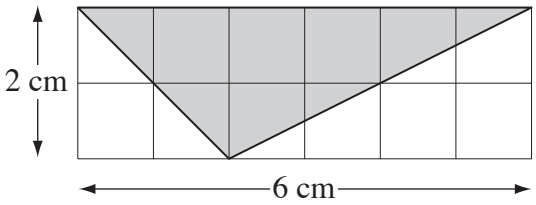
Skill 26.5 Calculating the area of triangles (1).

Area of a triangle



$$A = \frac{1}{2} \times b \times h$$
$$= \frac{1}{2} bh$$

Q. Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



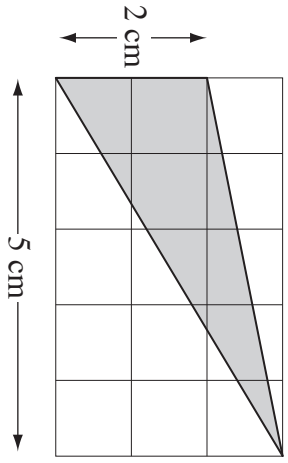
A. $A = \frac{1}{2} bh$ *where* $b = 6$ *and* $h = 2$

$= \frac{1}{2} \times 6 \times 2$

$= \frac{1}{2} \times 12$

$= \mathbf{6\ cm^2}$

a) Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



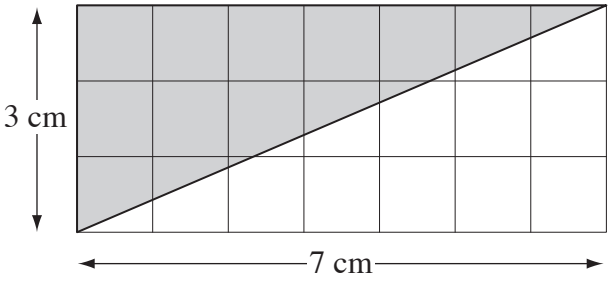
$A = \frac{1}{2} \times 2 \times 5$

.....

$= \frac{1}{2} \times 10$ $=$ cm^2

.....

b) Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



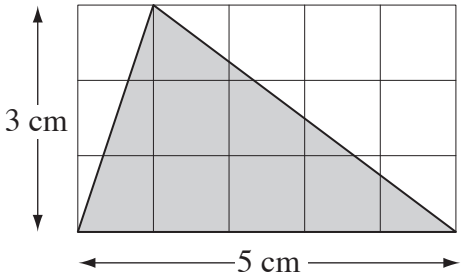
$A =$

.....

$=$ $=$ cm^2

.....

c) Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



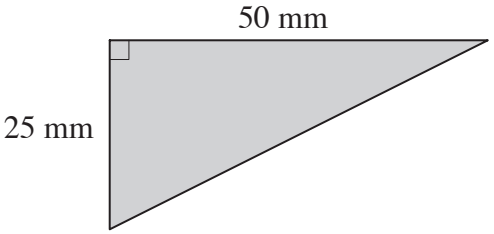
$A =$

.....

$=$ $=$ cm^2

.....

d) Using $A = \frac{1}{2} bh$ find the area of the right-angled triangle.



$A =$

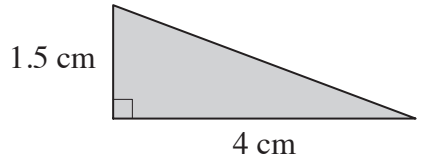
.....

$=$ $=$ mm^2

.....

Skill 26.5 Calculating the area of triangles (2).

e) Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



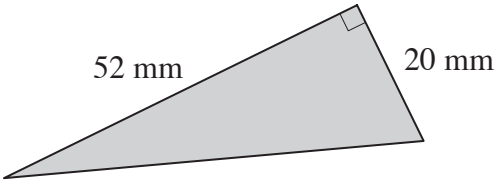
$A =$

.....

$=$ $=$ cm^2

.....

f) Using Area = $\frac{1}{2}bh$ find the area of the triangle.



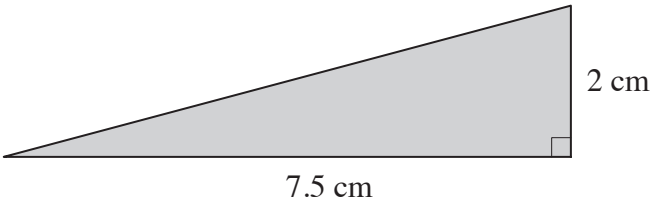
$A =$

.....

$=$ $=$ mm^2

.....

g) Using Area = $\frac{1}{2} \times$ base $\times$ height find the area of the triangle.



