A / A* questions

2019

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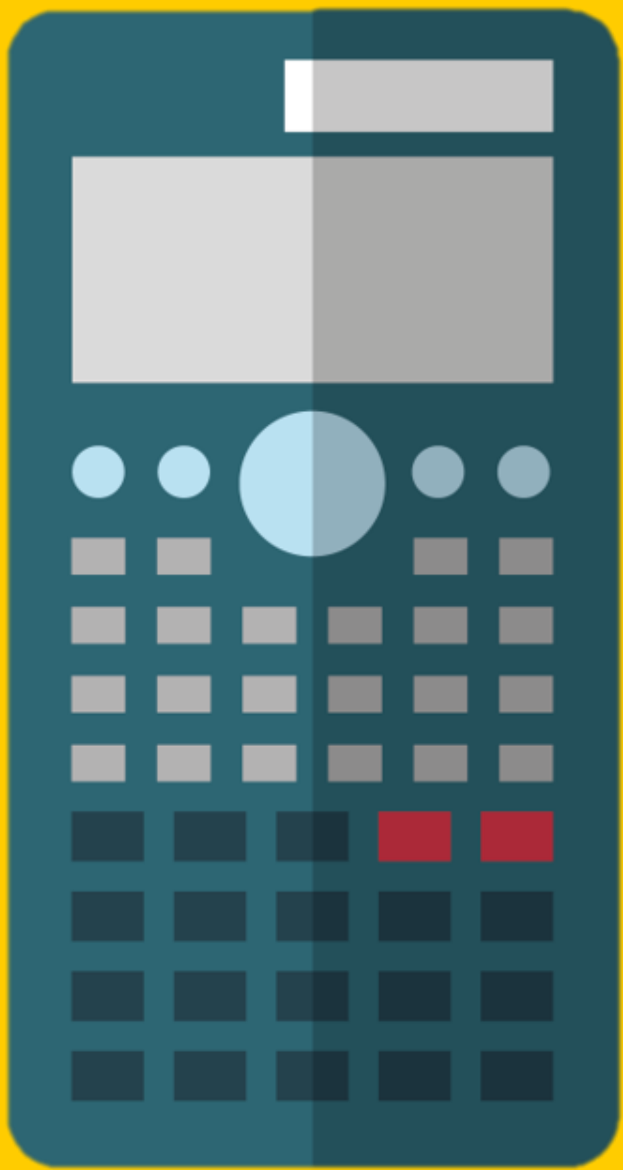

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12 A cone with height 14.8 cm has volume 275 cm^3.

Calculate the radius of the cone.

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

.... cm [3]

13 Factorise.

(a) $7k^2 - 15k$

.... [1]

(b) $12(m+p) + 8(m+p)^2$

.... [2]

14 Eric invests an amount in a bank that pays compound interest at a rate of 2.16% per year.
At the end of 5 years, the value of his investment is $6 999.31 .

Calculate the amount Eric invests.

$ .... [3]

17 **(a)** Find the value of n when $5^n = \frac{1}{125}$.

$n =$ .... [1]

(b) Simplify $\left(\frac{64}{m^3}\right)^{-\frac{1}{3}}$.

.... [2]

18 A pipe is full of water.
The cross-section of the pipe is a circle, radius 2.6 cm.
Water flows through the pipe into a tank at a speed of 12 centimetres per second.

Calculate the number of litres that flow into the tank in one hour.

.... litres [3]

19 Simplify.

$$\frac{ab-b^2}{a^2-b^2}$$

.... [3]

