A / A* questions

2010

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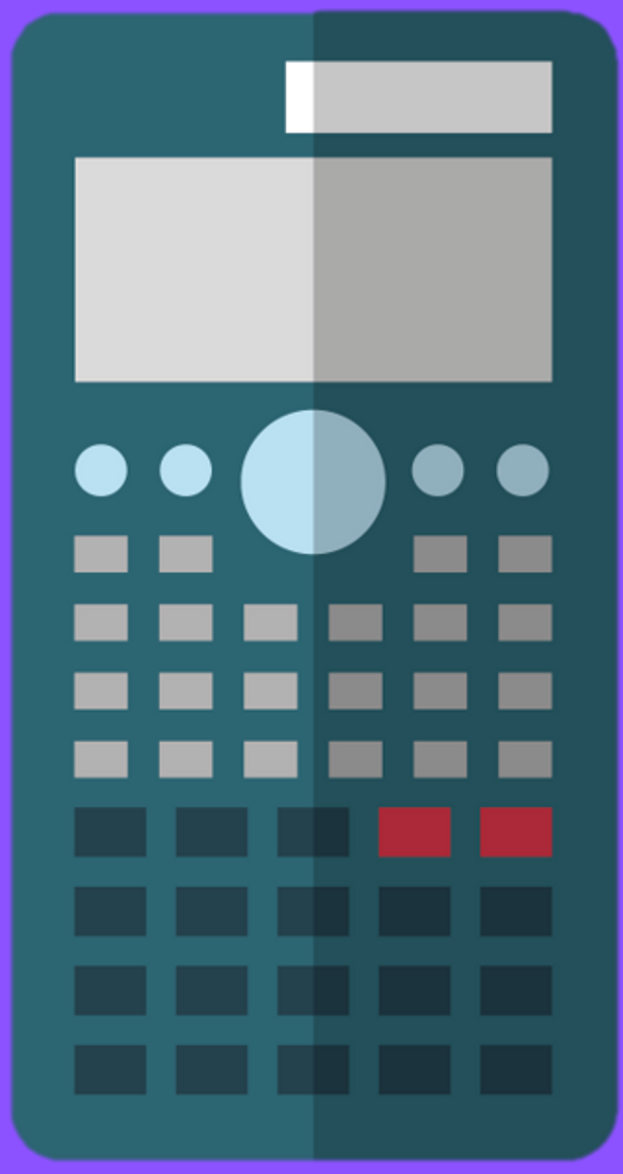

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1 Write the numbers in order of size with the **smallest** first.

$\sqrt{10}$ 3.14 $\frac{22}{7}$ π

Answer ..... < ..... < ..... < ..... [2]

---

2 Michel changed \$600 into pounds (£) when the exchange rate was £1 = \$2.40.
He later changed all the pounds back into dollars when the exchange rate was £1 = \$2.60.

How many dollars did he receive?

Answer \$ ..... [2]

---

3 p is the largest prime number between 50 and 100.
q is the smallest prime number between 50 and 100.

Calculate the value of $p - q$.

Answer ..... [2]

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4 A person in a car, travelling at 108 kilometres per hour, takes 1 second to go past a building on the side of the road.

Calculate the length of the building in metres.

Answer ..... m [2]

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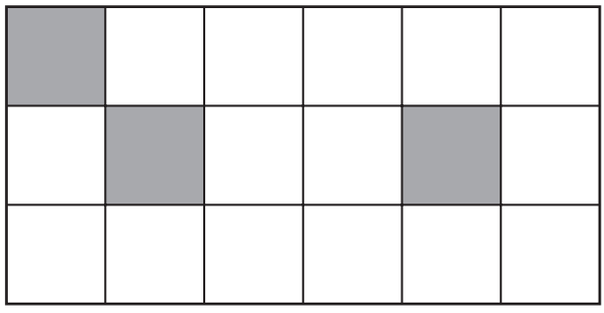
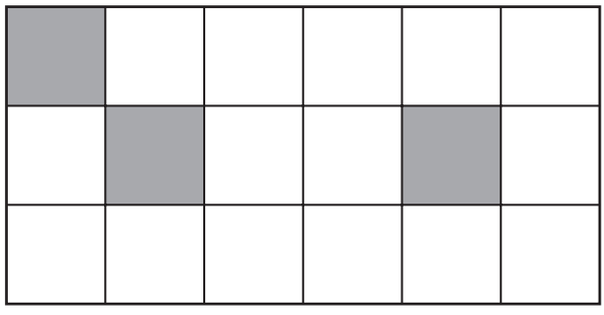
8 **(a)** Shade **one** square in each diagram so that there is

(i) one line of symmetry,



[1]

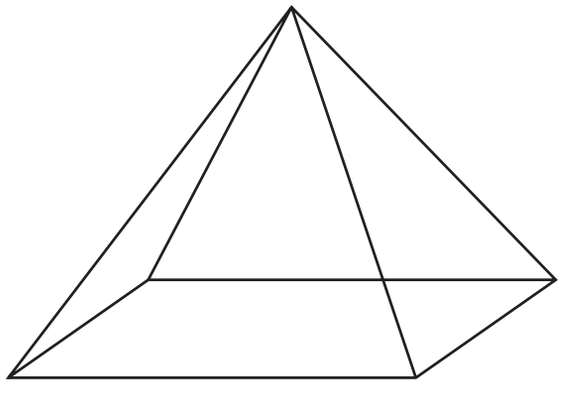
(ii) rotational symmetry of order 2.



[1]

(b) The pyramid below has a rectangular base.
The vertex of the pyramid is vertically above the centre of the base.

Write down the number of **planes** of symmetry for the pyramid.



Answer(b) ..... [1]

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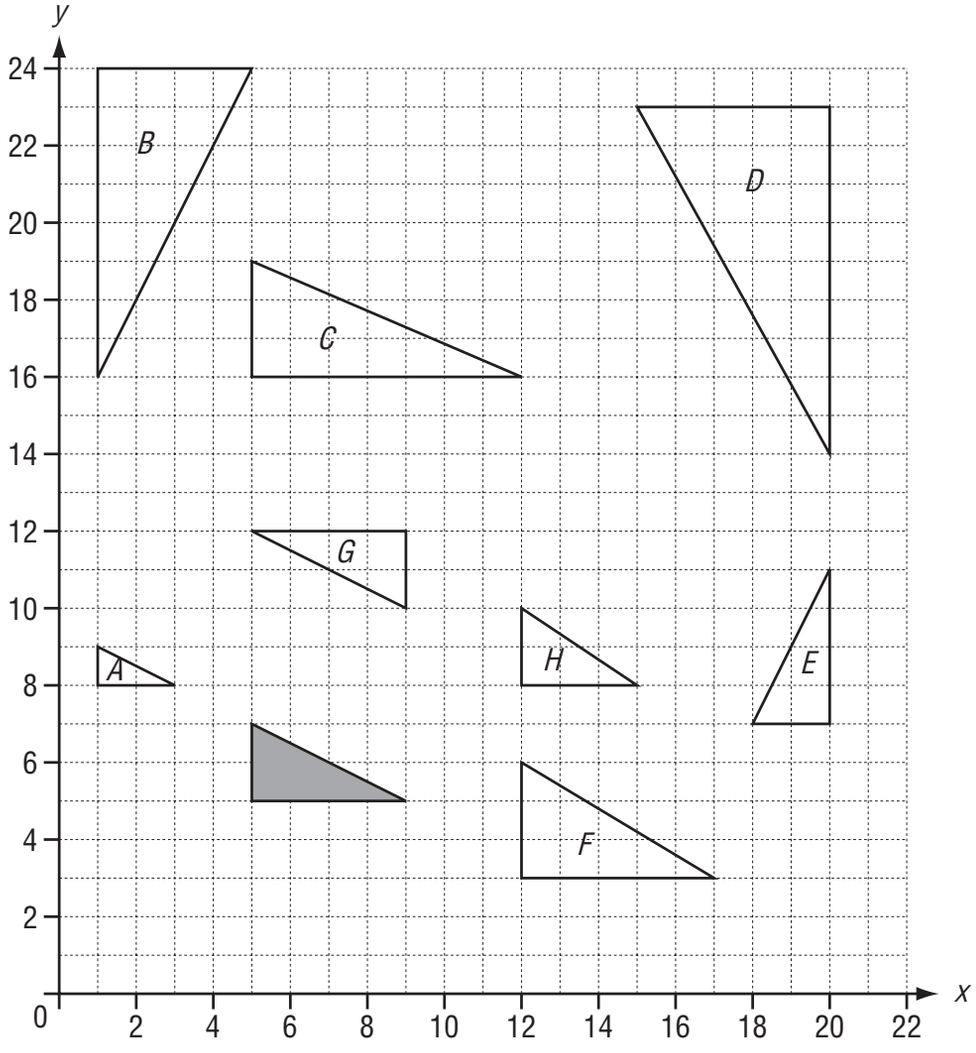


Write down the letters of all the triangles which are

(a) congruent to the shaded triangle,

Answer(a) ..... [2]

(b) similar, but not congruent, to the shaded triangle.

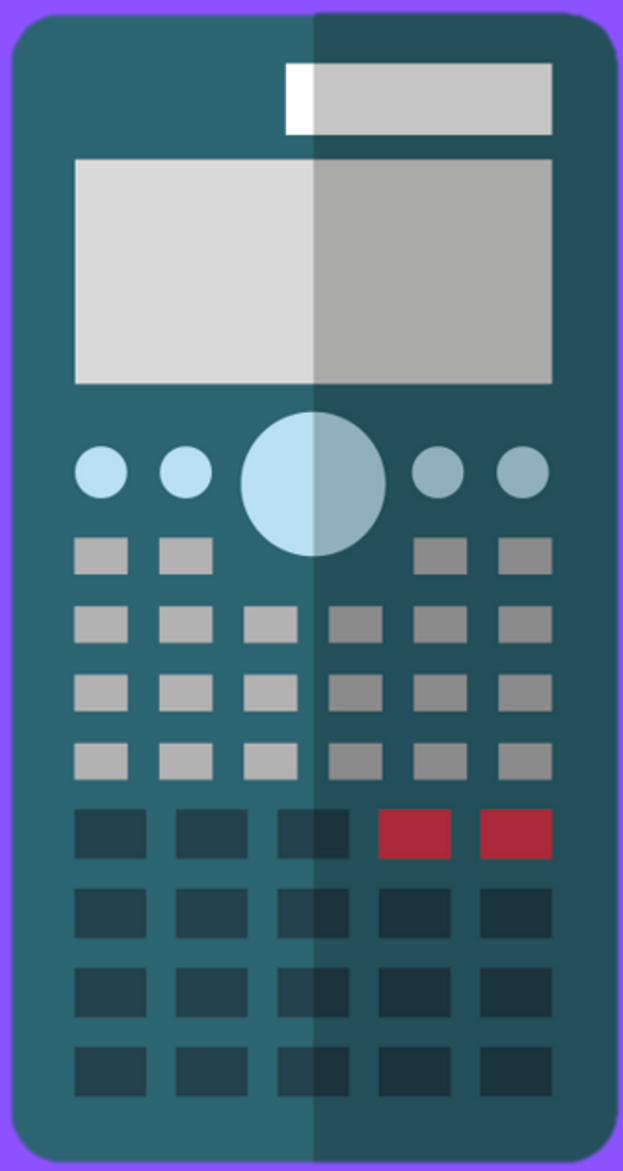
Answer(b) ..... [2]

0580/41

MAY/JUNE

YEAR

2010



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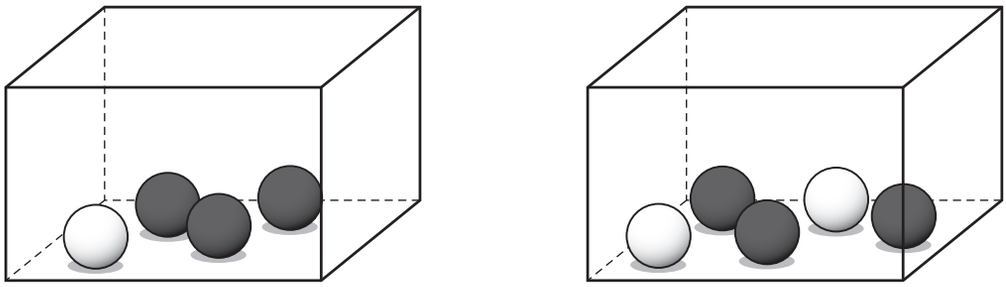


A B

Box A contains 3 black balls and 1 white ball.
Box B contains 3 black balls and 2 white balls.

(a) A ball can be chosen at random from either box.
Complete the following statement.

There is a greater probability of choosing a white ball from Box ..... .

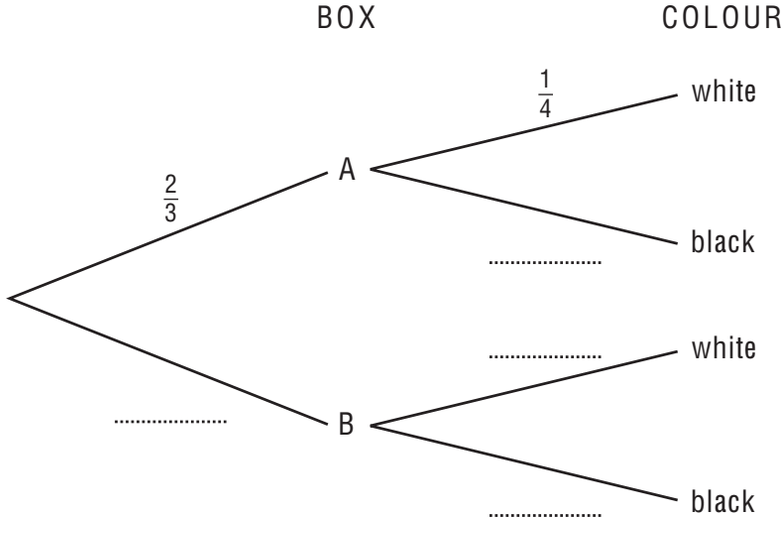
Explain your answer.

Answer(a) ..... [1]

(b) Abdul chooses a box and then chooses a ball from this box at random.

The probability that he chooses box A is $\frac{2}{3}$.

(i) Complete the tree diagram by writing the four probabilities in the empty spaces.



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(ii) Find the probability that Abdul chooses box A and a black ball.

Answer(b)(ii) ..... [2]

(iii) Find the probability that Abdul chooses a black ball.

Answer(b)(iii) ..... [2]

(c) Tatiana chooses a box and then chooses **two** balls from this box at random (without replacement).

The probability that she chooses box A is $\frac{2}{3}$.

Find the probability that Tatiana chooses two white balls.