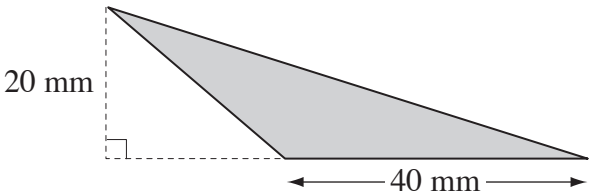
$A =$

.....

$=$ $=$ cm^2

.....

h) Using Area = $\frac{1}{2}bh$ find the area of the triangle.



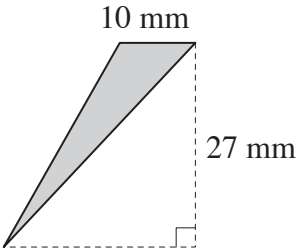
$A =$

.....

$=$ $=$ mm^2

.....

i) Using Area = $\frac{1}{2}bh$ find the area of the triangle.



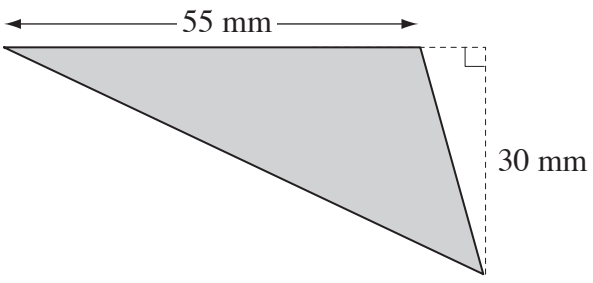
$A =$

.....

$=$ $=$ mm^2

.....

j) Using Area = $\frac{1}{2}bh$ find the area of the triangle.



$A =$

.....

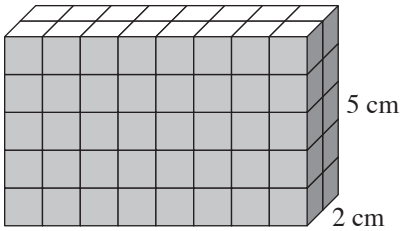
$=$ $=$ mm^2

.....

Skill 26.6 Calculating the volume of rectangular prisms by counting cubes (1).

- Count the cubes.
  Hint: Count the cubes in one layer and then multiply the result by the total number of layers.

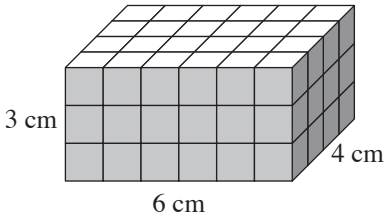
Q. Find the volume of the rectangular prism.



A. $V = 16 \times 5$
$= 80\ cm^3$

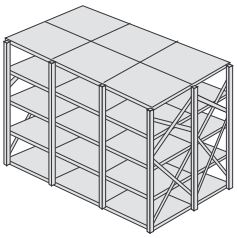
16 cubes in top layer
5 layers all together

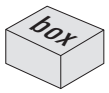
a) Using Volume = length × width × height, find the volume of the rectangular prism.



$V = 24 \times 3$ = ____ cm^3

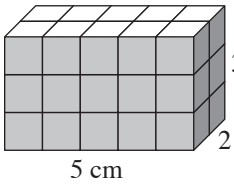
b) If 24 boxes can fit inside these shelves, find the total volume of the boxes.





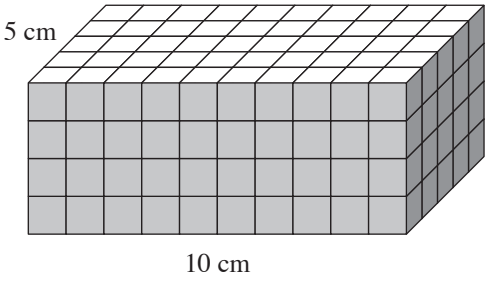
V = ... = ____ cm^3

c) Using Volume = length × width × height, find the volume of the rectangular prism.



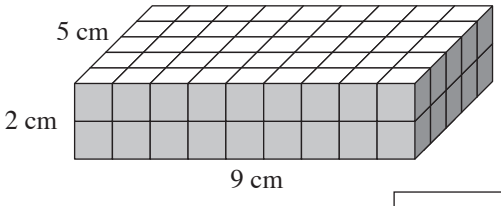
V = ... = ____ cm^3

d) Using Volume = length × width × height, find the volume of the rectangular prism.



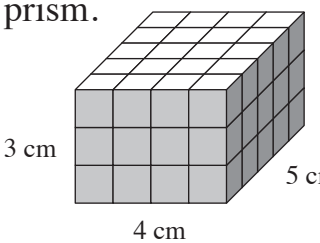
V = ... = ____ cm^3

e) Using Volume = length × width × height, find the volume of the rectangular prism.