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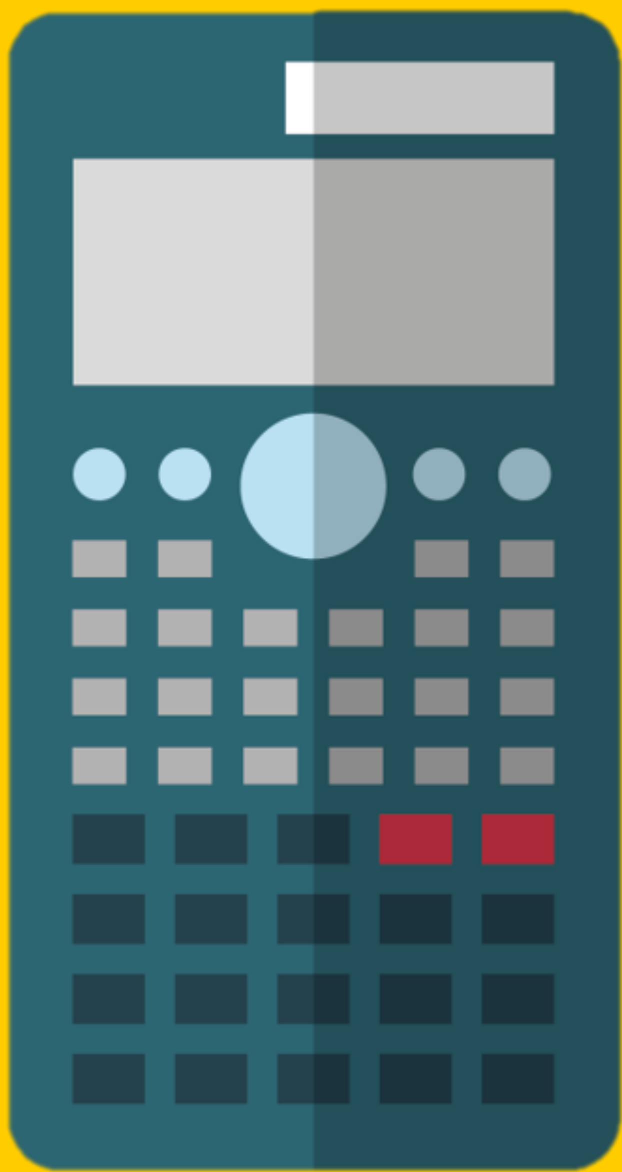

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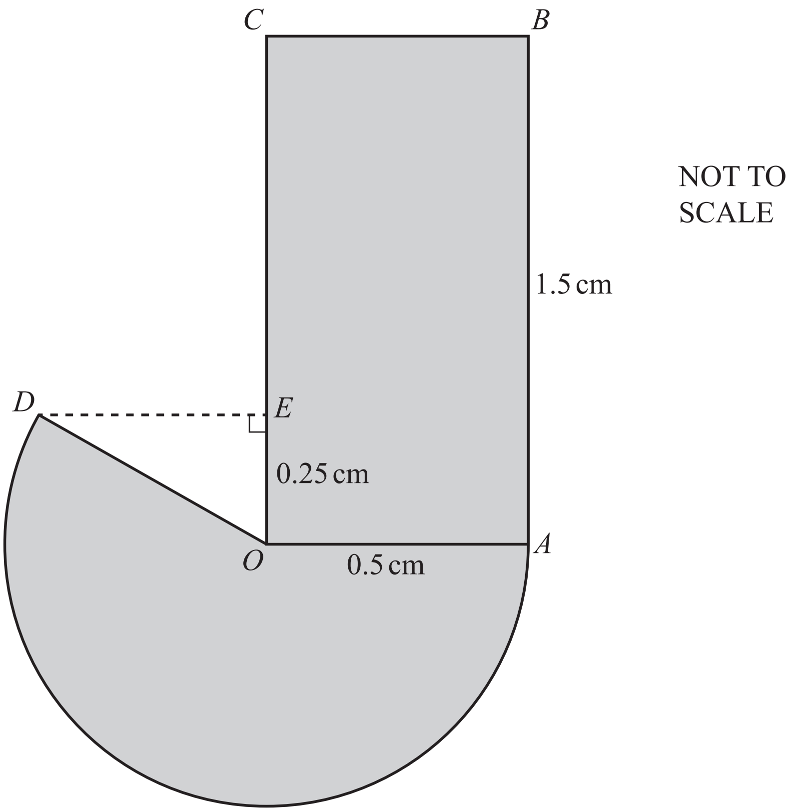


The diagram shows a company logo made from a rectangle and a major sector of a circle.
The circle has centre O and radius OA.
$OA = OD = 0.5$ cm and $AB = 1.5$ cm.
E is a point on OC such that $OE = 0.25$ cm and angle $OED = 90°$.