Answer(c) ..... [2]

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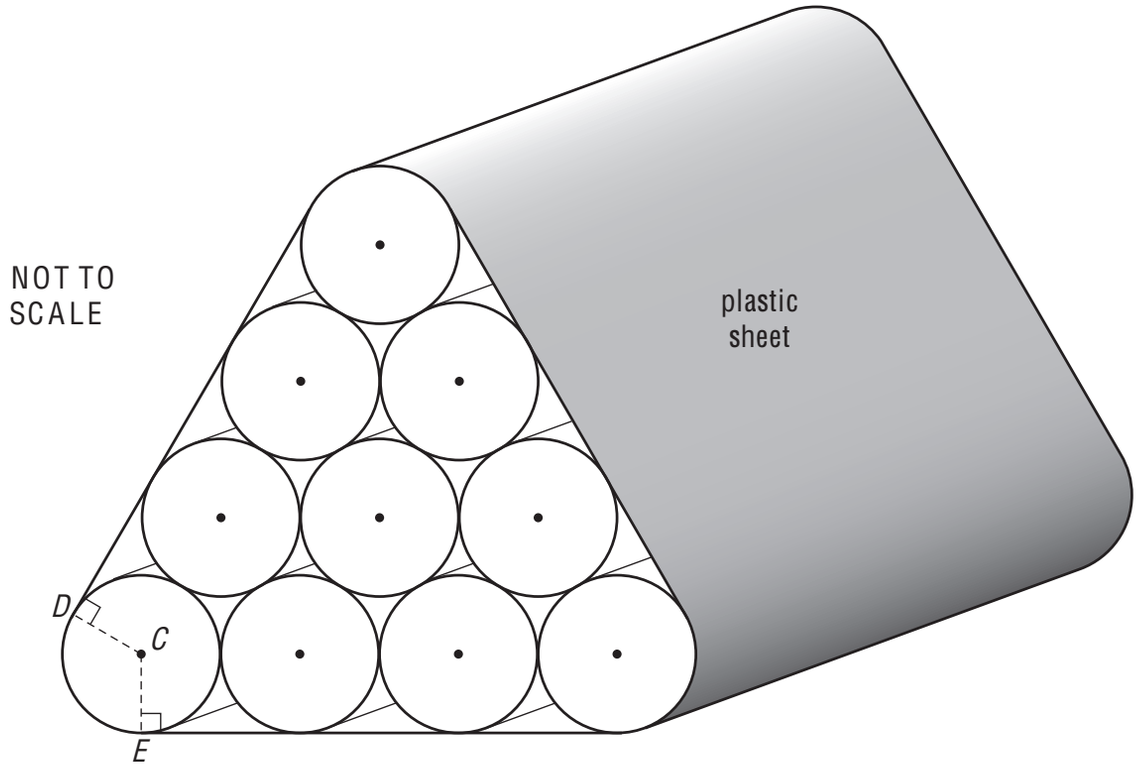
7 **(a)** Calculate the volume of a cylinder of radius 31 **centimetres** and length 15 **metres**.
Give your answer in cubic metres.

Answer(a) ..... m^3 [3]

(b) A tree trunk has a circular cross-section of radius 31 cm and length 15 m.
One cubic metre of the wood has a mass of 800 kg.
Calculate the mass of the tree trunk, giving your answer in tonnes.

Answer(b) ..... tonnes [2]

(c)



The diagram shows a pile of 10 tree trunks.
Each tree trunk has a circular cross-section of radius 31 cm and length 15 m.
A plastic sheet is wrapped around the pile.

C is the centre of one of the circles.
CE and *CD* are perpendicular to the straight edges, as shown.

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(i) Show that angle $ECD = 120°$.

Answer(c)(i)

[2]

(ii) Calculate the length of the arc DE, giving your answer in metres.

Answer(c)(ii) ..... m [2]

(iii) The edge of the plastic sheet forms the perimeter of the cross-section of the pile.
The perimeter consists of three straight lines and three arcs.
Calculate this perimeter, giving your answer in metres.

Answer(c)(iii) ..... m [3]

(iv) The plastic sheet does not cover the two ends of the pile.
Calculate the area of the plastic sheet.

Answer(c)(iv) ..... m^2 [1]

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10 A company has a vehicle parking area of 1200 m^2 with space for x cars and y trucks.

Each car requires 20 m^2 of space and each truck requires 100 m^2 of space.

(a) Show that $x + 5y \leqslant 60$.

Answer(a)

[1]

(b) There must also be space for

(i) at least 40 vehicles,

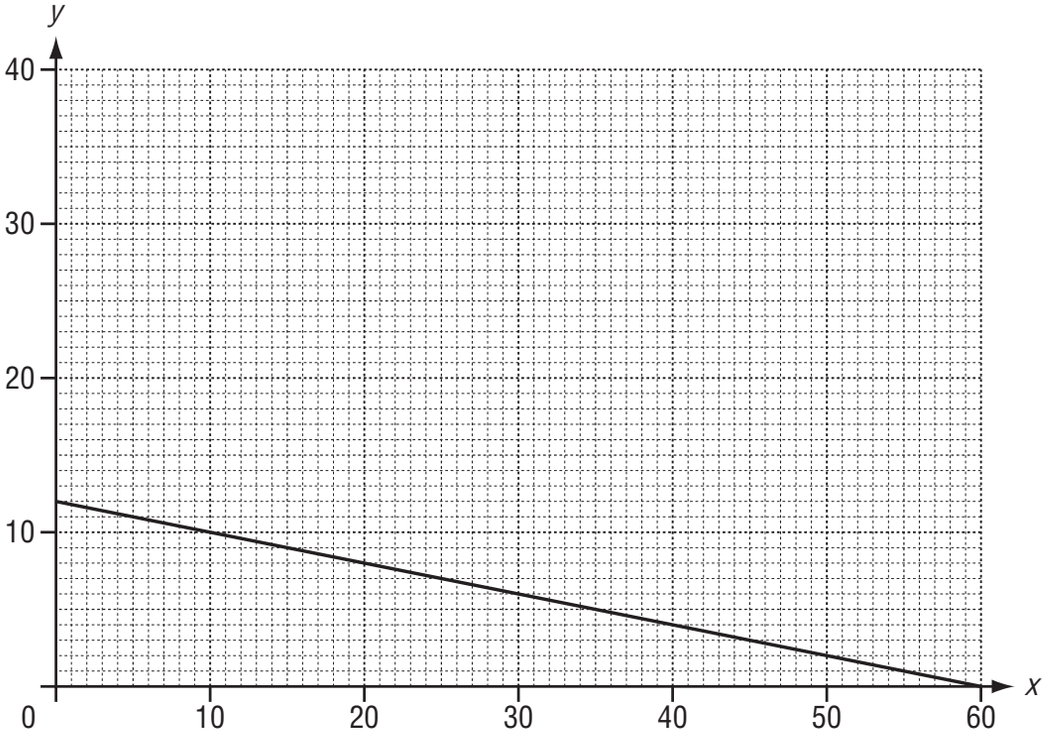
(ii) at least 2 trucks.

Write down two more inequalities to show this information.

Answer(b)(i) ..... [1]

Answer(b)(ii) ..... [1]

(c) One line has been drawn for you.
On the grid, show the three inequalities by drawing the other two lines and shading the **unwanted** regions.



[4]

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(d) Use your graph to find the largest possible number of trucks.

Answer(d) ..... [1]

(e) The company charges \$5 for parking each car and \$10 for parking each truck.
Find the number of cars and the number of trucks which give the company the greatest possible income.

Calculate this income.

Answer(e) Number of cars = ...

Number of trucks = ...

Greatest possible income = \$ ..... [3]

11

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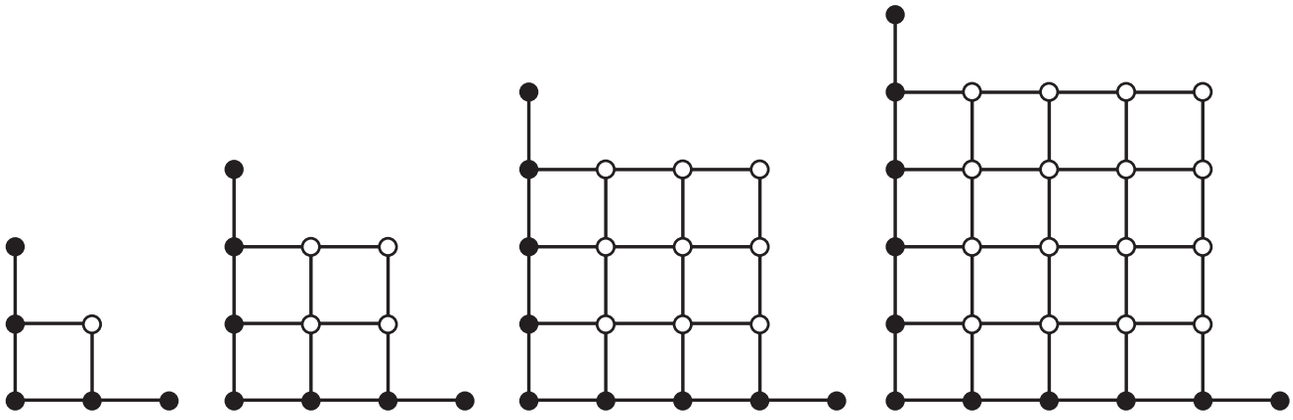

Diagram 1	Diagram 2	Diagram 3	Diagram 4
1 white dot	4 white dots	9 white dots	16 white dots
5 black dots	7 black dots	9 black dots	11 black dots
6 lines	14 lines	26 lines	42 lines

The four diagrams above are the first four of a pattern.

(a) Diagram 5 has been started below.
Complete this diagram and write down the information about the numbers of dots and lines.

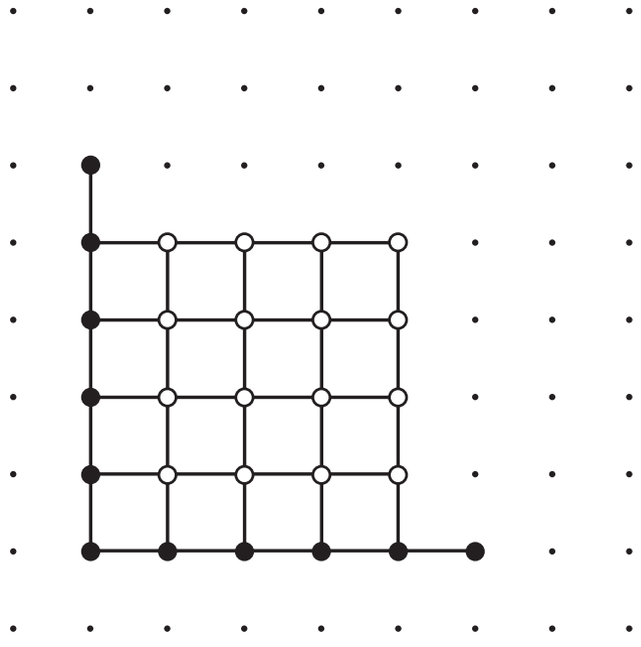

Diagram 5

..... white dots

..... black dots

..... lines

[4]

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(b) Complete the information about the number of dots and lines in Diagram 8.

Answer(b) ..... white dots

..... black dots

..... lines [3]

(c) Complete the information about the number of dots in Diagram n.
Give your answers in terms of n.

Answer(c) ..... white dots

..... black dots [2]

(d) The number of lines in diagram n is $k(n^2 + n + 1)$.

Find

(i) the value of k,

Answer(d)(i) $k =$ ..... [1]

(ii) the number of lines in Diagram 100.

Answer(d)(ii) ..... [1]

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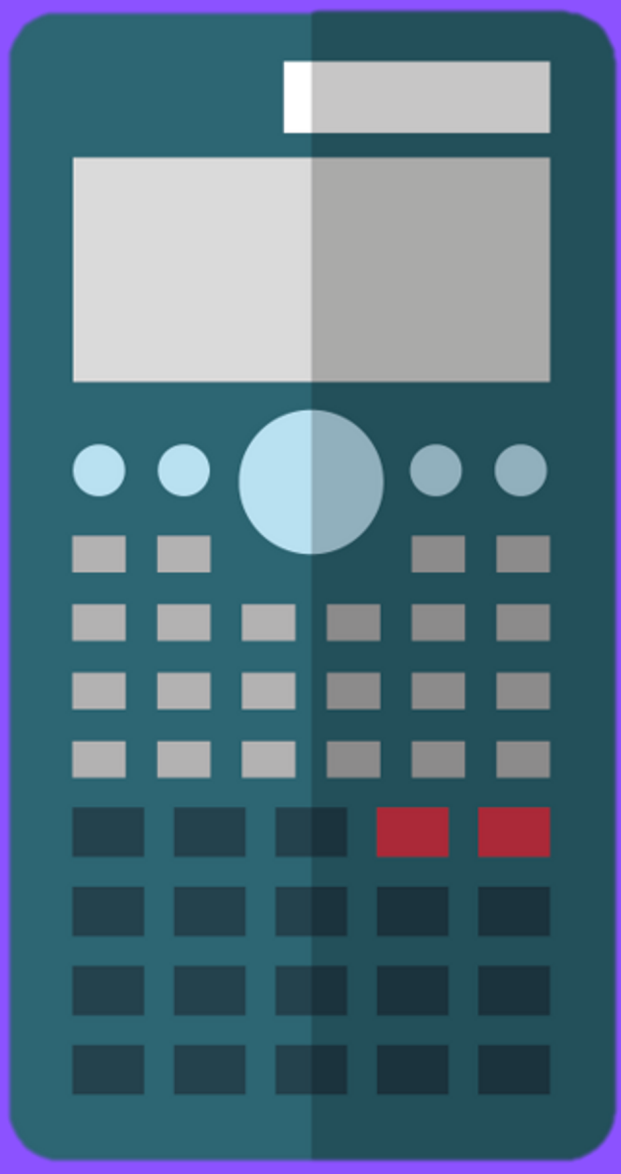

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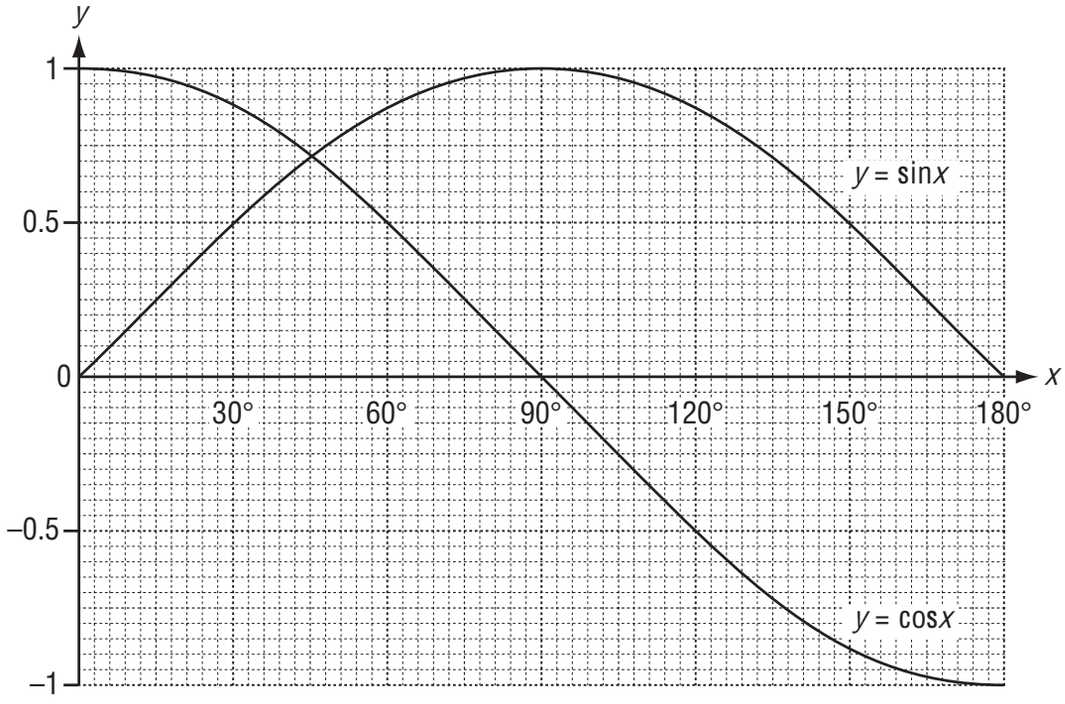

The diagram shows accurate graphs of $y = \sin x$ and $y = \cos x$ for $0° \leqslant x \leqslant 180°$.

Use the graph to solve the equations

(a) $\sin x - \cos x = 0$,

Answer(a) $x =$ ..... [1]

(b) $\sin x - \cos x = 0.5$.

Answer(b) $x =$ ..... [2]

---

9 A fence is made from 32 identical pieces of wood, each of length 2 metres correct to the nearest centimetre.

Calculate the lower bound for the total length of the wood used to make this fence.