V = ... = ____ cm^3

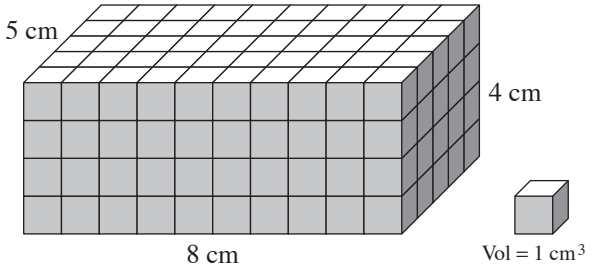
f) Using Volume = length × width × height, find the volume of the rectangular prism.



V = ... = ____ cm^3

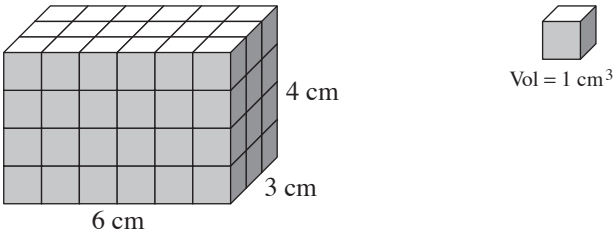
Skill 26.6 Calculating the volume of rectangular prisms by counting cubes (2).

g) Using Volume = length × width × height, find the volume of the rectangular prism.



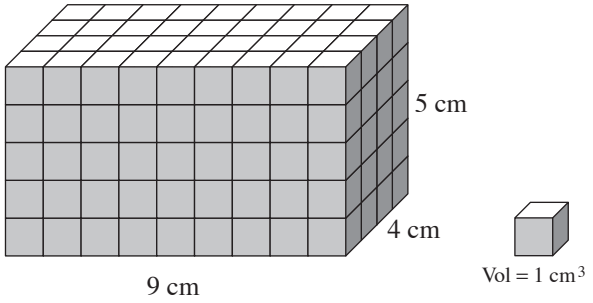
$V =$ ..... $=$ cm^3

h) Using $V = lwh$ find the volume of the rectangular prism.



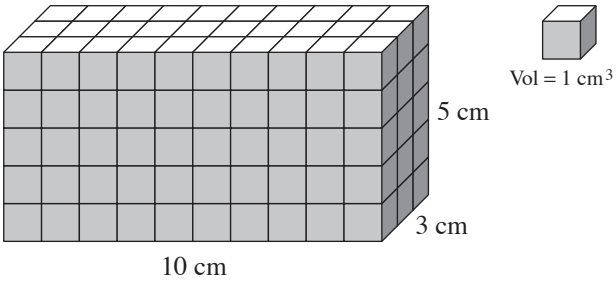
$V =$ ..... $=$ cm^3

i) Using $V = lwh$ find the volume of the rectangular prism.



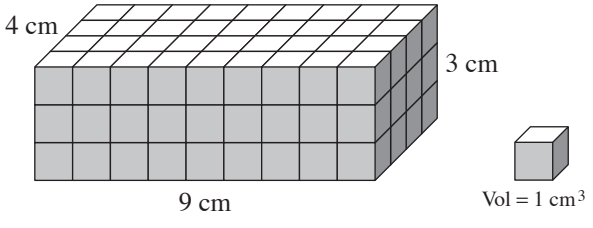
$V =$ ..... $=$ cm^3

j) Using $V = lwh$ find the volume of the rectangular prism.



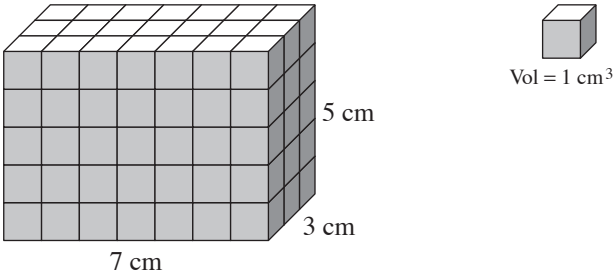
$V =$ ..... $=$ cm^3

k) Using $V = lwh$ find the volume of the rectangular prism.



$V =$ ..... $=$ cm^3

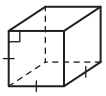
l) Using $V = lwh$ find the volume of the rectangular prism.



$V =$ ..... $=$ cm^3

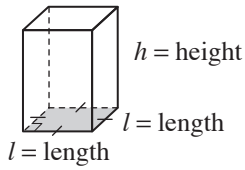
Skill 26.7 Calculating the volume of square and rectangular prisms (1).