(a) Calculate the perimeter of the logo.

.... cm [5]

(b) Calculate the area of the logo.

.... cm^2 [3]

(c) A mathematically similar logo is drawn.
The area of this logo is 77.44 cm^2.

(i) Calculate the radius of the major sector in this logo.

.... cm [3]

(ii) A gold model is made.
This model is a prism with a cross-section of area 77.44 cm^2.

This gold model is 15 mm thick.
One cubic centimetre of gold has a mass of 19 grams.

Calculate the mass of the gold model in kilograms.

.... kg [3]

8 $\mathrm{f}(x)=\dfrac{3}{x+2},\ x\neq-2$ $\qquad$ $\mathrm{g}(x)=8x-5$ $\qquad$ $\mathrm{h}(x)=x^2+6$

(a) Work out $\mathrm{g}\left(\dfrac{1}{4}\right)$.

.... [1]

(b) Work out ff(2).

.... [2]

(c) Find gg(x), giving your answer in its simplest form.

.... [2]

(d) Find $\mathrm{g}^{-1}(x)$.

$\mathrm{g}^{-1}(x)=$ .... [2]

(e) Write $\mathrm{g}(x)-\mathrm{f}(x)$ as a single fraction in its simplest form.

.... [3]

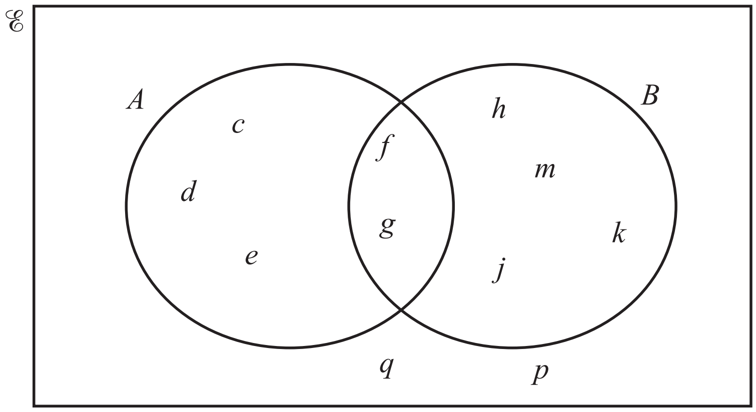
(f) **(i)** Show that $hg(x) = 19$ simplifies to $16x^2 - 20x + 3 = 0$.

[3]

(ii) Use the quadratic formula to solve $16x^2 - 20x + 3 = 0$.
Show all your working and give your answers correct to 2 decimal places.

$x =$ .... or $x =$ .... [4]

9 **(a)** The Venn diagram shows two sets, A and B.



(i) Use set notation to complete the statements.

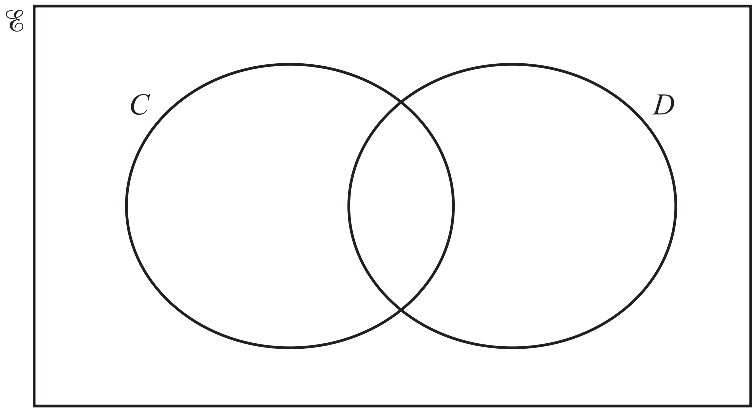
(a) d .... A [1]

(b) $\{f, g\}$ = ... [1]

(ii) Complete the statement.

n (.........................) = 6 [1]

(b) In the Venn diagram below, shade $C \cap D'$.