Write down your full calculator display.

Answer ..... m [3]

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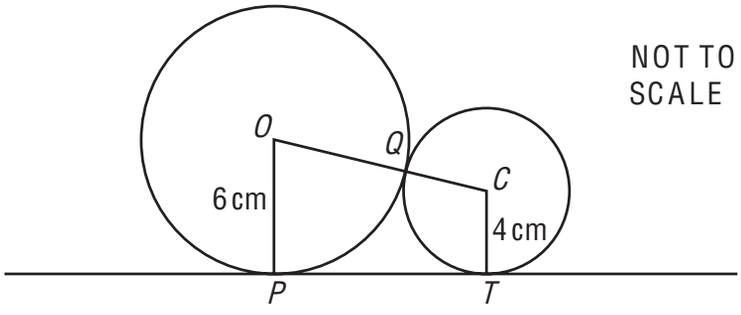
10 Make x the subject of the formula.

$$P = \frac{x + 3}{x}$$

Answer $x =$ [4]

11



Two circles, centres O and C, of radius 6 cm and 4 cm respectively, touch at Q. PT is a tangent to both circles.

(a) Write down the distance OC.

Answer(a) $OC =$ ..... cm [1]

(b) Calculate the distance PT.

Answer(b) $PT =$ ..... cm [3]

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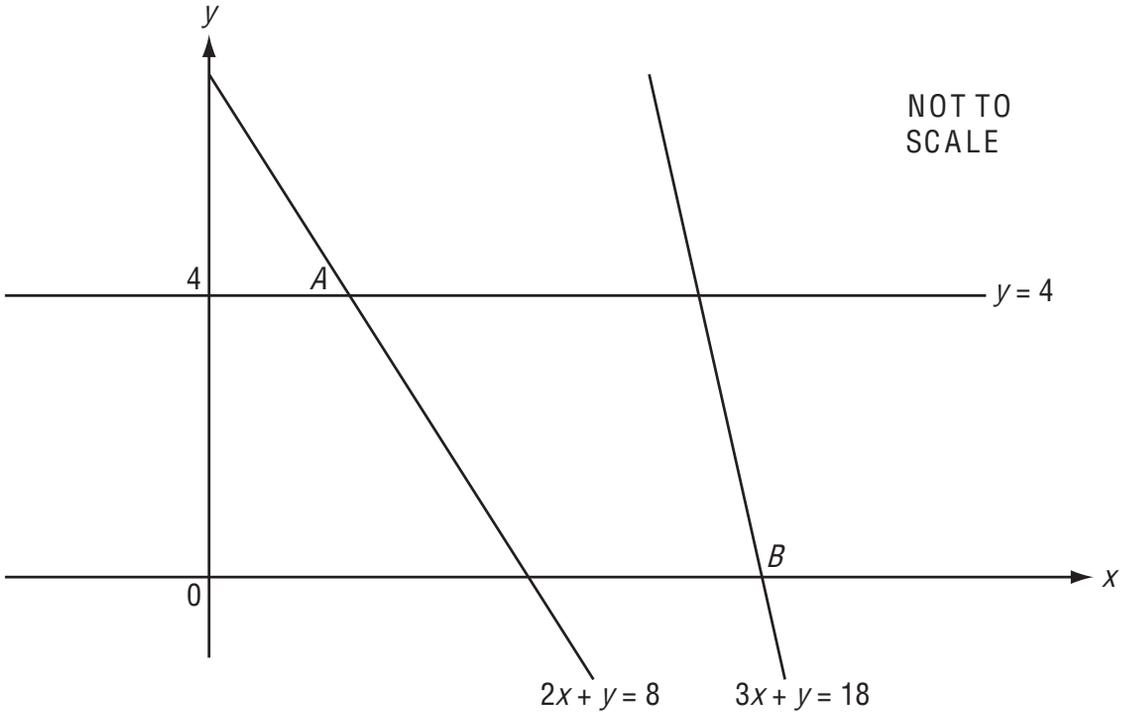

(a) The line $y = 4$ meets the line $2x + y = 8$ at the point A.
Find the co-ordinates of A.

Answer(a) A (..... , ...) [1]

(b) The line $3x + y = 18$ meets the x axis at the point B.
Find the co-ordinates of B.

Answer(b) B (..... , ...) [1]

(c) **(i)** Find the co-ordinates of the mid-point M of the line joining A to B.

Answer(c)(i) M (..... , ...) [1]

(ii) Find the equation of the line through M parallel to $3x + y = 18$.

Answer(c)(ii) ..... [2]

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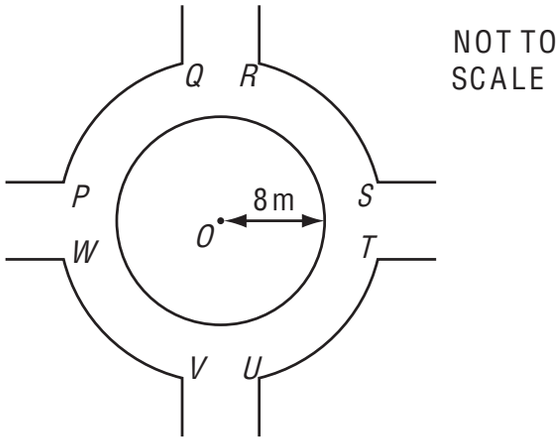
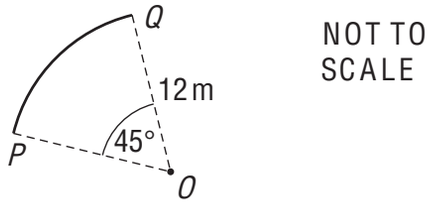


The diagram shows the junction of four paths.
In the junction there is a circular area covered in grass.
This circle has centre O and radius 8 m.

(a) Calculate the area of grass.

Answer(a) ..... m^2 [2]

(b)



The arc PQ and the other three identical arcs, RS, TU and VW are each part of a circle, centre O, radius 12m.
The angle POQ is 45°.
The arcs PQ, RS, TU, VW and the circumference of the circle in **part(a)** are painted white.
Calculate the total length painted white.

Answer(b) ..... m [4]

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19 The braking distance, d metres, for Alex's car travelling at v km/h is given by the formula

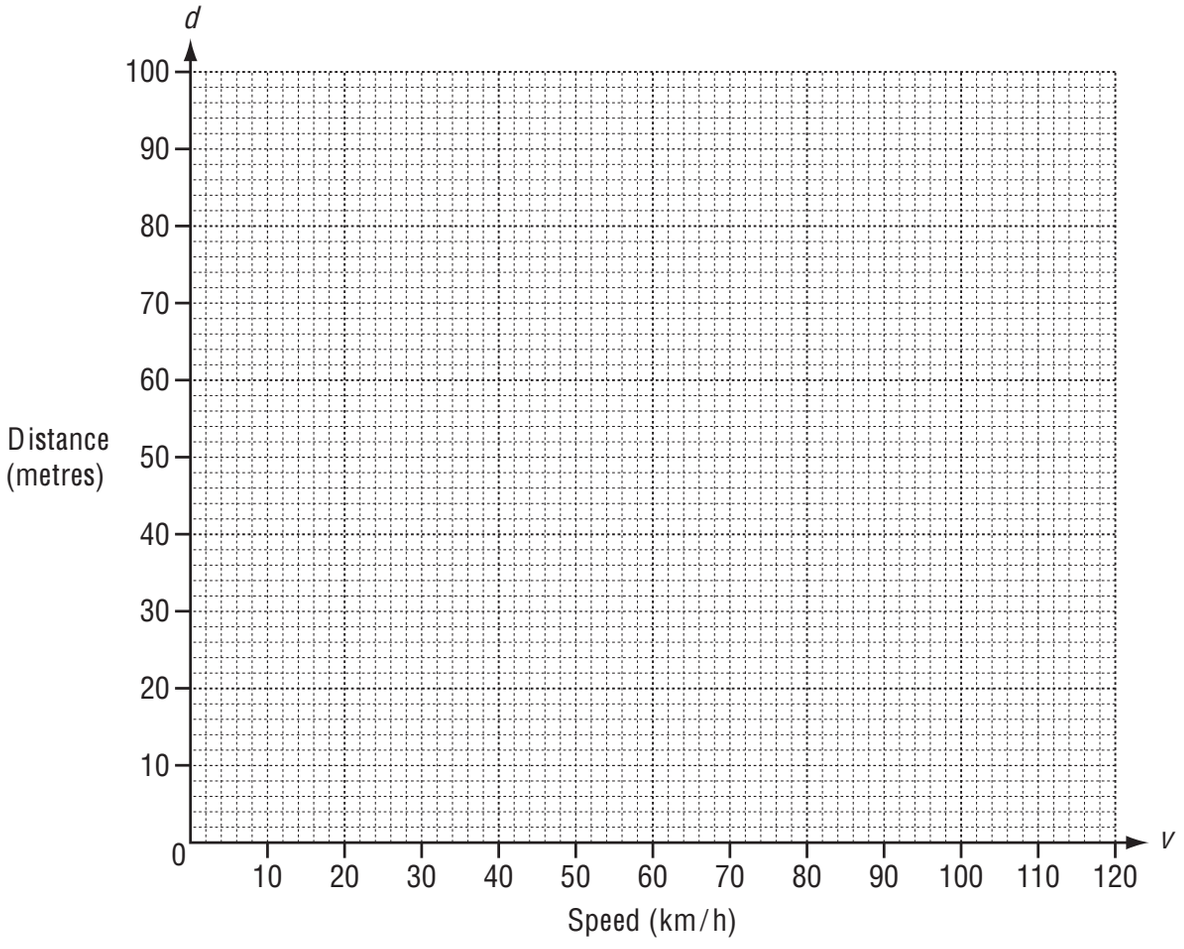
$$200d = v(v + 40).$$

(a) Calculate the missing values in the table.

v (km/h)	0	20	40	60	80	100	120
d (metres)	0		16		48		96

[2]

(b) On the grid below, draw the graph of $200d = v(v + 40)$ for $0 \leqslant v \leqslant 120$.



[3]

(c) Find the braking distance when the car is travelling at 110 km/h.

Answer(c) ..... m [1]

(d) Find the speed of the car when the braking distance is 80 m.

Answer(d) ..... km/h [1]

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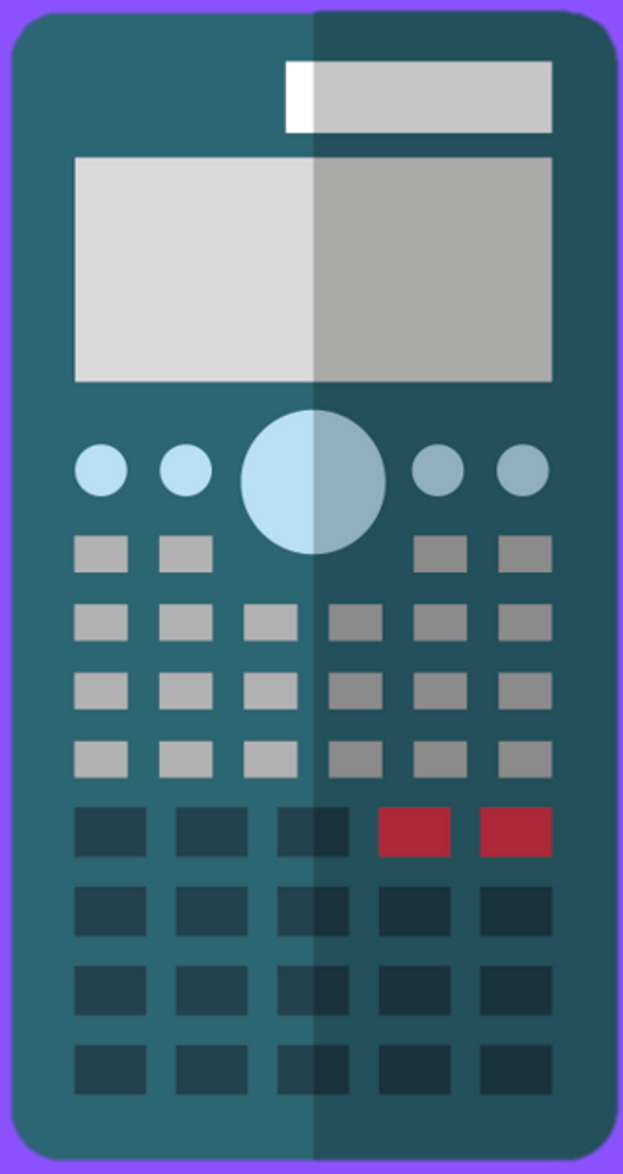

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2 **(a)** $\mathbf{p} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$.

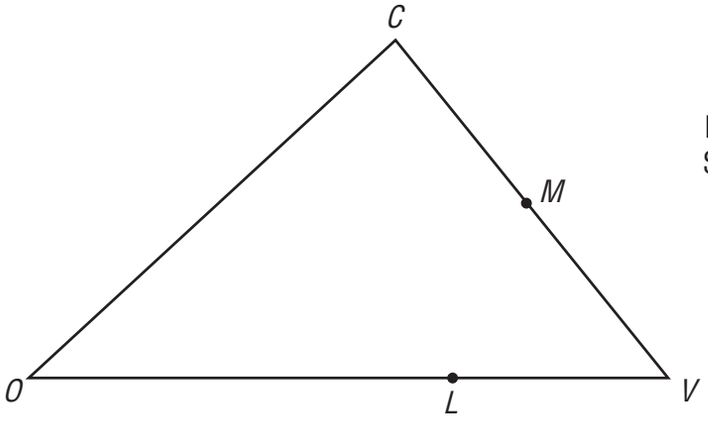
(i) Find, as a single column vector, $\mathbf{p} + 2\mathbf{q}$.

Answer(a)(i) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [2]

(ii) Calculate the value of $|\ \mathbf{p} + 2\mathbf{q}\ |$.

Answer(a)(ii) ..... [2]

(b)



In the diagram, $CM = MV$ and $OL = 2LV$.
O is the origin. $\overrightarrow{OC} = \mathbf{c}$ and $\overrightarrow{OV} = \mathbf{v}$.

Find, in terms of **c** and **v**, in their simplest forms

(i) $\overrightarrow{CM}$,

Answer(b)(i) ..... [2]

(ii) the position vector of M,

Answer(b)(ii) ..... [2]

(iii) $\overrightarrow{ML}$.

Answer(b)(iii) ..... [2]

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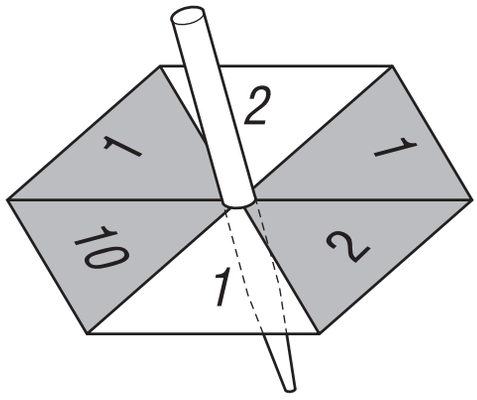

The diagram shows a spinner with six numbered sections.
Some of the sections are shaded.
Each time the spinner is spun it stops on one of the six sections.
It is equally likely that it stops on any one of the sections.

(a) The spinner is spun once.

Find the probability that it stops on

(i) a shaded section,

Answer(a)(i) ..... [1]

(ii) a section numbered 1,

Answer(a)(ii) ..... [1]

(iii) a shaded section numbered 1,

Answer(a)(iii) ..... [1]

(iv) a shaded section or a section numbered 1.

Answer(a)(iv) ..... [1]

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(b) The spinner is now spun twice.

Find the probability that the total of the two numbers is

(i) 20,

Answer(b)(i) ..... [2]

(ii) 11.