Volume of a cube



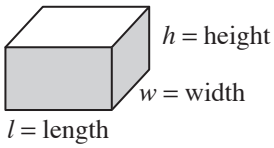
$V = l \times l \times l$
$= l^3$

Volume of a square prism



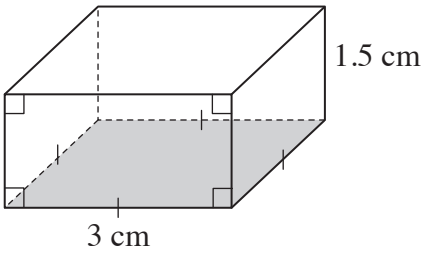
$V = l \times l \times h$
$= l^2h$

Volume of a rectangular prism



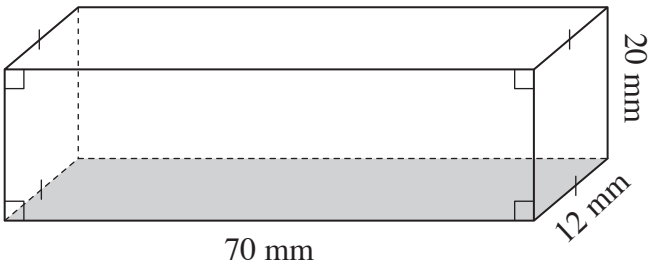
$V = l \times w \times h$
$= lwh$

Q. Using $V = l^2h$ find the volume of the square prism.



A. $V = 3^2 \times 1.5$
$= 9 \times 1.5$
$= \mathbf{13.5\ cm^3}$

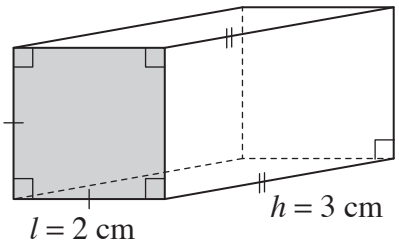
a) Using $V = lwh$ find the volume of the rectangular prism.



$V = 70 \times 12 \times 20$

$= 840 \times 20$ = 16 800 mm^3

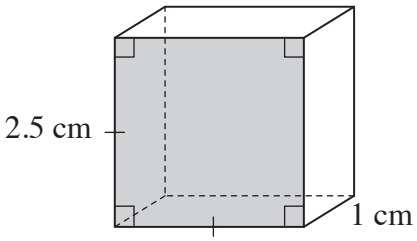
b) Using $V = l^2h$ find the volume of the square prism.



$V =$

$=$ = cm^3

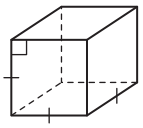
c) Using $V = l^2h$ find the volume of the square prism.



$V =$

$=$ = cm^3

d) Using $V = l^3$ find the volume of the cube.

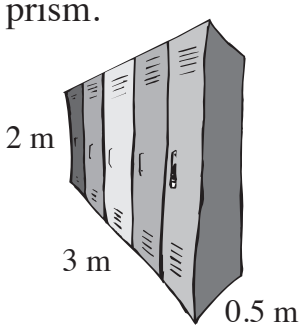


$V =$

$=$ = mm^3

Skill 26.7 Calculating the volume of square and rectangular prisms (2).

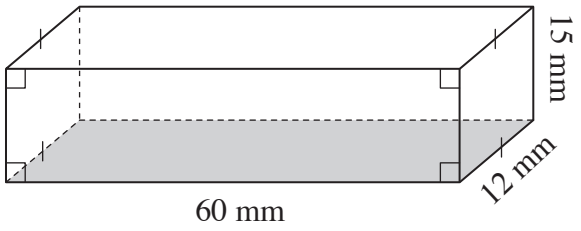
e) Using $V = lwh$ find the volume of the bank of lockers that is a rectangular prism.



$V =$ .....

= ..... = $\boxed{\text{m}^3}$

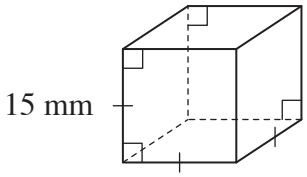
f) Using $V = lwh$ find the volume of the rectangular prism.



$V =$ .....

= ..... = $\boxed{\text{mm}^3}$

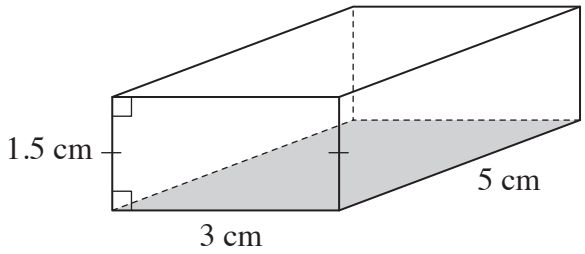
g) Using $V = l^3$ find the volume of the cube.



$V =$ .....

= ..... = $\boxed{\text{mm}^3}$

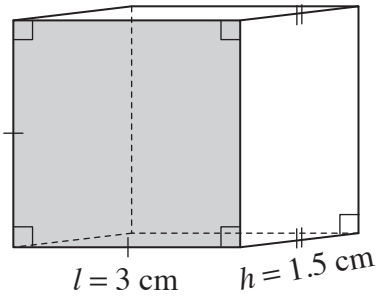
h) Using $V = lwh$ find the volume of the rectangular prism.