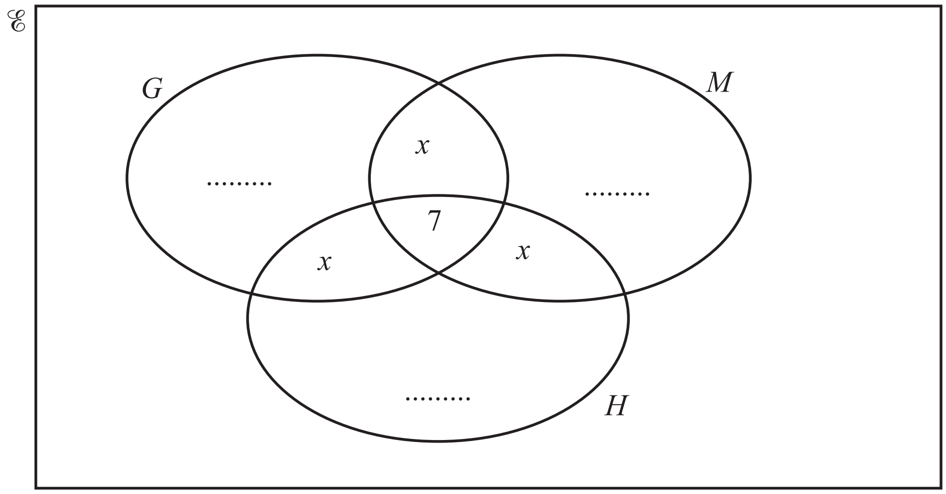


[1]

(c) 50 students study at least one of the subjects geography (G), mathematics (M) and history (H).

18 study only mathematics.
19 study two or three of these subjects.
23 study geography.

The Venn diagram below is to be used to show this information.



(i) Show that $x = 4$.

[2]

(ii) Complete the Venn diagram. [2]

(iii) Use set notation to complete this statement.

$$(G \cup M \cup H)' = \text{.......................}$$ [1]

(iv) Find $n(G \cap (M \cup H))$.

.... [1]

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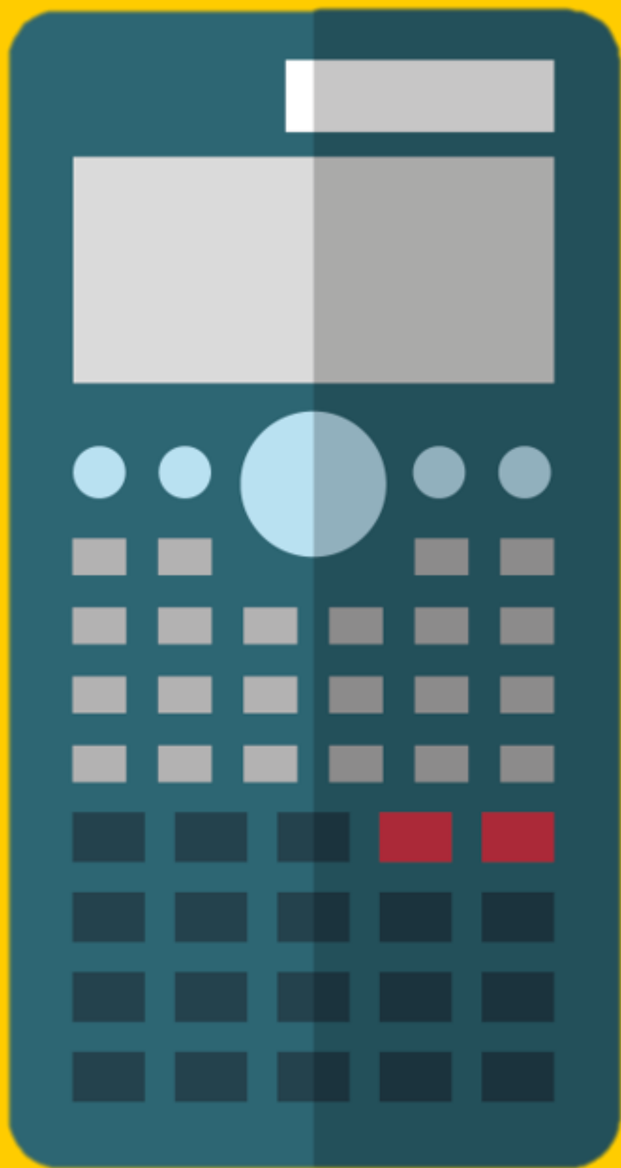