Answer(b)(ii) ..... [2]

(c) **(i)** The spinner stops on a shaded section.

Find the probability that this section is numbered 2.

Answer(c)(i) ..... [1]

(ii) The spinner stops on a section numbered 2.

Find the probability that this section is shaded.

Answer(c)(ii) ..... [1]

(d) The spinner is now spun until it stops on a section numbered 2.
The probability that this happens on the nth spin is $\frac{16}{243}$.

Find the value of n.

Answer(d) $n =$ ..... [2]

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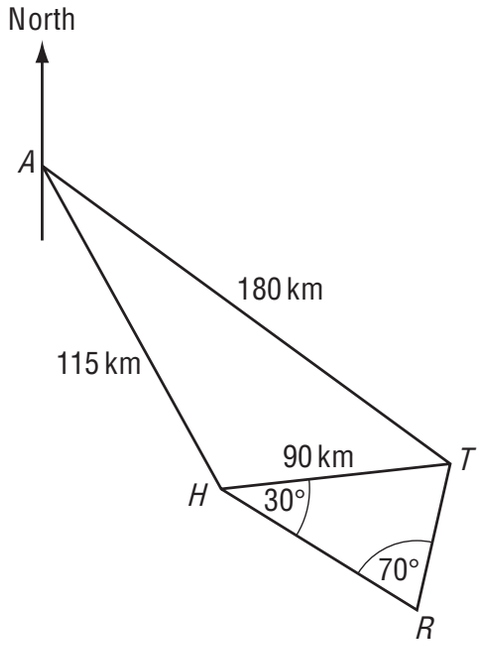

The diagram shows some straight line distances between Auckland (A), Hamilton (H), Tauranga (T) and Rotorua (R).
AT = 180 km, AH = 115 km and HT = 90 km.

(a) Calculate angle HAT.
Show that this rounds to 25.0°, correct to 3 significant figures.

Answer(a)

[4]

(b) The bearing of H from A is 150°.

Find the bearing of

(i) T from A,

Answer(b)(i) ..... [1]

(ii) A from T.

Answer(b)(ii) ..... [1]

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(c) Calculate how far T is east of A.

Answer(c) ..... km [3]

(d) Angle $THR = 30°$ and angle $HRT = 70°$.

Calculate the distance TR.

Answer(d) ..... km [3]

(e) On a map the distance representing HT is 4.5cm.

The scale of the map is 1 : n.

Calculate the value of n.

Answer(e) $n =$ ..... [2]

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6 A spherical ball has a radius of 2.4 cm.

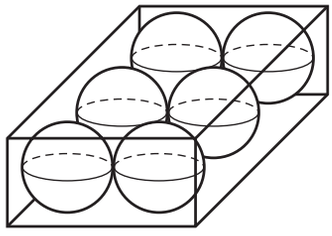
(a) Show that the volume of the ball is 57.9 cm^3, correct to 3 significant figures.

[The volume V of a sphere of radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(a)

[2]

(b)



NOT TO SCALE

Six spherical balls of radius 2.4 cm fit exactly into a **closed** box.
The box is a cuboid.

Find

(i) the length, width and height of the box,

Answer(b)(i) ..... cm, ... cm, ... cm [3]

(ii) the volume of the box,

Answer(b)(ii) ..... cm^3 [1]

(iii) the volume of the box **not** occupied by the balls,

Answer(b)(iii) ..... cm^3 [1]

(iv) the surface area of the box.

Answer(b)(iv) ..... cm^2 [2]

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(c)

NOT TO SCALE

The six balls can also fit exactly into a **closed** cylindrical container, as shown in the diagram.

Find

(i) the volume of the cylindrical container,

Answer(c)(i) ..... cm^3 [3]

(ii) the volume of the cylindrical container **not** occupied by the balls,

Answer(c)(ii) ..... cm^3 [1]

(iii) the surface area of the cylindrical container.

Answer(c)(iii) ..... cm^2 [3]

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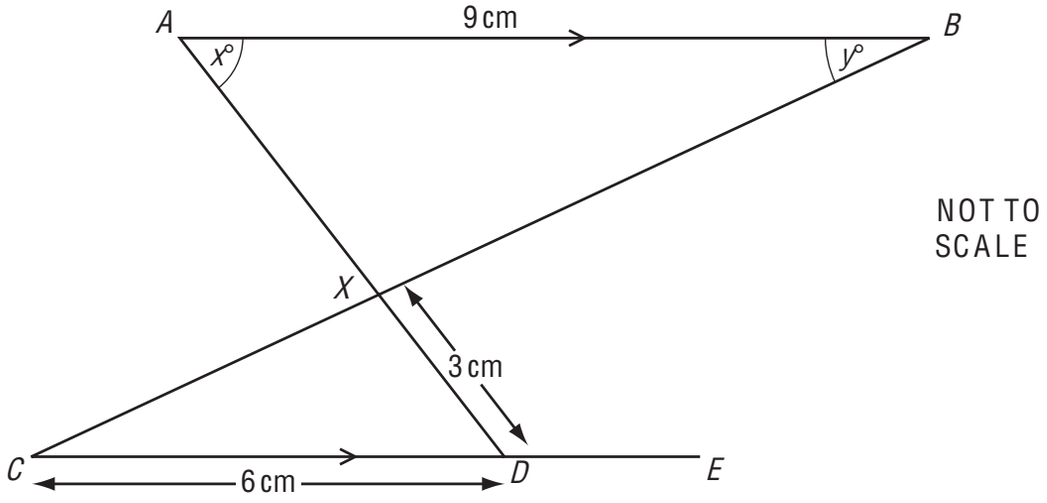
9 (a)



The lines AB and CDE are parallel.
AD and CB intersect at X.
$AB = 9$ cm, $CD = 6$ cm and $DX = 3$ cm.

(i) Complete the following statement.

Triangle ABX is ..... to triangle DCX. [1]

(ii) Calculate the length of AX.

Answer(a)(ii) $AX =$ ..... cm [2]

(iii) The area of triangle DCX is 6 cm^2.

Calculate the area of triangle ABX.

Answer(a)(iii) ..... cm^2 [2]

(iv) Angle $BAX = x°$ and angle $ABX = y°$.

Find angle AXB and angle XDE in terms of x and/or y.

Answer(a)(iv) Angle AXB = ...

Angle XDE = ... [2]

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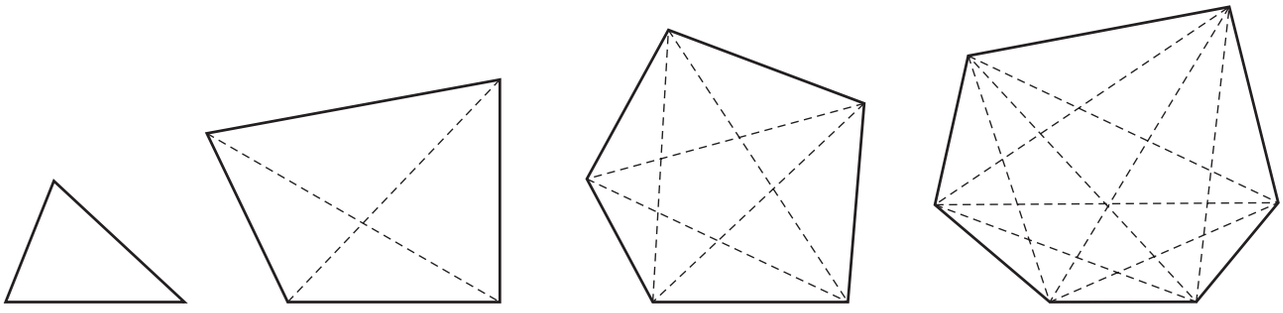

The diagrams show some polygons and their diagonals.

(a) Complete the table.

Number of sides	Name of polygon	Total number of diagonals
3	triangle	0
4	quadrilateral	2
5		5
6	hexagon	9
7	heptagon	14
8		

[3]

(b) Write down the total number of diagonals in

(i) a decagon (a 10-sided polygon),

Answer(b)(i) ..... [1]

(ii) a 12-sided polygon.

Answer(b)(ii) ..... [1]

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(c) A polygon with n sides has a total of $\frac{1}{p}n(n-q)$ diagonals, where p and q are integers.

(i) Find the values of p and q.

Answer(c)(i) p = ...

q = ... [3]

(ii) Find the total number of diagonals in a polygon with 100 sides.

Answer(c)(ii) ..... [1]

(iii) Find the number of sides of a polygon which has a total of 170 diagonals.

Answer(c)(iii) ..... [2]

(d) A polygon with $n + 1$ sides has 30 more diagonals than a polygon with n sides.

Find n.

Answer(d) n = ... [1]

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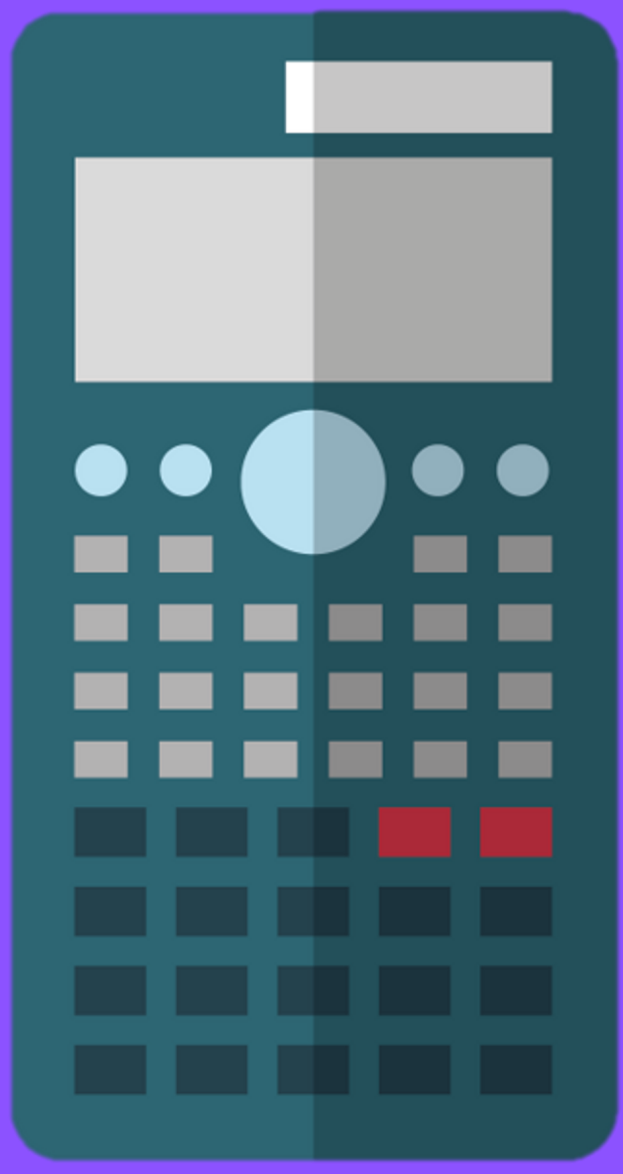

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9 1 second = 10^6 microseconds.

Change 3×10^{13} microseconds into minutes. Give your answer in standard form.

Answer ..... min [2]

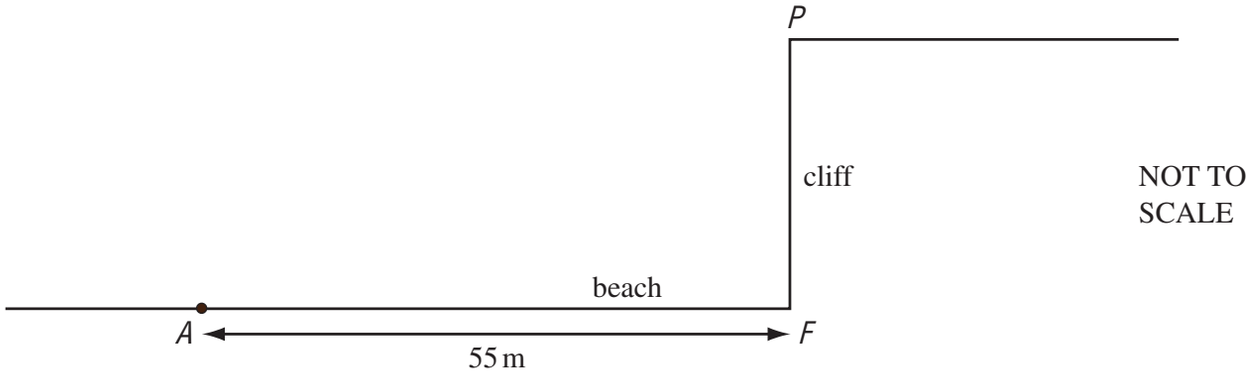
---

10 The length of each side of an equilateral triangle is 74 mm, correct to the nearest millimetre.

Calculate the smallest possible perimeter of the triangle.

Answer ..... mm [2]

11



The diagram shows a point P at the top of a cliff.
The point F is on the beach and vertically below P.
The point A is 55m from F, along the horizontal beach.
The angle of elevation of P from A is 17°.

Calculate PF, the height of the cliff.

Answer PF = ... m [3]

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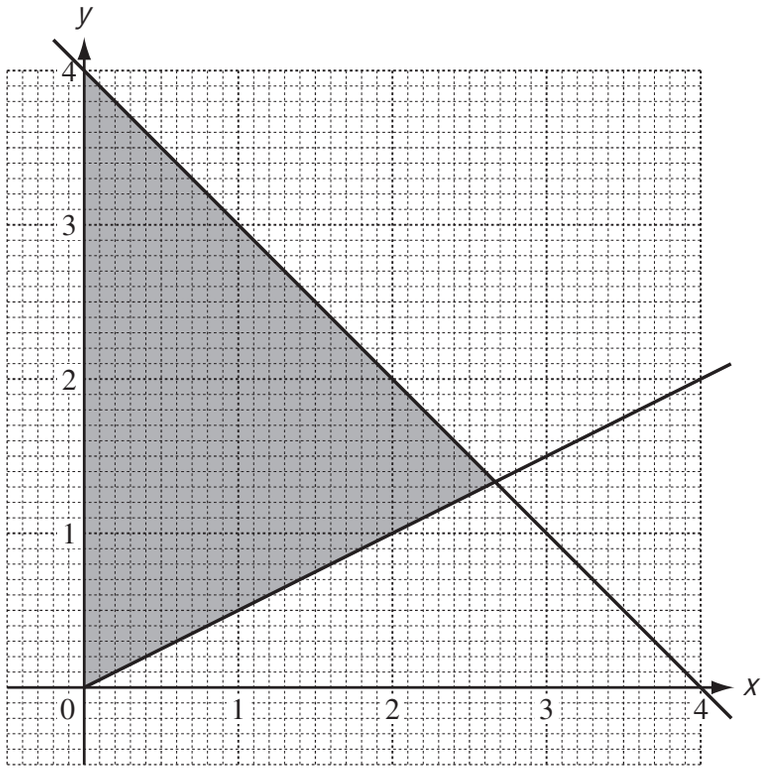

Find the three inequalities which define the shaded region on the grid.

Answer .....

.....