$V =$ .....

= ..... = $\boxed{\text{cm}^3}$

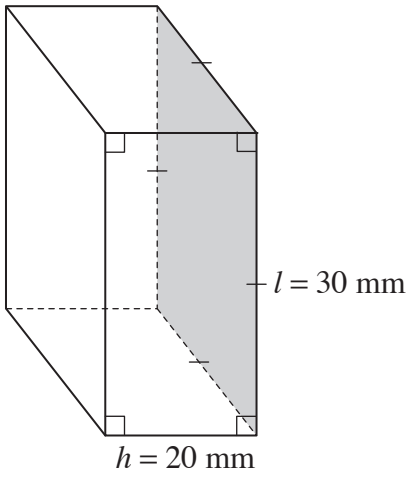
i) Using $V = l^2h$ find the volume of the square prism.



$V =$ .....

= ..... = $\boxed{\text{cm}^3}$

j) Using $V = l^2h$ find the volume of the square prism.



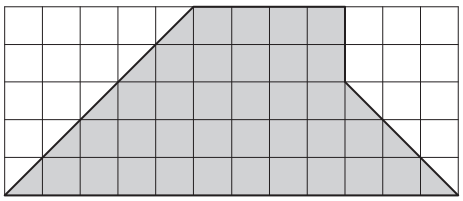
$V =$ .....

= ..... = $\boxed{\text{mm}^3}$

Skill 26.8 Calculating the area of composite shapes (1).

- Break the shape up into workable parts (rectangles/triangles).
- Calculate the area of each part. (see skills 26.4 to 26.5, pages 252 to 254)
- Add the results.

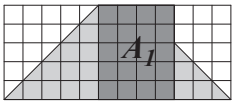
Q. Find the area of the shaded polygon.



A. $A_1 = lw$ *where* $l = 4$ *and* $w = 5$

$= 4 \times 5$

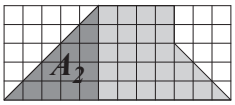
$= 20$



$A_2 = \frac{1}{2} bh$ *where* $b = 5$ *and* $h = 5$

$= \frac{1}{2} \times 5 \times 5$

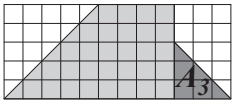
$= 12.5$



$A_3 = \frac{1}{2} bh$ *where* $b = 3$ *and* $h = 3$

$= \frac{1}{2} \times 3 \times 3$

$= 4.5$

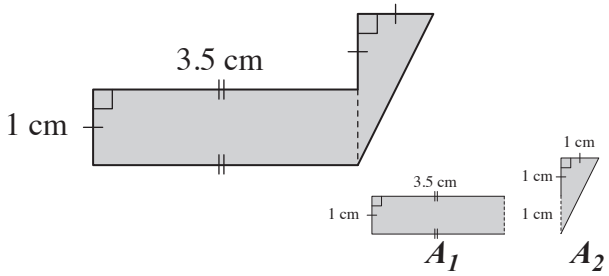


$A = A_1 + A_2 + A_3$

$= 20 + 12.5 + 4.5$

$= \mathbf{37\ sq.\ units}$

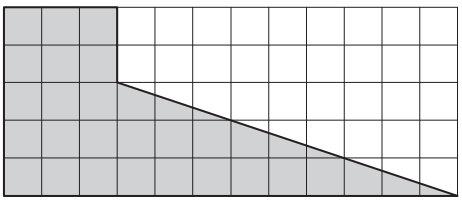
a) Find the area of the shaded polygon.



$A_1 = 1 \times 3.5 = 3.5$ $A_2 = \frac{1}{2} \times 1 \times 2 = 1$

$A = 3.5 + 1$ $= \boxed{\text{cm}^2}$

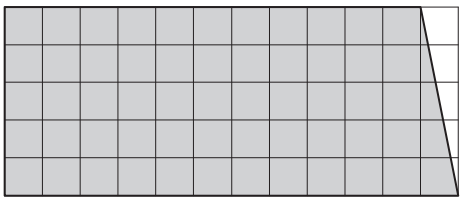
b) Find the area of the shaded polygon.



$A_1 =$ $A_2 =$

$A =$ $= \boxed{\text{sq. units}}$

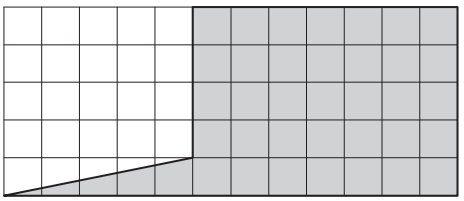
c) Find the area of the shaded polygon.