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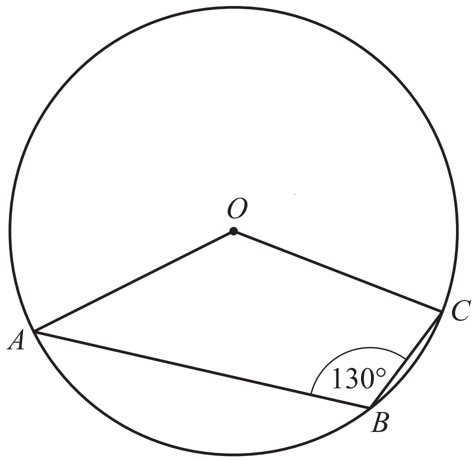

NOT TO SCALE

A, B and C are points on the circle, centre O.

Find the obtuse angle AOC.

Angle AOC = ... [2]

9 Write the recurring decimal $0.4\dot{7}$ as a fraction.
Show all your working.

.... [2]

10 $f(x) = 2x + 3$

Find $f(1 - x)$ in its simplest form.

.... [2]

11

1	2	3	4	5

The diagram shows five cards.
Two of the cards are taken at random, without replacement.

Find the probability that both cards show an even number.

.... [2]

12 27 28 29 30 31 32 33

From the list of numbers, write down

(a) a multiple of 7,

.... [1]

(b) a cube number,

.... [1]

(c) a prime number.

.... [1]

13 $$x^2 + 4x - 9 = (x + a)^2 + b$$

Find the value of a and the value of b.

a = ...

b = ... [3]

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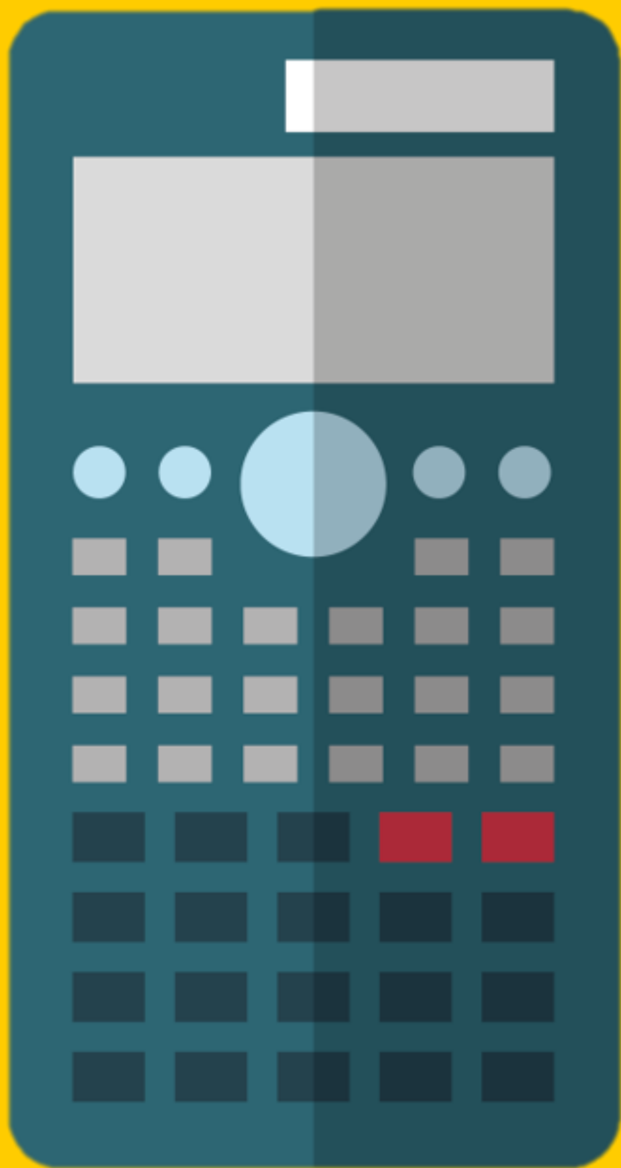