..... [5]

0580/43

MAY/JUNE

YEAR

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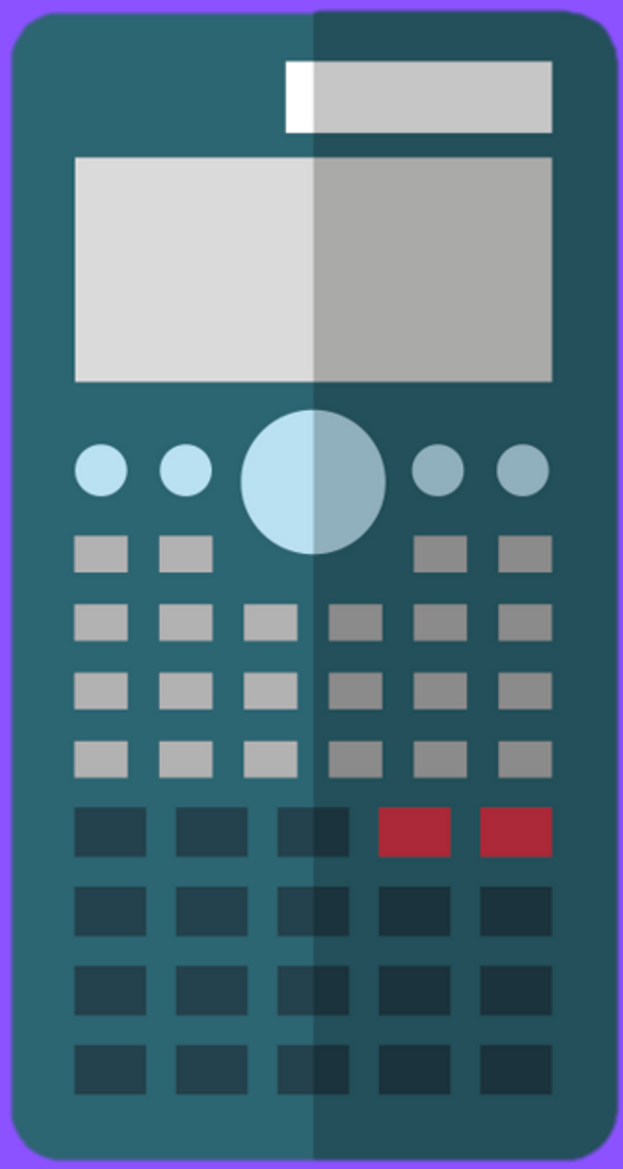

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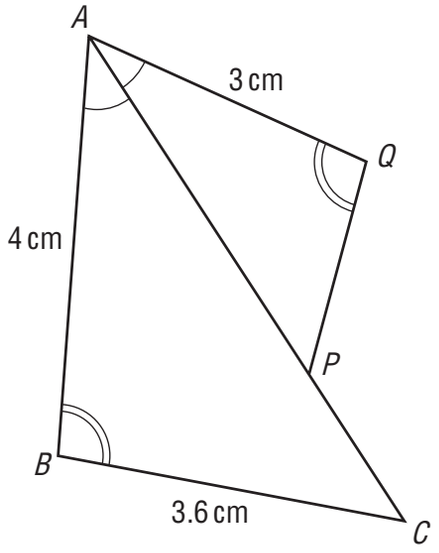
5 (a)



The diagram shows two triangles ACB and APQ.

Angle PAQ = angle BAC and angle AQP = angle ABC.

AB = 4 cm, BC = 3.6 cm and AQ = 3 cm.

(i) Complete the following statement.

Triangle ACB is ..... to triangle APQ. [1]

(ii) Calculate the length of PQ.

Answer(a)(ii) PQ = ... cm [2]

(iii) The area of triangle ACB is 5.6 cm^2.

Calculate the area of triangle APQ.

Answer(a)(iii) ..... cm^2 [2]

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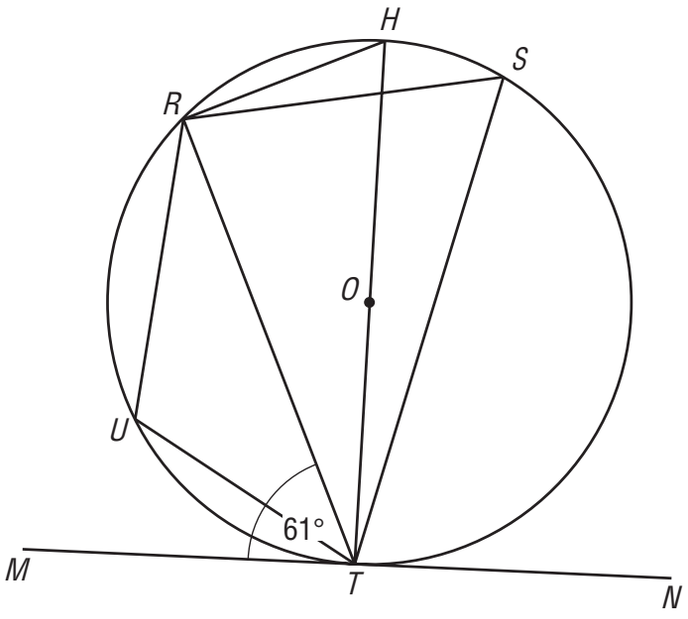
(b)



NOT TO SCALE

R, *H*, *S*, *T* and *U* lie on a circle, centre *O*.
HT is a diameter and *MN* is a tangent to the circle at *T*.
Angle *RTM* = 61°.

Find

(i) angle *RTH*,

Answer(b)(i) Angle *RTH* = ... [1]

(ii) angle *RHT*,

Answer(b)(ii) Angle *RHT* = ... [1]

(iii) angle *RST*,

Answer(b)(iii) Angle *RST* = ... [1]

(iv) angle *RUT*.

Answer(b)(iv) Angle *RUT* = ... [1]

(c) *ABCDEF* is a hexagon.
The interior angle *B* is 4° greater than interior angle *A*.
The interior angle *C* is 4° greater than interior angle *B*, and so on, with each of the next interior angles 4° greater than the previous one.

(i) By how many degrees is interior angle *F* greater than interior angle *A*?

Answer(c)(i) ..... [1]

(ii) Calculate interior angle *A*.

Answer(c)(ii) ..... [3]

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10

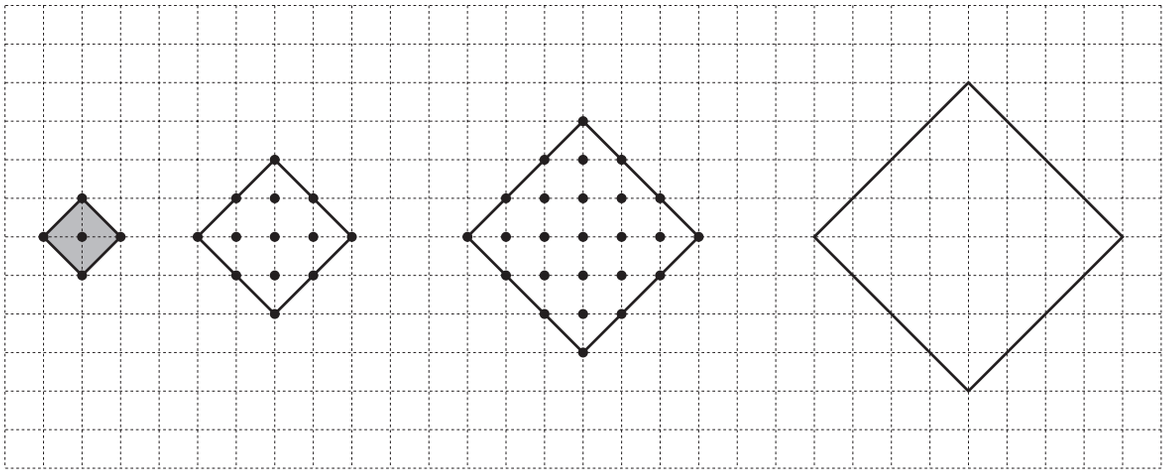

Diagram 1 Diagram 2 Diagram 3 Diagram 4

The diagrams show squares and dots on a grid.

Some dots are on the sides of each square and other dots are inside each square.

The area of the square (shaded) in Diagram 1 is 1 unit^2.

(a) Complete Diagram 4 by marking all the dots. [1]

(b) Complete the columns in the table below for Diagrams 4, 5 and n.

Diagram	1	2	3	4	5	-------	n
Number of units of area	1	4	9			-------	
Number of dots inside the square	1	5	13			-------	$(n-1)^2 + n^2$
Number of dots on the sides of the square	4	8	12			-------	
Total number of dots	5	13	25			-------	

[7]

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(c) For Diagram 200, find the number of dots

(i) inside the square,

Answer(c)(i) ..... [1]

(ii) on the sides of the square.

Answer(c)(ii) ..... [1]

(d) Which diagram has 265 dots inside the square?

Answer(d) ..... [1]

0580/21

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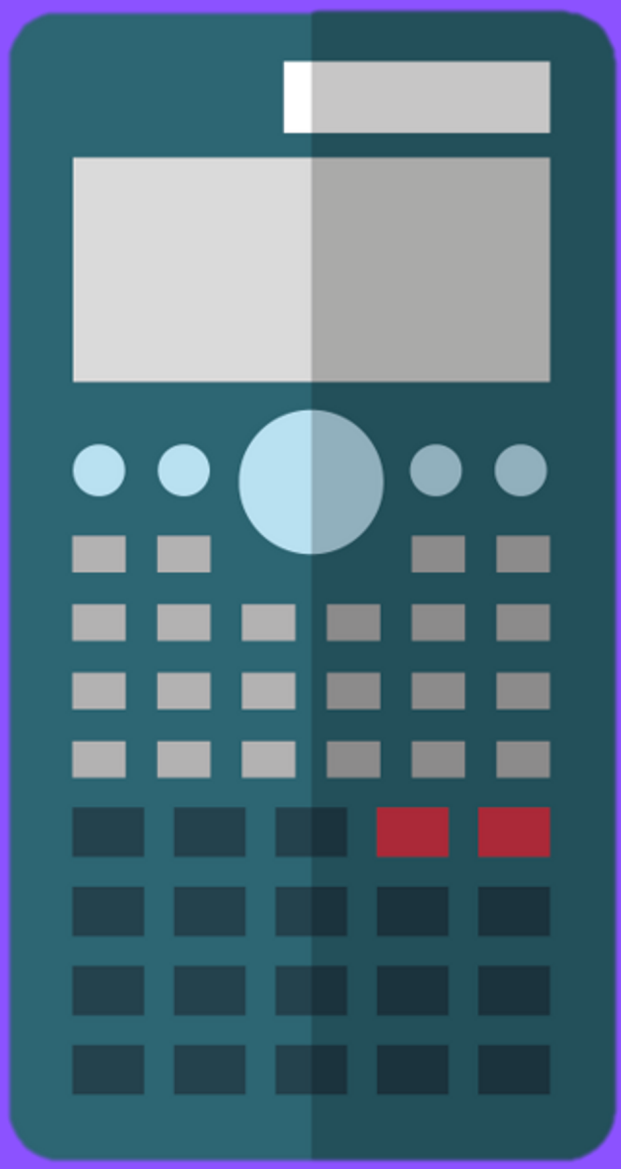

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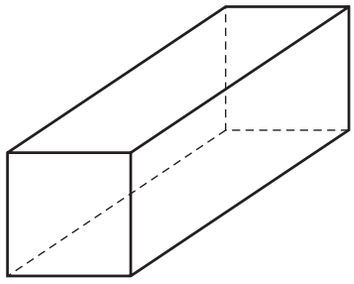
5 (a)

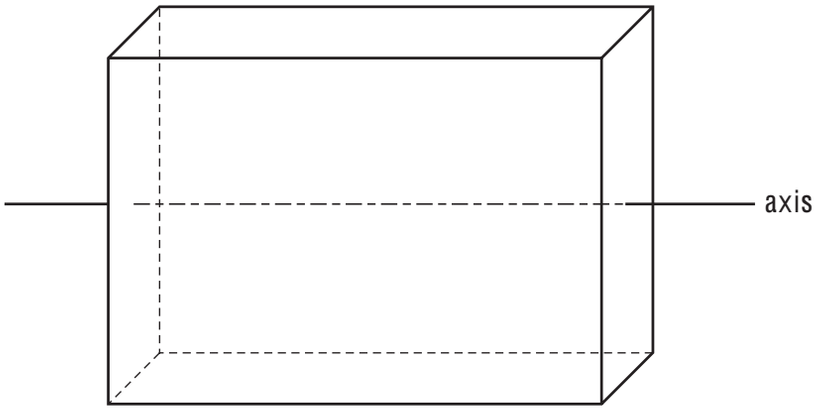


This cuboid has a **square** cross-section.

Write down the number of planes of symmetry.

Answer(a) ..... [1]

(b)



This cuboid has a **rectangular** cross-section.

The axis shown passes through the centre of two opposite faces.

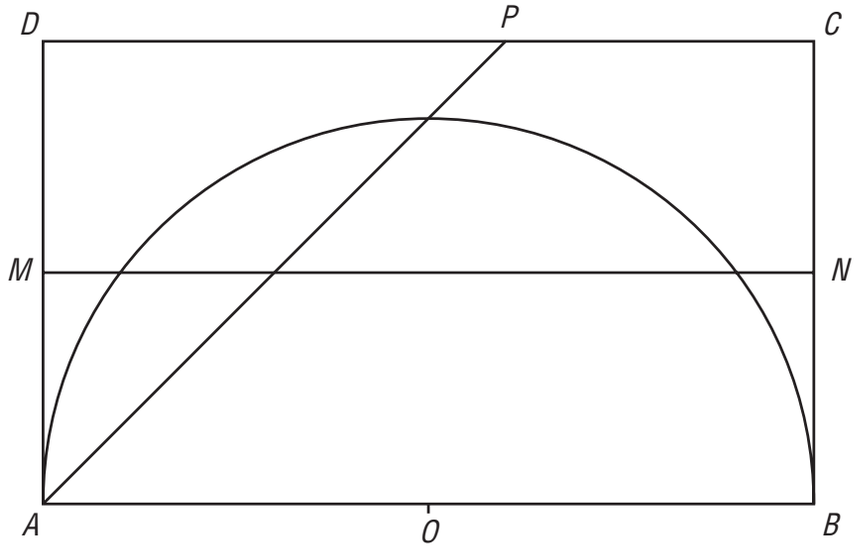
Write down the order of rotational symmetry of the cuboid about this axis.

Answer(b) ..... [1]

11 $ABCD$ is a rectangle with $AB = 10$ cm and $BC = 6$ cm. MN is the perpendicular bisector of BC.

AP is the bisector of angle BAD.

O is the midpoint of AB and also the centre of the semicircle, radius 5 cm.



Write the letter R in the region which satisfies **all** three of the following conditions.

- nearer to AB than to AD
- nearer to C than to B
- less than 5 cm from O

[3]

---

12 Make x the subject of $y = \dfrac{(x+3)^2}{5}$.

Answer $x =$ ..... [3]

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13 Solve the inequality. $2x + 5 < \frac{x-1}{4}$

Answer ..... [3]

---

14 Find the value of n in the following equations.

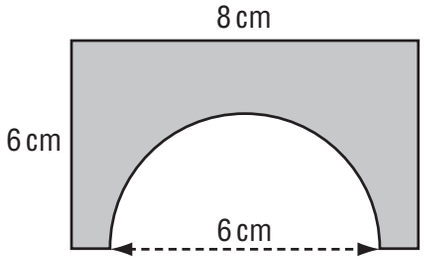
(a) $2^n = 1024$

Answer(a) $n =$ ..... [1]

(b) $4^{2n-3} = 16$

Answer(b) $n =$ ..... [2]

15



NOT TO SCALE

A semicircle of diameter 6 cm is cut from a rectangle with sides 6 cm and 8 cm.

Calculate the perimeter of the shaded shape, correct to 1 decimal place.