$A_1 =$ $A_2 =$

$A =$ $= \boxed{\text{sq. units}}$

d) Find the area of the shaded polygon.

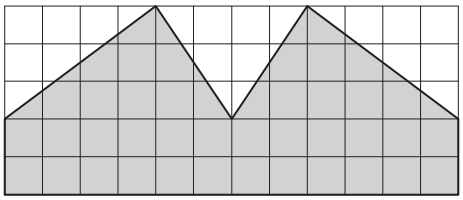


$A_1 =$ $A_2 =$

$A =$ $= \boxed{\text{sq. units}}$

Skill 26.8 Calculating the area of composite shapes (2).

e) Find the area of the shaded polygon.

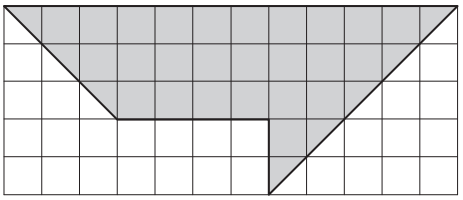


$A_1 =$ ..... $A_2 =$ .....

....

$A =$ ..... $=$ sq. units

f) Find the area of the shaded polygon.

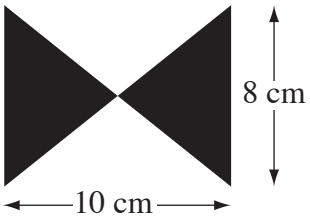


$A_1 =$ ..... $A_2 =$ .....

....

$A =$ ..... $=$ sq. units

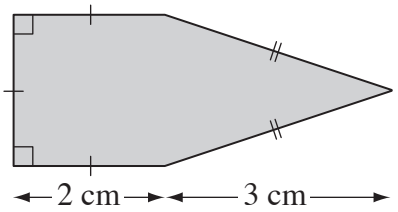
g) Find the area of the bowtie.



$A_1 =$ ..... $A_2 =$ .....

$A =$ ..... $=$ cm^2

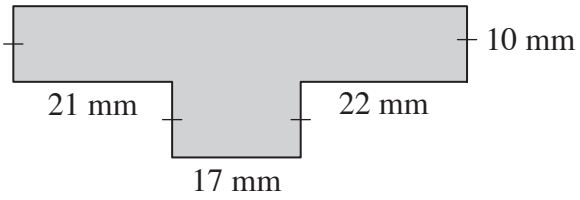
h) Find the area of the polygon.



$A_1 =$ ..... $A_2 =$ .....

$A =$ ..... $=$ cm^2

i) Find the area of the shaded polygon.

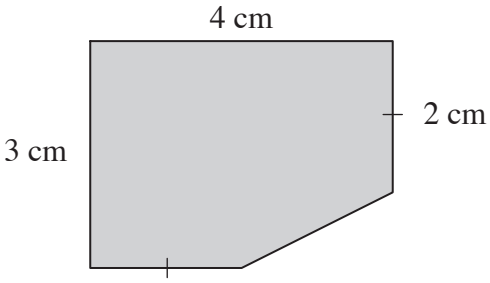


$A_1 =$ ..... $A_2 =$ .....

....

$A =$ ..... $=$ mm^2

j) Find the area of the polygon.



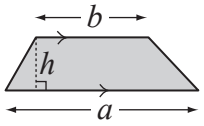
$A_1 =$ ..... $A_2 =$ .....

....

$A =$ ..... $=$ cm^2

Skill 26.9 Calculating the area of trapeziums and rhombii.

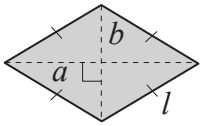
Area of a trapezium



$A = \frac{1}{2}$ (base a + base b) × height h

$= \frac{1}{2}(a + b)h$

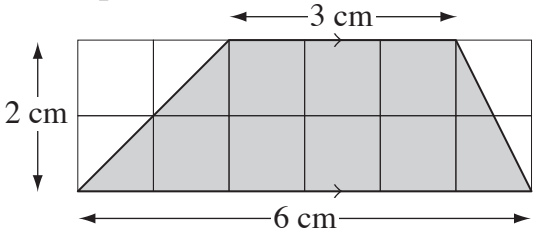
Area of a rhombus



$A = \frac{1}{2} \times$ diagonal $a \times$ diagonal b

$= \frac{1}{2} ab$

Q. Using $A = \frac{1}{2}(a + b)h$ find the area of the trapezium.



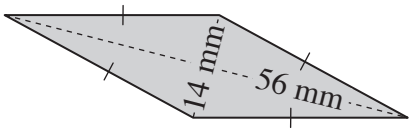
A. $A = \frac{1}{2}(a + b)h$ *where* $a = 3$, $b = 6$ *and* $h = 2$

$= \frac{1}{2} \times (6 + 3) \times 2$

$= \frac{1}{2} \times 9 \times 2$

$=$ ***9 cm²***

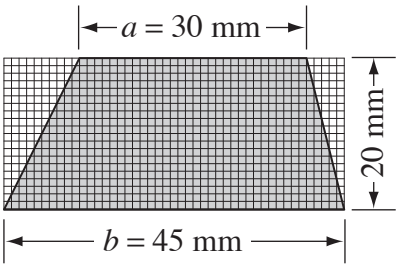
a) Using $A = \frac{1}{2}ab$ find the area of the rhombus.