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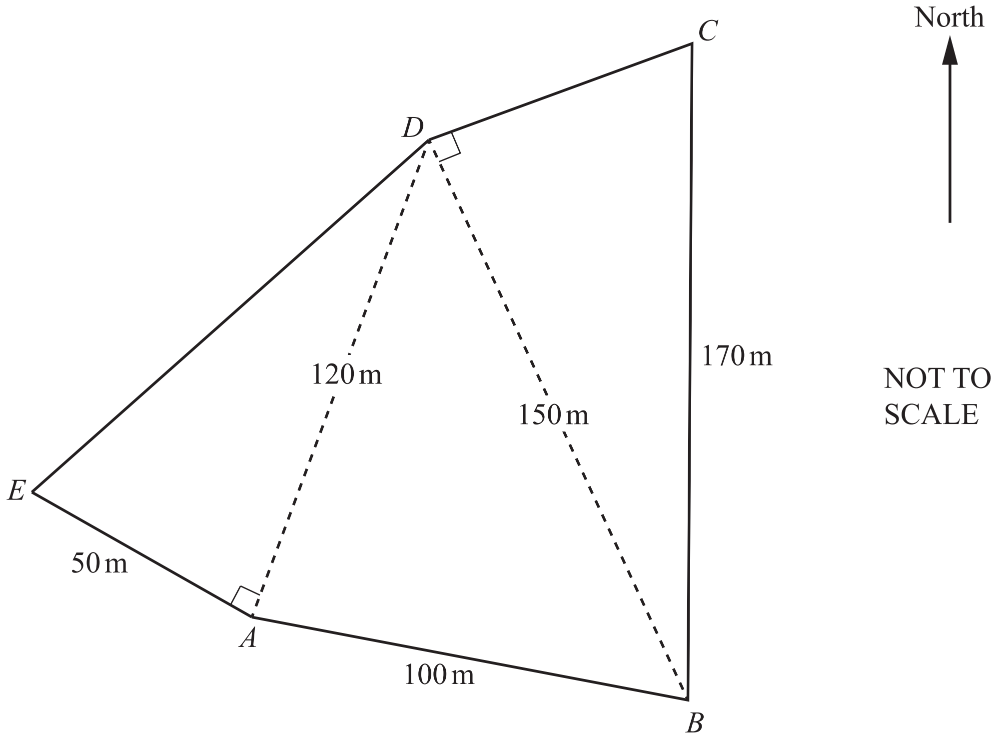


The diagram shows a field *ABCDE*.

(a) Calculate the perimeter of the field *ABCDE*.

.... m [4]

(b) Calculate angle *ABD*.

Angle *ABD* = ... [4]

(c) **(i)** Calculate angle *CBD*.

Angle *CBD* = ... [2]

(ii) The point *C* is due north of the point *B*.

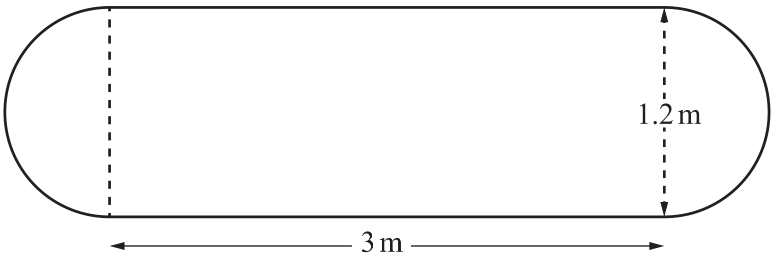
Find the bearing of *D* from *B*.

.... [2]

(d) Calculate the area of the field *ABCDE*.
Give your answer in hectares.
[1 hectare = 10 000 m^2]

.... hectares [4]

5



NOT TO SCALE

The diagram shows the surface of a garden pond, made from a rectangle and two semicircles.
The rectangle measures 3 m by 1.2 m.

(a) Calculate the area of this surface.

.... m^2 [3]

(b) The pond is a prism and the water in the pond has a depth of 20 cm.

Calculate the number of litres of water in the pond.

.... litres [3]

(c) After a rainfall, the number of litres of water in the pond is 1007.

Calculate the increase in the depth of water in the pond.
Give your answer in centimetres.

.... cm [3]

10 The volume of each of the following solids is $1000\,\text{cm}^3$.

Calculate the value of x for each solid.