Answer ..... cm [3]

0580/41

OCT/NOV

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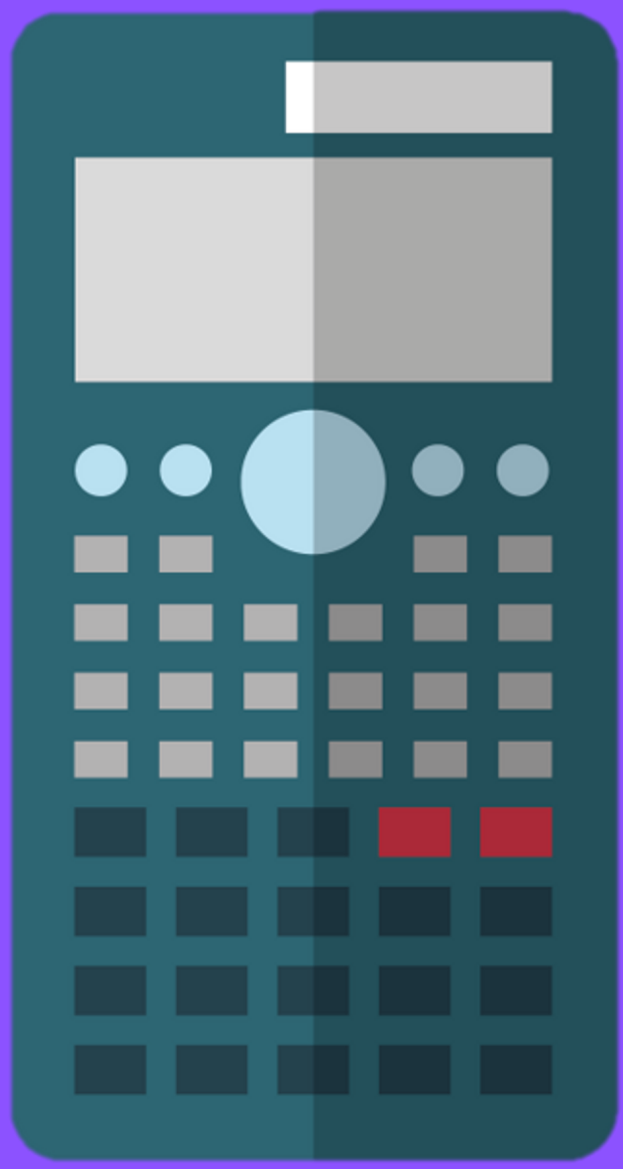

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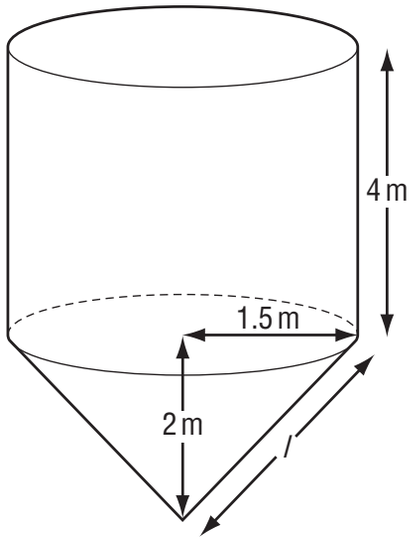

NOT TO SCALE

An **open** water storage tank is in the shape of a cylinder on top of a cone.
The radius of both the cylinder and the cone is 1.5 m.
The height of the cylinder is 4 m and the height of the cone is 2 m.

(a) Calculate the **total** surface area of the **outside** of the tank.
[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]

Answer(a) ..... m^2 [6]

(b) The tank is completely full of water.

(i) Calculate the volume of water in the tank and show that it rounds to 33 m^3, correct to the nearest whole number.

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(b)(i)

[4]

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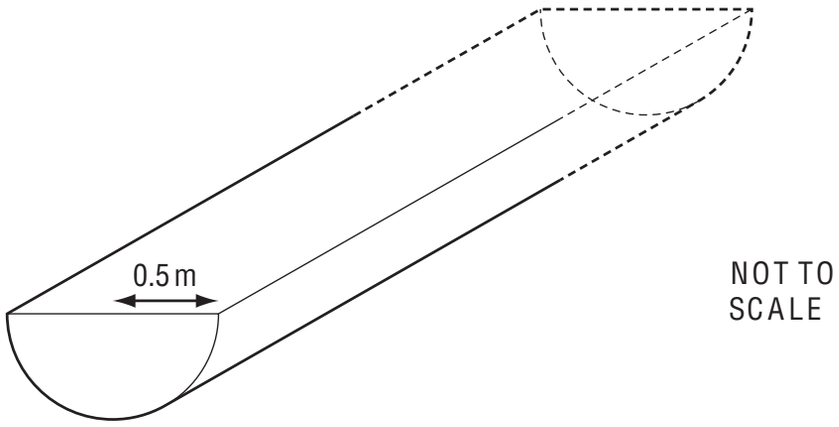
(ii)



The cross-section of an irrigation channel is a semi-circle of radius 0.5 m.
The 33 m^3 of water from the tank completely fills the irrigation channel.

Calculate the length of the channel.

Answer(b)(ii) ..... m [3]

(c) (i) Calculate the number of litres in a full tank of 33 m^3.

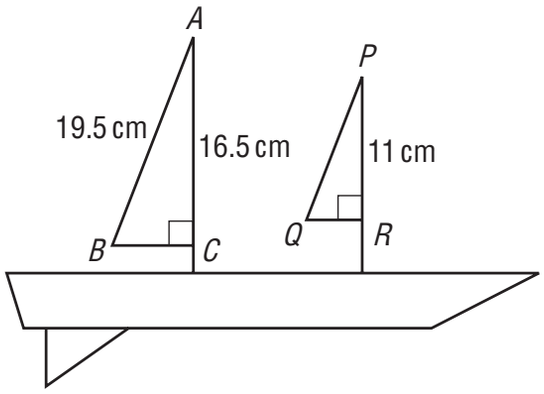
Answer(c)(i) ..... litres [1]

(ii) The water drains from the tank at a rate of 1800 litres per minute.

Calculate the time, in minutes and seconds, taken to empty the tank.

Answer(c)(ii) ..... min ..... s [2]

6 (a)



NOT TO SCALE

The diagram shows a toy boat.
$AC = 16.5$ cm, $AB = 19.5$ cm and $PR = 11$ cm.
Triangles ABC and PQR are **similar**.

(i) Calculate PQ.

Answer(a)(i) PQ = ... cm [2]

(ii) Calculate BC.

Answer(a)(ii) BC = ... cm [3]

(iii) Calculate angle ABC.

Answer(a)(iii) Angle ABC = ... [2]

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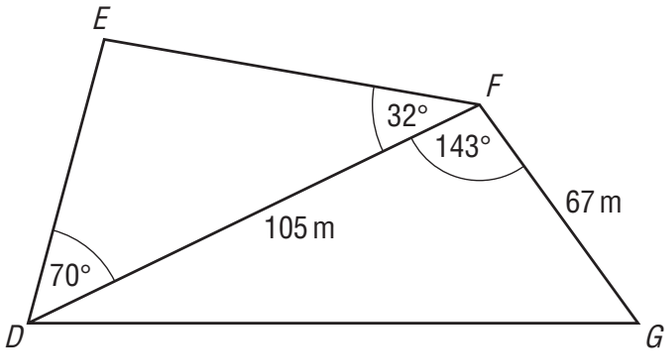
(iv) The toy boat is mathematically similar to a real boat.
The length of the real boat is 32 times the length of the toy boat.
The fuel tank in the toy boat holds 0.02 litres of diesel.

Calculate how many litres of diesel the fuel tank of the real boat holds.

Answer(a)(iv) ..... litres [2]

(b)



NOT TO SCALE

The diagram shows a field *DEFG*, in the shape of a quadrilateral, with a footpath along the diagonal *DF*.
DF = 105 m and *FG* = 67 m.
Angle *EDF* = 70°, angle *EFD* = 32° and angle *DFG* = 143°.

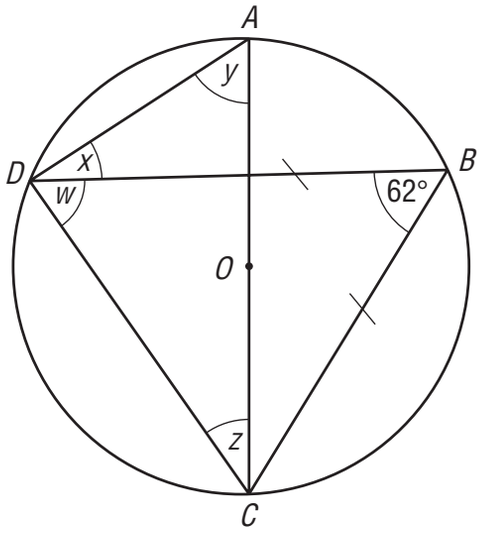
(i) Calculate *DG*.

Answer(b)(i) *DG* = ... m [4]

(ii) Calculate *EF*.

Answer(b)(ii) *EF* = ... m [4]

7 (a)



NOT TO SCALE

A, *B*, *C* and *D* are points on the circumference of a circle centre *O*.
AC is a diameter.
BD = *BC* and angle *DBC* = 62°.

Work out the values of *w*, *x*, *y* and *z*.
Give a reason for each of your answers.

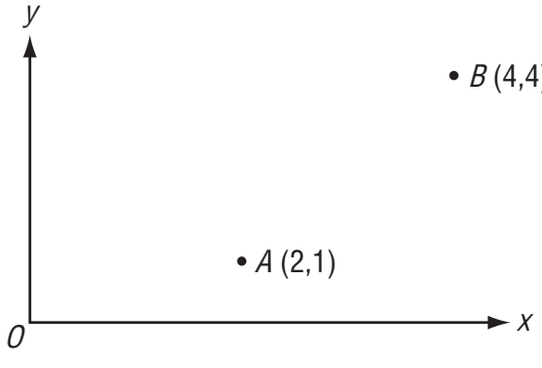
w = ... because ..... [2]

x = ... because ..... [2]

y = ... because ..... [2]

z = ... because ..... [2]

(b)



NOT TO SCALE

(i) Write down $\overrightarrow{AB}$ as a column vector.

Answer(b)(i) $\overrightarrow{AB}$ = $\begin{pmatrix} \\ \end{pmatrix}$ [1]

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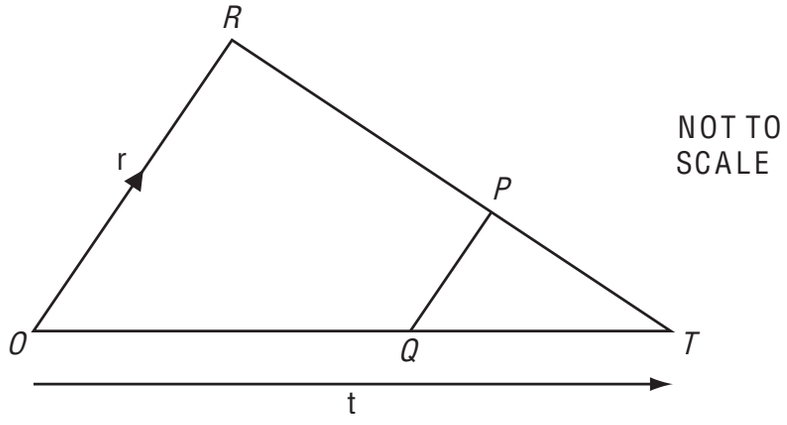
(ii) $\overrightarrow{AC} = \begin{pmatrix} 0 \\ 7 \end{pmatrix}$.

Work out $\overrightarrow{BC}$ as a column vector.

Answer(b)(ii) $\overrightarrow{BC} =$ $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [2]

(c)



$\overrightarrow{OR} = \mathbf{r}$ and $\overrightarrow{OT} = \mathbf{t}$.
P is on RT such that $RP : PT = 2 : 1$.
Q is on OT such that $OQ = \frac{2}{3}OT$.

Write the following in terms of **r** and/or **t**.
Simplify your answers where possible.

(i) $\overrightarrow{QT}$

Answer(c)(i) $\overrightarrow{QT} =$ ..... [1]

(ii) $\overrightarrow{TP}$

Answer(c)(ii) $\overrightarrow{TP} =$ ..... [2]

(iii) $\overrightarrow{QP}$

Answer(c)(iii) $\overrightarrow{QP} =$ ..... [2]

(iv) Write down two conclusions you can make about the line segment QP.

Answer(c)(iv) .....

..... [2]

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9 **(a)** The first five terms P_1, P_2, P_3, P_4 and P_5 of a sequence are given below.

$1 = 1 = P_1$

$1 + 2 = 3 = P_2$

$1 + 2 + 3 = 6 = P_3$

$1 + 2 + 3 + 4 = 10 = P_4$

$1 + 2 + 3 + 4 + 5 = 15 = P_5$

(i) Write down the next term, P_6, in the sequence 1, 3, 6, 10, 15…

Answer(a)(i) ..... [1]

(ii) The formula for the nth term of this sequence is

$$P_n = \frac{1}{2}n(n + 1).$$

Show this formula is true when $n = 6$.

Answer (a)(ii)

[1]

(iii) Use the formula to find P_{50}, the 50th term of this sequence.

Answer(a)(iii) ..... [1]

(iv) Use your answer to **part (iii)** to find 3 + 6 + 9 + 12 +15 + …… + 150.

Answer(a)(iv) ..... [1]

(v) Find 1 + 2 + 3 + 4 + 5 +…… + 150.

Answer(a)(v) ..... [1]

(vi) Use your answers to **parts (iv)** and **(v)** to find the sum of the numbers less than 150 which are **not** multiples of 3.

Answer(a)(vi) ..... [1]

This question continues on the next page.

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(b) The first five terms, S_1, S_2, S_3, S_4 and S_5 of a different sequence are given below.

(1×1) $= 1 = S_1$

$(1 \times 2) + (2 \times 1)$ $= 4 = S_2$

$(1 \times 3) + (2 \times 2) + (3 \times 1)$ $= 10 = S_3$

$(1 \times 4) + (2 \times 3) + (3 \times 2) + (4 \times 1)$ $= 20 = S_4$

$(1 \times 5) + (2 \times 4) + (3 \times 3) + (4 \times 2) + (5 \times 1)$ $= 35 = S_5$

(i) Work out the next term, S_6, in the sequence 1, 4, 10, 20, 35…

Answer(b)(i) ..... [2]

(ii) The formula for the nth term of this sequence is

$$S_n = \frac{1}{6} n(n + 1)(n + 2).$$

Show this formula is true for $n = 6$.

Answer(b)(ii)

[1]

(iii) Find $(1 \times 20) + (2 \times 19) + (3 \times 18)$ …… $+ (20 \times 1)$.

Answer(b)(iii) ..... [1]

(c) Show that $S_6 - S_5 = P_6$, where P_6 is your answer to **part (a)(i)**.

Answer(c)

[1]

(d) Show by algebra that $S_n - S_{n-1} = P_n$. $\left[P_n = \frac{1}{2} n(n + 1)\right]$

Answer(d)

[3]

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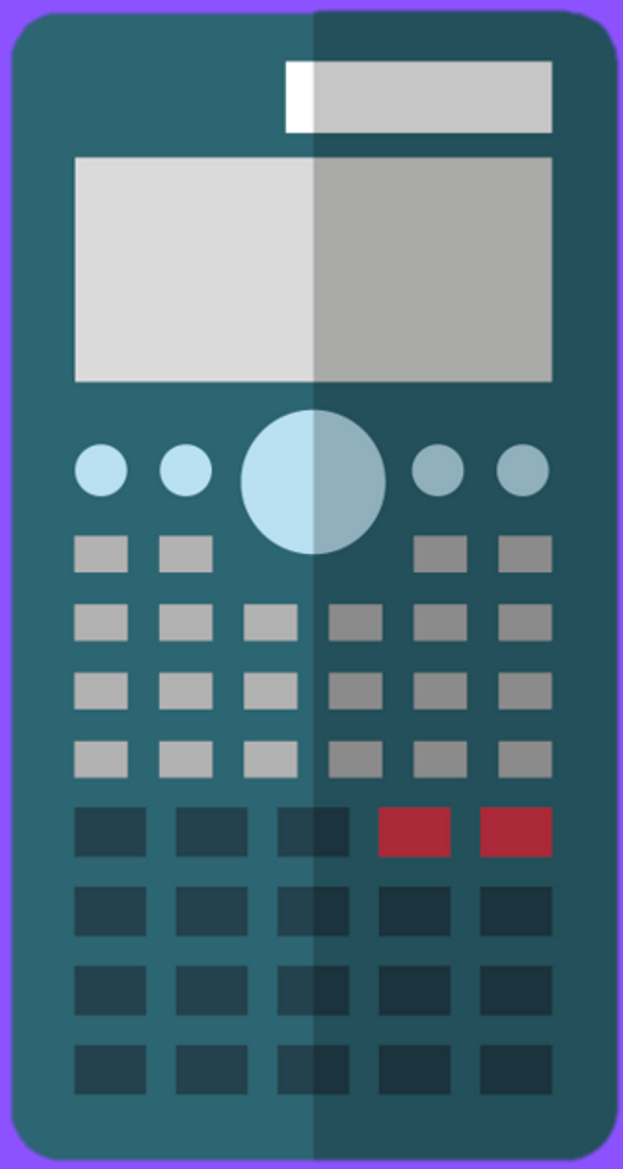

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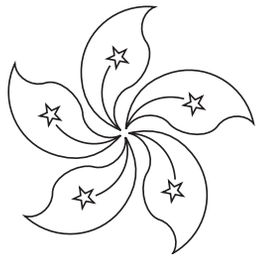

For the diagram, write down

(a) the order of rotational symmetry,

Answer(a) ..... [1]

(b) the number of lines of symmetry.