$A = \frac{1}{2} \times 14 \times 56$

$= 7 \times 56$ = mm²

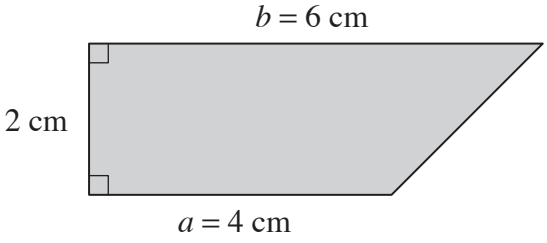
b) Using Area = $\frac{1}{2}$(base a + base b) × height find the area of the trapezium.



$A =$

$=$ = mm²

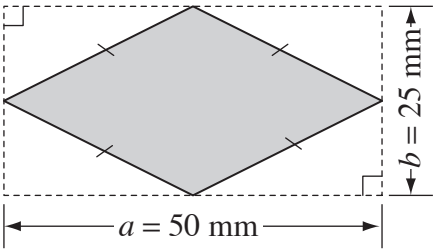
c) Using $A = \frac{1}{2}(a + b)h$ find the area of the trapezium.



$A =$

$=$ = cm²

d) Using Area = $\frac{1}{2} \times$ diagonal $a \times$ diagonal b find the area of the rhombus.

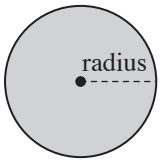


$A =$

$=$ = mm²

Skill 26.10 Calculating the area of circles and composite circular shapes.

Area of a circle

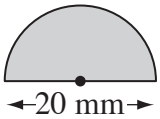


$A = \pi \times radius \times radius$
$= \pi r^2$

where $\pi \approx 3.14...$
or $\approx \frac{22}{7}$

Hint: If you are given the diameter then halve to find the radius: $r = \frac{d}{2}$

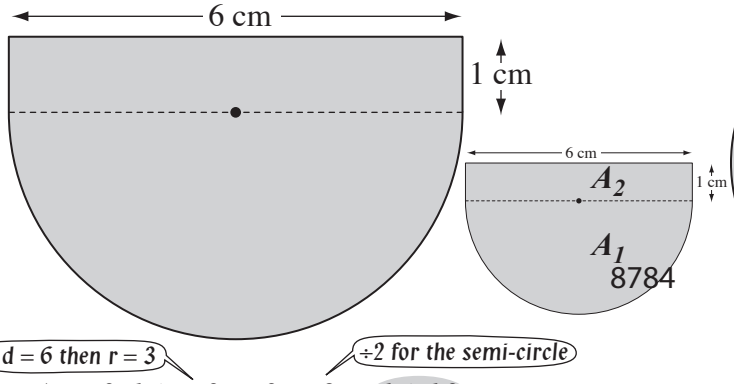
Q. Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the semi-circle.



A. *Area of circle* $= \pi r^2$ *where* $d = 20$ *and* $r = 10$
$= 3.14 \times 10^2$
$= 3.14 \times 100$
$= 314$
Area of semi-circle
$= 314 \div 2$
$= \mathbf{157\ mm^2}$

$r = \frac{d}{2}$

a) Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the shaded shape.



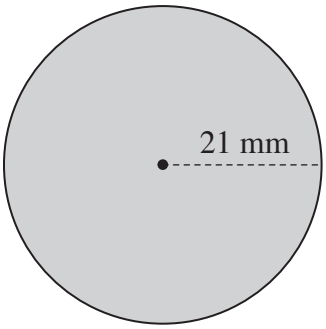
If $d = 6$ then $r = 3$ ÷2 for the semi-circle

$A_1 = 3.14 \times 3 \times 3 \div 2 = 14.13$

$A_2 = 6 \times 1 = 6$ *and using* $A = A_1 + A_2$

$A = 14.13 + 6$ = cm²

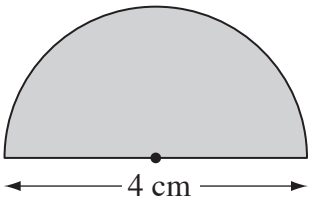
b) Using $A = \pi r^2$ and $\pi \approx \frac{22}{7}$, find the area of the circle.