(a) A cube with side length x cm.

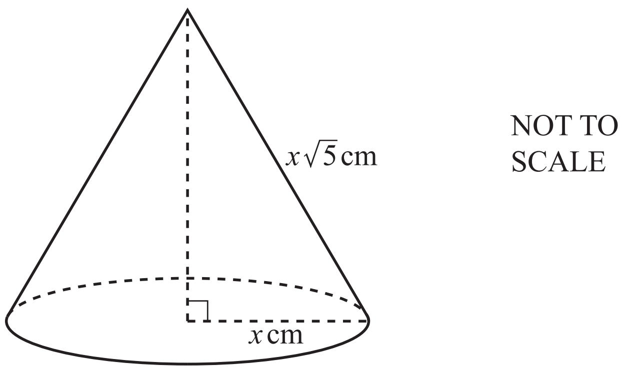
$x =$ .... [1]

(b) A sphere with radius x cm.

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

$x =$ .... [3]

(c)

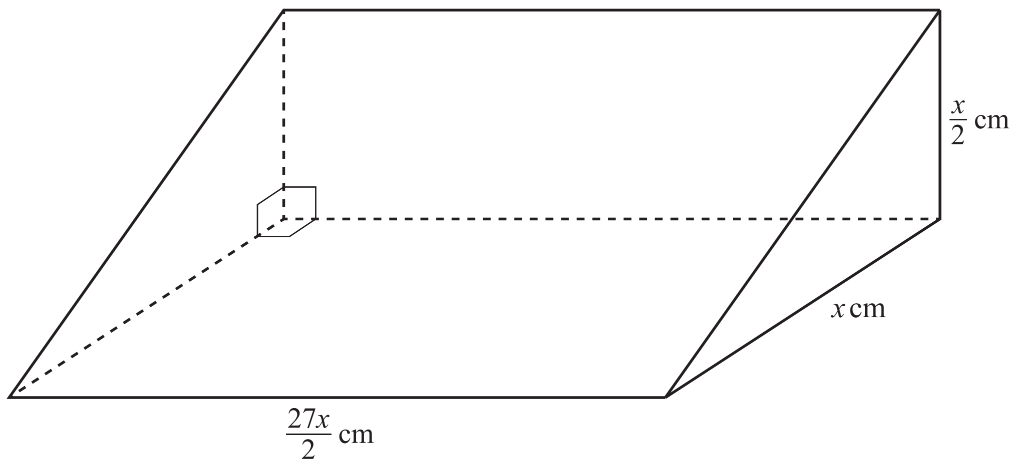


A cone with radius x cm and slant height $x\sqrt{5}$ cm.

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

$x =$ .... [4]

(d)



A prism with a right-angled triangle as its cross-section.

x = ... [4]

Question 11 is printed on the next page.

11 Brad travelled from his home in New York to Chamonix.

- He left his home at 16 30 and travelled by taxi to the airport in New York.
  This journey took 55 minutes and had an average speed of 18 km/h.

- He then travelled by plane to Geneva, departing from New York at 22 15.
  The flight path can be taken as an arc of a circle of radius 6400 km with a sector angle of 55.5°.
  The local time in Geneva is 6 hours ahead of the local time in New York.
  Brad arrived in Geneva at 11 25 the next day.

- To complete his journey, Brad travelled by bus from Geneva to Chamonix.
  This journey started at 13 00 and took 1 hour 36 minutes.
  The average speed was 65 km/h.
  The local time in Chamonix is the same as the local time in Geneva.

Find the overall average speed of Brad's journey from his home in New York to Chamonix.
Show all your working and give your answer in km/h.