Answer(b) ..... [1]

---

2 In a group of 30 students, 18 have visited Australia, 15 have visited Botswana and 5 have not visited either country.

Work out the number of students who have visited Australia but not Botswana.

Answer ..... [2]

---

3 Rearrange the formula $J = mv - mu$ to make m the subject.

Answer $m =$ [2]

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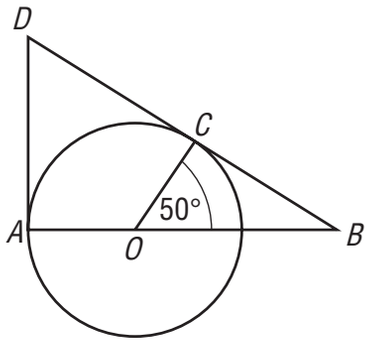


NOT TO SCALE

O is the centre of the circle.
DA is the tangent to the circle at A and DB is the tangent to the circle at C.
AOB is a straight line. Angle $COB = 50°$.
Calculate

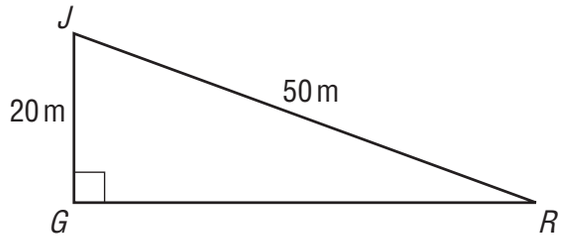
(a) angle CBO,

Answer(a) Angle CBO = ... [1]

(b) angle DOC.

Answer(b) Angle DOC = ... [1]

5



NOT TO SCALE

JGR is a right-angled triangle. $JR = 50$m and $JG = 20$m.
Calculate angle JRG.

Answer Angle JRG = ... [2]

---

6 Write 0.00658

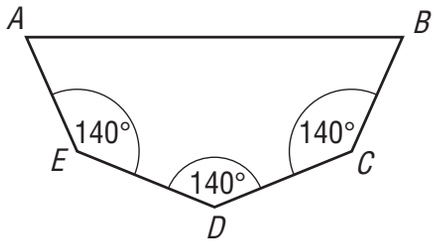
(a) in standard form,

Answer(a) ..... [1]

(b) correct to 2 significant figures.

Answer(b) ..... [1]

10



NOT TO SCALE

The pentagon has three angles which are each 140°.
The other two interior angles are equal.
Calculate the size of one of these angles.

Answer ..... [3]

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11 The resistance, R, of an object being towed through the water varies directly as the **square** of the speed, v.

$R = 50$ when $v = 10$.

Find R when $v = 16$.

Answer $R =$ ..... [3]

---

12 Write as a single fraction, in its simplest form.

$$\frac{3}{x+2} - \frac{2}{x-1}$$

Answer [3]

0580/42

OCT/NOV

YEAR

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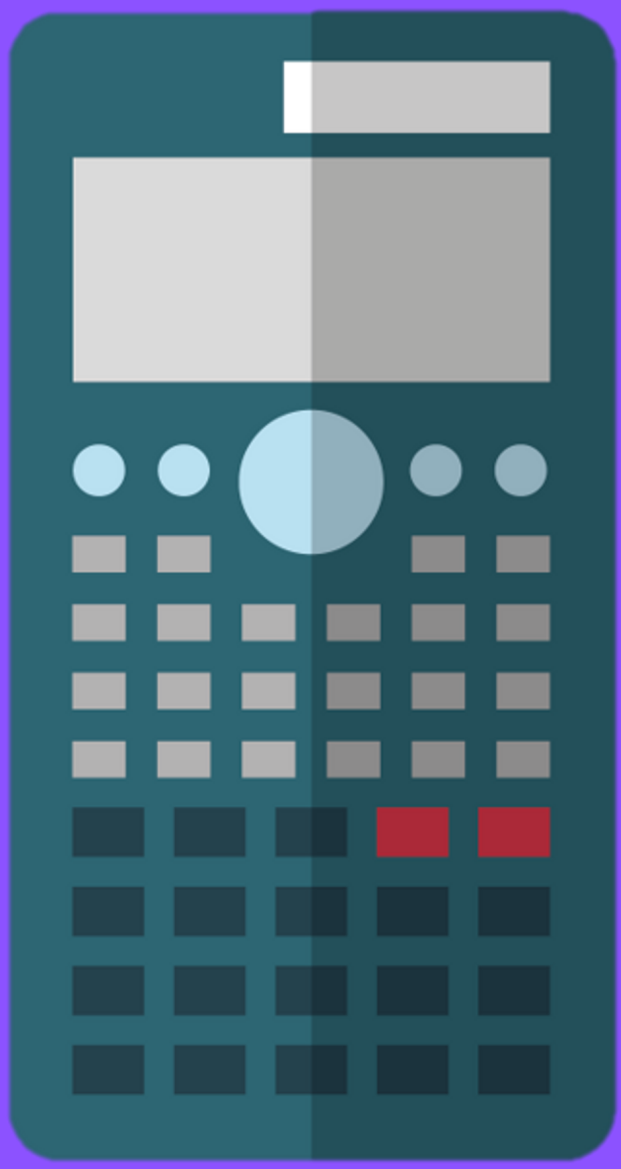

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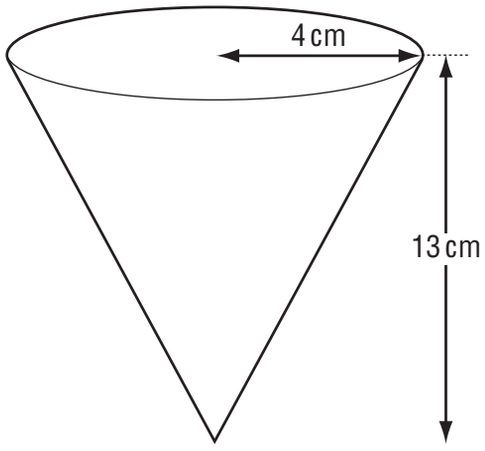
4 (a)



The diagram shows a cone of radius 4 cm and height 13 cm.
It is filled with soil to grow small plants.
Each cubic centimetre of soil has a mass of 2.3g.

(i) Calculate the volume of the soil inside the cone.

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(a)(i) ..... cm^3 [2]

(ii) Calculate the mass of the soil.

Answer(a)(ii) ..... g [1]

(iii) Calculate the greatest number of these cones which can be filled **completely** using 50 kg of soil.

Answer(a)(iii) ..... [2]

(b) A **similar** cone of height 32.5 cm is used for growing larger plants.

Calculate the volume of soil used to fill this cone.

Answer(b) ..... cm^3 [3]

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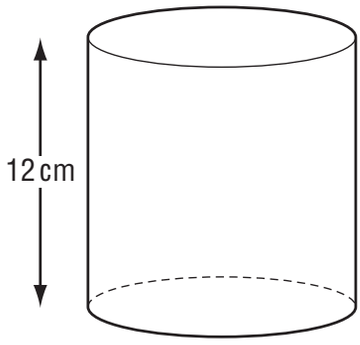
(c)



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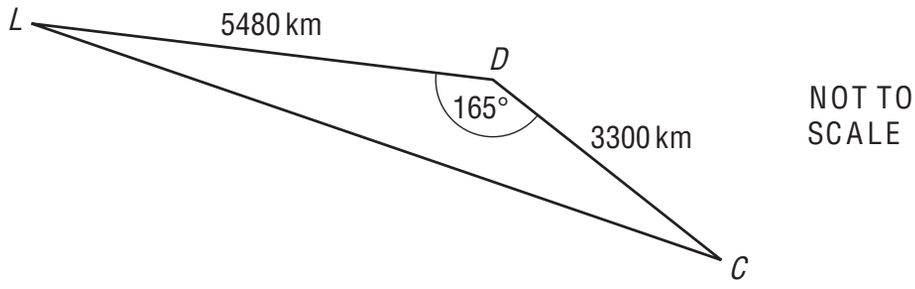
Some plants are put into a cylindrical container with height 12 cm and volume 550 cm^3.

Calculate the radius of the cylinder.

Answer(c) ..... cm [3]

6



The diagram shows the positions of London (L), Dubai (D) and Colombo (C).

(a) (i) Show that LC is 8710 km correct to the nearest kilometre.

Answer(a)(i)

[4]

(ii) Calculate the angle CLD.

Answer(a)(ii) Angle CLD = ... [3]

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(b) A plane flies from London to Dubai and then to Colombo.
It leaves London at 01 50 and the total journey takes 13 hours and 45 minutes.
The local time in Colombo is 7 hours ahead of London.
Find the arrival time in Colombo.

Answer(b) ..... [2]

(c) Another plane flies the 8710 km directly from London to Colombo at an average speed of 800 km/h.
How much longer did the plane in **part (b)** take to travel from London to Colombo?
Give your answer in hours and minutes, correct to the nearest minute.

Answer(c) ..... h ..... min [4]

For Examiner's Use

10 In all the following sequences, after the first two terms, the rule is to add the previous two terms to find the next term.

(a) Write down the next two terms in this sequence.

1 1 2 3 5 8 13 .... [1]

(b) Write down the first two terms of this sequence.

.... 3 11 14 [2]

(c) **(i)** Find the value of d and the value of e.

2 d e 10

Answer(c)(i) d = ...

e = ... [3]

(ii) Find the value of x, the value of y and the value of z.

-33 x y z 18

Answer(c)(ii) x = ...

y = ...

z = ... [5]

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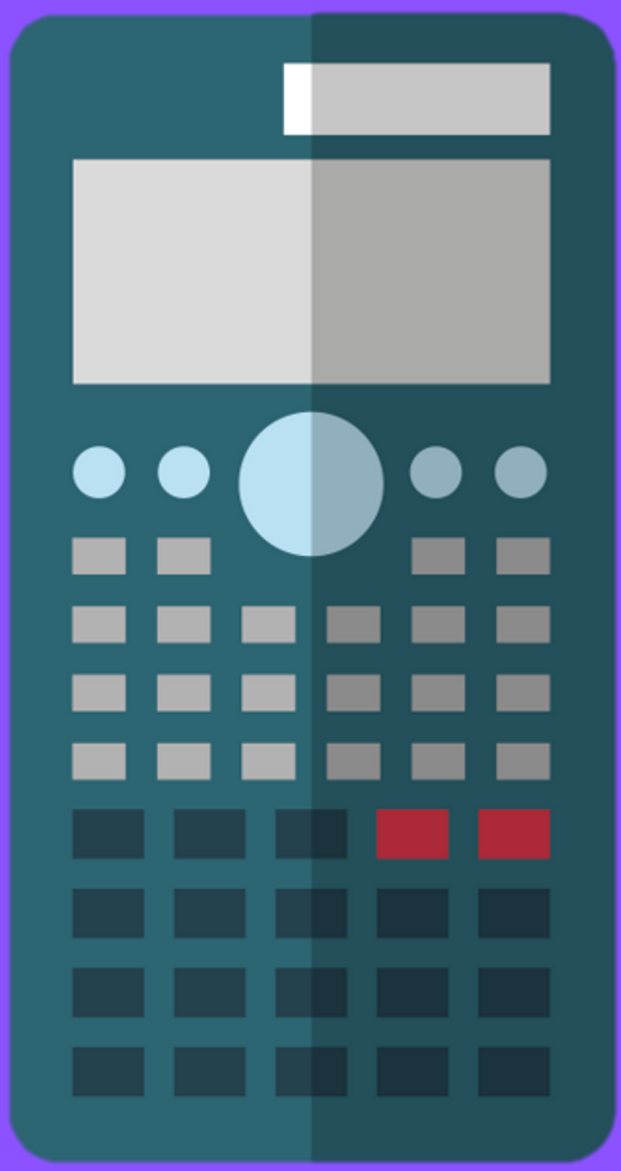

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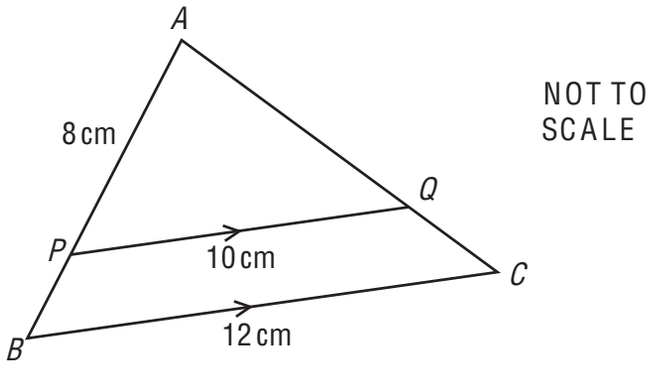
9



APB and *AQC* are straight lines. *PQ* is parallel to *BC*.
AP = 8 cm, *PQ* = 10 cm and *BC* = 12 cm.
Calculate the length of *AB*.

Answer AB = ... cm [2]

---

10 Nikhil invests \$200 for 2 years at 4% per year **compound** interest.
Calculate the **exact** amount Nikhil has after 2 years.

Answer \$ ..... [2]

---

11 In a group of 24 students, 21 like football and 15 like swimming.
One student does **not** like football and does **not** like swimming.
Find the number of students who like **both** football and swimming.