$A =$

= = mm²

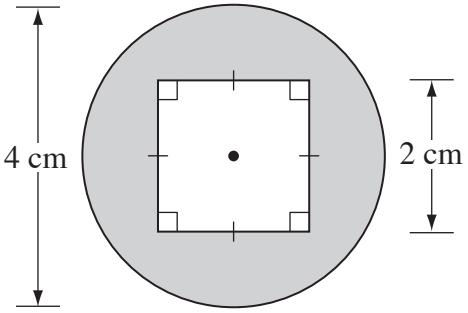
c) Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the semi-circle.



$A =$

= = cm²

d) Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the shaded shape.



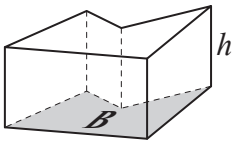
$A_1 =$

$A_2 =$

$A =$ = cm²

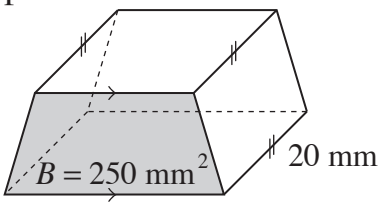
Skill 26.11 Calculating the volume of any prism.

Volume of a prism



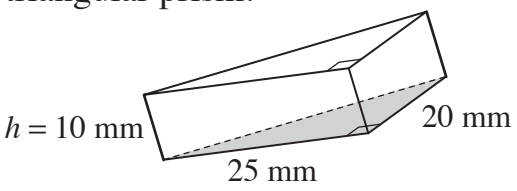
V = *Area of base* × *height of prism*
$= Bh$

Q. Using $V = Bh$ find the volume of the prism.



A. $A = Bh$ *where* $B = 250$ *and* $h = 20$
$= 250 \times 20$
$= \mathbf{5000\ mm^3}$

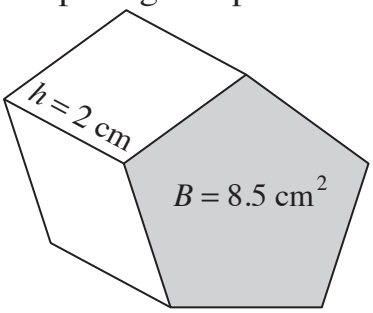
a) Using $V = Bh$ find the volume of the triangular prism.



$B = \frac{1}{2} \times 25 \times 20 = 250$

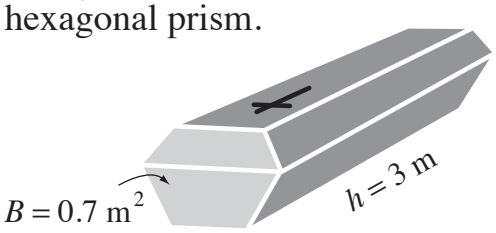
$V = 250 \times 10$ = [mm³]

b) Using Volume = area of the base × height of the prism find the volume of the pentagonal prism.



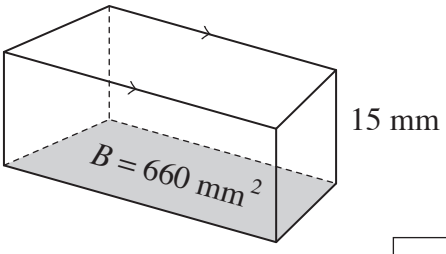
V = = [cm³]

c) Using $V = Bh$ find the volume of the hexagonal prism.



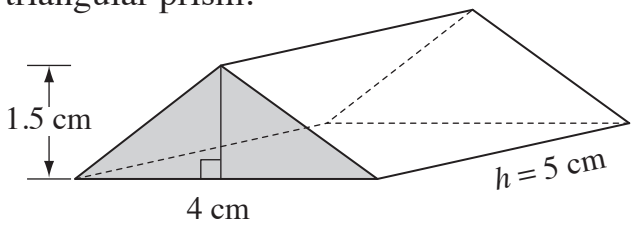
V = = [m³]

d) Using $V = Bh$ find the volume of the prism.



V = = [mm³]

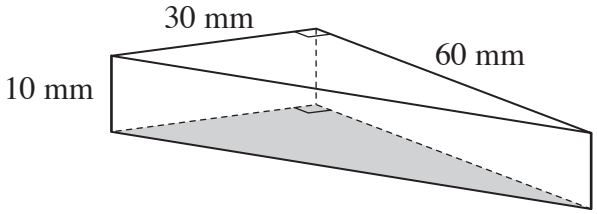
e) Using $V = Bh$ find the volume of the triangular prism.



B =

V = = [cm³]

f) Using $V = Bh$ find the volume of the triangular prism.



B =

V = = [mm³]