Answer ..... [2]

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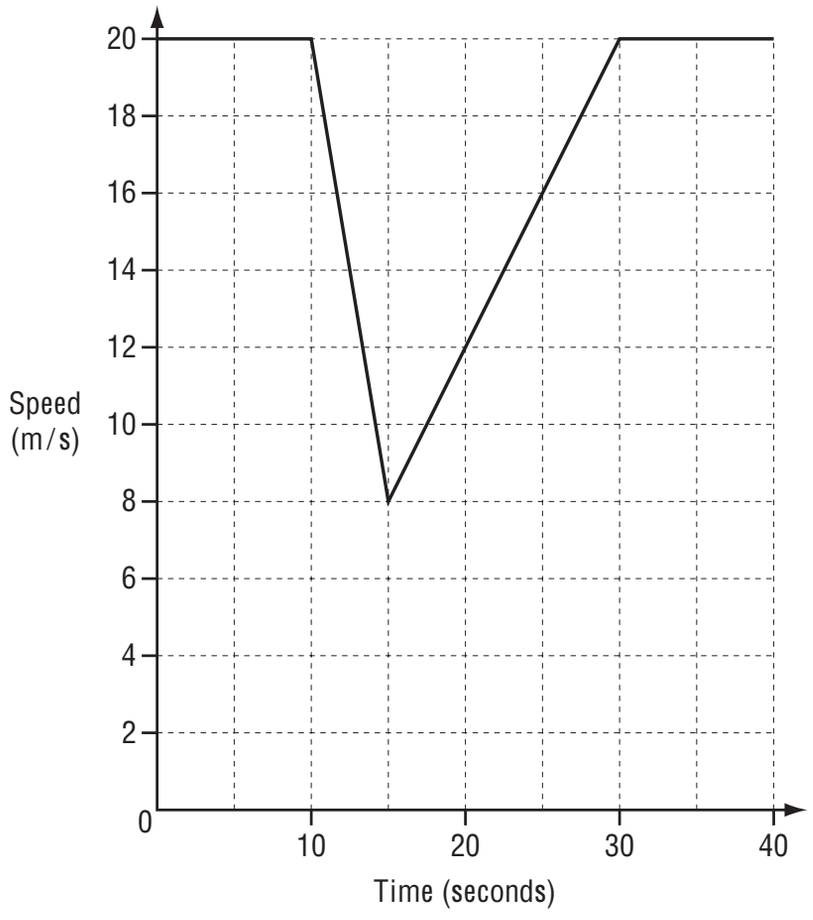


The graph shows 40 seconds of a car journey.

The car travelled at a constant speed of 20 m/s, decelerated to 8 m/s then accelerated back to 20 m/s.

Calculate

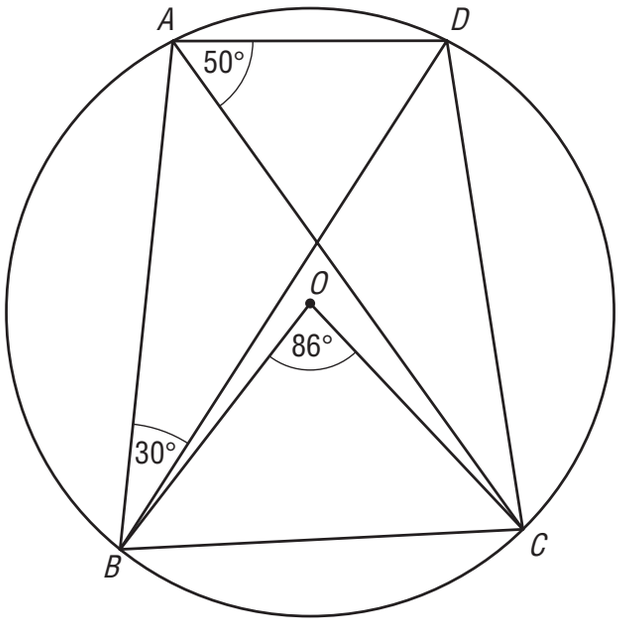
(a) the deceleration of the car,

Answer(a) ..... m/s^2 [1]

(b) the total distance travelled by the car during the 40 seconds.

Answer(b) ..... m [3]

23



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The points A, B, C and D lie on the circumference of the circle, centre O.

Angle $ABD = 30°$, angle $CAD = 50°$ and angle $BOC = 86°$.

(a) Give the reason why angle $DBC = 50°$.

Answer(a) ..... [1]

(b) Find

(i) angle ADC,

Answer(b)(i) Angle ADC = ... [1]

(ii) angle BDC,

Answer(b)(ii) Angle BDC = ... [1]

(iii) angle OBD.

Answer(b)(iii) Angle OBD = ... [2]

Questions 24 and 25 are printed on the next page.

0580/43

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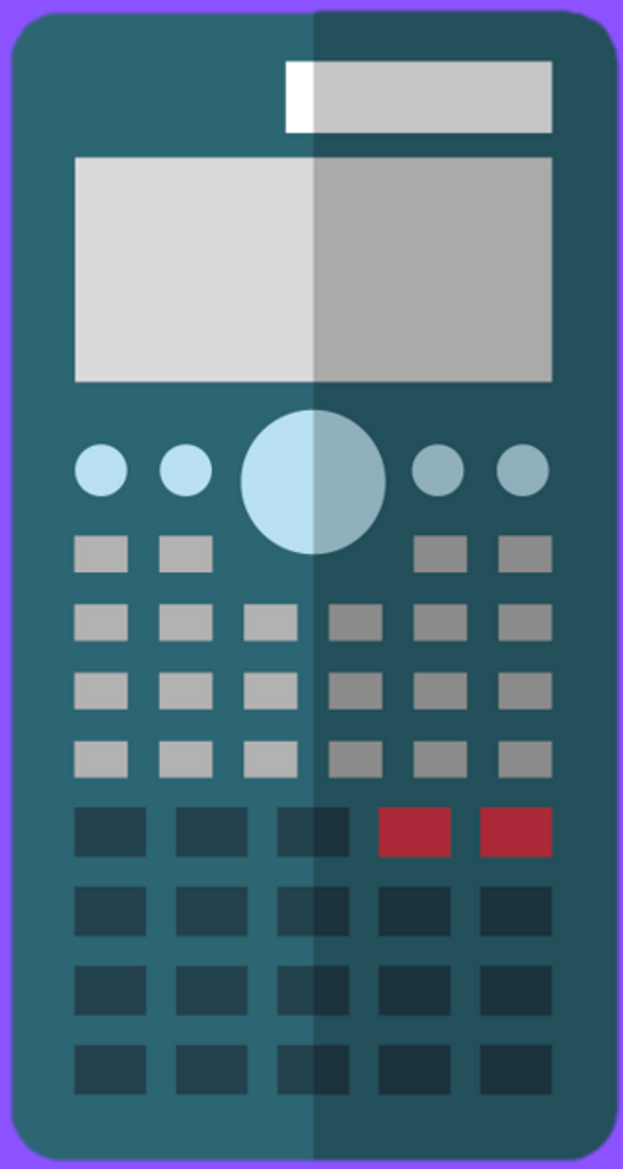

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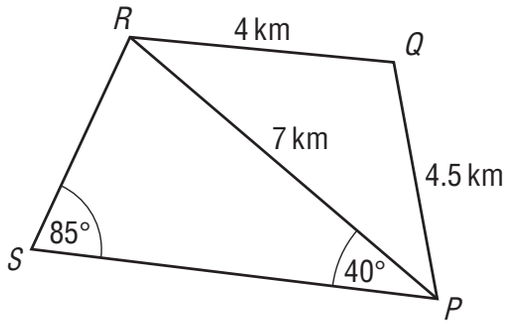

NOT TO SCALE

The diagram shows five straight roads.
PQ = 4.5 km, QR = 4 km and PR = 7 km.
Angle RPS = 40° and angle PSR = 85°.

(a) Calculate angle PQR and show that it rounds to 110.7°.

Answer(a)

[4]

(b) Calculate the length of the road RS and show that it rounds to 4.52 km.

Answer(b)

[3]

(c) Calculate the area of the quadrilateral $PQRS$.
[Use the value of 110.7° for angle PQR and the value of 4.52 km for RS.]

Answer(c) ..... km^2 [5]

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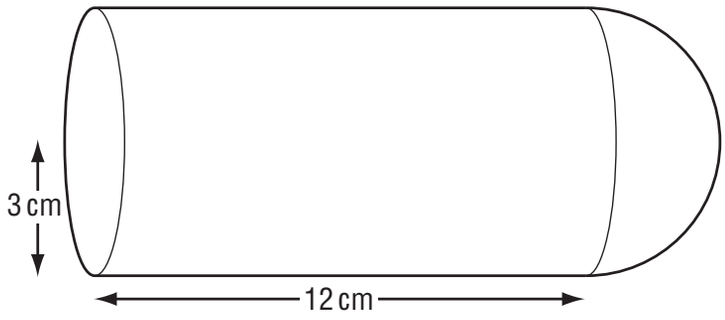
[Turn over

8



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The diagram shows a solid made up of a hemisphere and a cylinder.
The radius of both the cylinder and the hemisphere is 3 cm.
The length of the cylinder is 12 cm.

(a) (i) Calculate the volume of the solid.

[The volume, V, of a **sphere** with radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(a)(i) ..... cm^3 [4]

(ii) The solid is made of steel and 1 cm^3 of steel has a mass of 7.9 g.
Calculate the mass of the solid.
Give your answer in kilograms.

Answer(a)(ii) ..... kg [2]

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(iii) The solid fits into a box in the shape of a cuboid, 15 cm by 6 cm by 6 cm.
Calculate the volume of the box **not** occupied by the solid.

Answer(a)(iii) ..... cm^3 [2]

(b) (i) Calculate the **total** surface area of the solid.
You must show your working.
[The surface area, A, of a **sphere** with radius r is $A = 4\pi r^2$.]

Answer(b)(i) ..... cm^2 [5]

(ii) The surface of the solid is painted.
The cost of the paint is \$0.09 per millilitre.
One millilitre of paint covers an area of 8 cm^2.
Calculate the cost of painting the solid.

Answer(b)(ii) \$ ..... [2]

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10 **(a)** For a set of six integers, the mode is 8, the median is 9 and the mean is 10.

The smallest integer is greater than 6 and the largest integer is 16.

Find the two possible sets of six integers.

Answer(a) First set ..... , ... , ... , ... , ... , ...

Second set ..... , ... , ... , ... , ... , ... [5]

(b) One day Ahmed sells 160 oranges.
He records the mass of each orange.
The results are shown in the table.

Mass (m grams)	$50 < m \leqslant 80$	$80 < m \leqslant 90$	$90 < m \leqslant 100$	$100 < m \leqslant 120$	$120 < m \leqslant 150$
Frequency	30	35	40	40	15

(i) Calculate an estimate of the mean mass of the 160 oranges.

Answer(b)(i) ..... g [4]

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(ii) On the grid, complete the histogram to show the information in the table.

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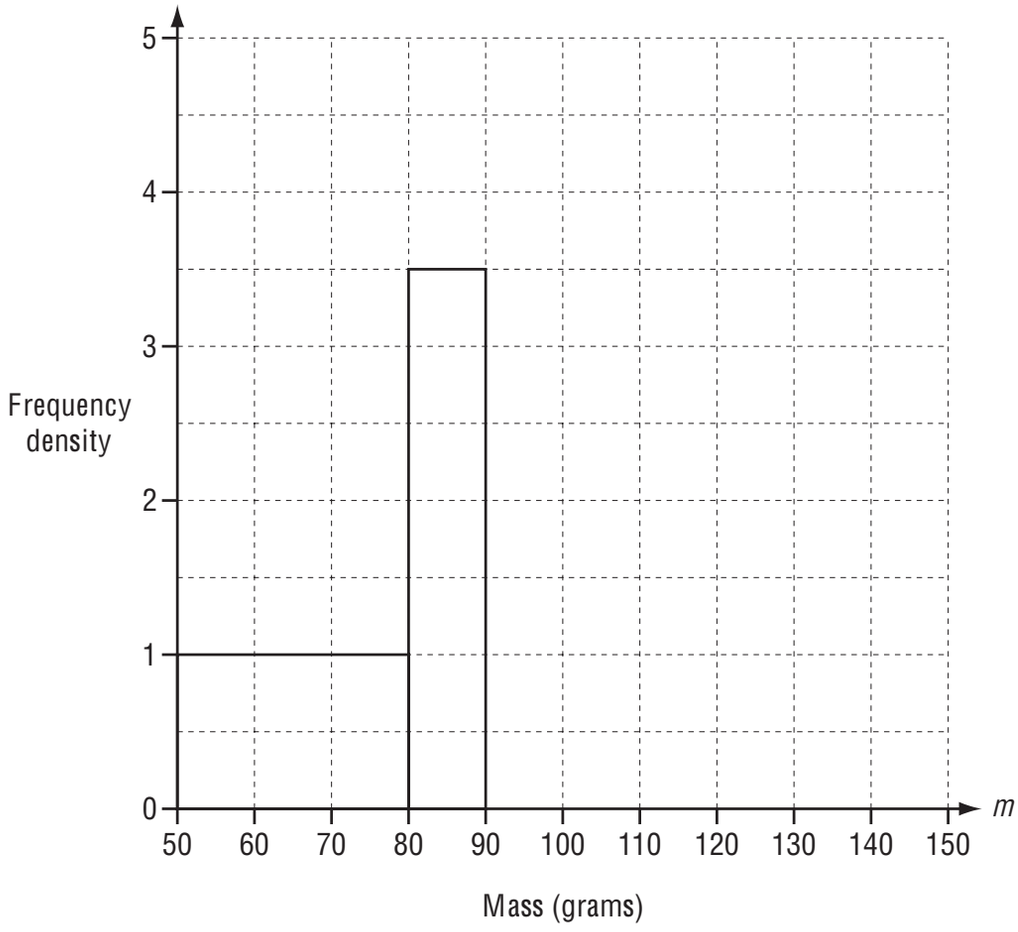

[4]

Question 11 is printed on the next page.

11

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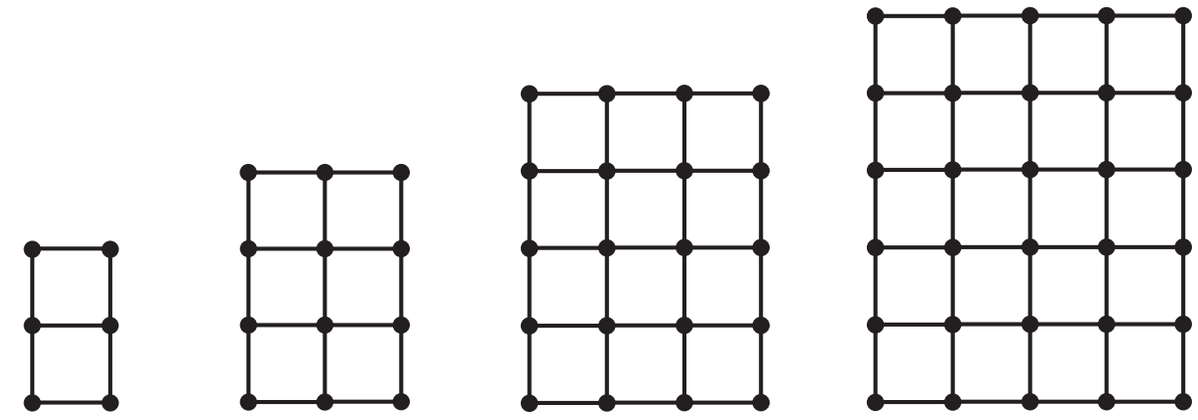

Diagram 1 Diagram 2 Diagram 3 Diagram 4

The first four Diagrams in a sequence are shown above.
Each Diagram is made from dots and one centimetre lines.
The area of each small square is 1 cm^2.

(a) Complete the table for Diagrams 5 and 6.

Diagram	1	2	3	4	5	6
Area (cm^2)	2	6	12	20		
Number of dots	6	12	20	30		
Number of one centimetre lines	7	17	31	49		

[4]

(b) The **area** of Diagram n is $n(n+1)$ cm^2.

(i) Find the **area** of Diagram 50.

Answer(b)(i) ..... cm^2 [1]

(ii) Which Diagram has an **area** of 930 cm^2?

Answer(b)(ii) ..... [1]

(c) Find, in terms of n, the number of **dots** in Diagram n.

Answer(c) ..... [1]

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(d) The number of one centimetre lines in Diagram n is $2n^2 + pn + 1$.

(i) Show that $p = 4$.

Answer(d)(i)

[2]

(ii) Find the number of one centimetre lines in Diagram 10.

Answer(d)(ii) ..... [1]

(iii) Which Diagram has 337 one centimetre lines?

Answer(d)(iii) ..... [3]

(e) For **each** Diagram, the number of squares of area 1 cm^2 is A, the number of dots is D and the number of one centimetre lines is L.

Find a connection between A, D and L that is true for each Diagram.

Answer(e) ..... [1]