.... km/h [11]

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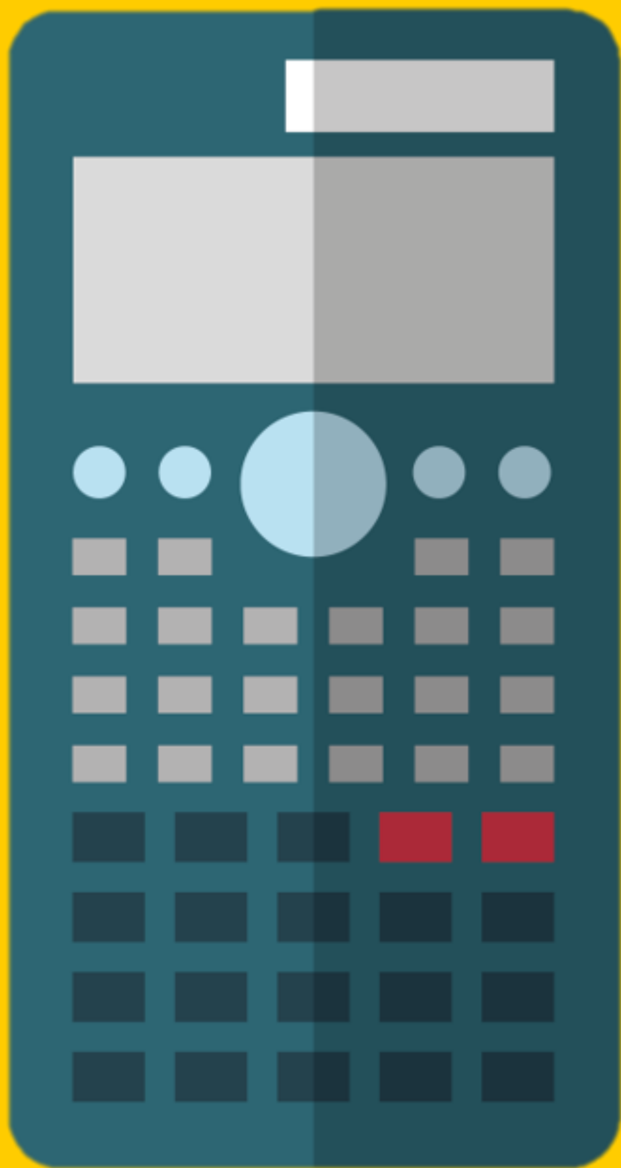

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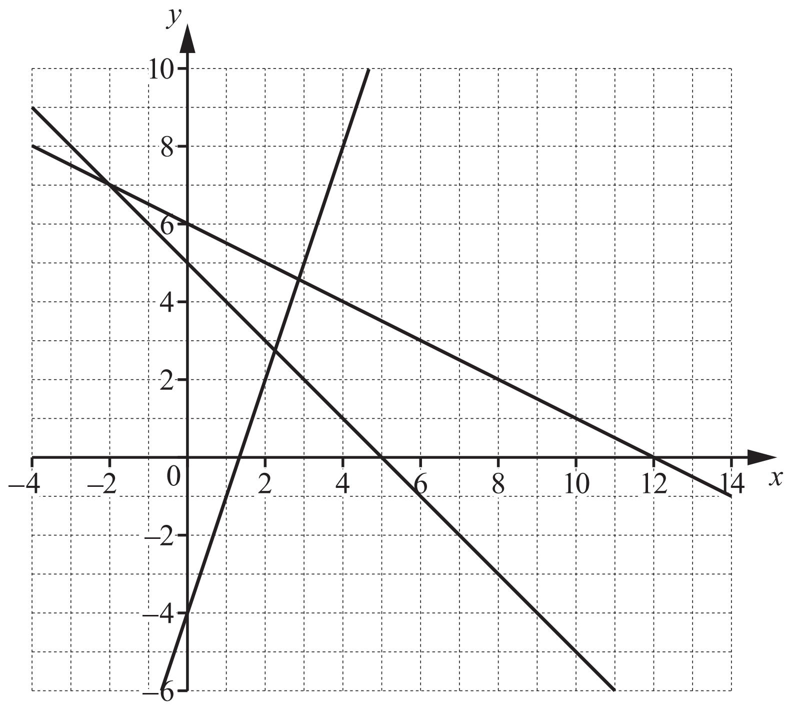


$y \leqslant -\frac{1}{2}x + 6$ $\quad\quad$ $y \geqslant 3x - 4$ $\quad\quad$ $x + y \geqslant 5$

(a) By shading the **unwanted** regions of the grid, find and label the region R that satisfies the three inequalities. [2]

(b) Find the largest value of $x + y$ in the region R, where x and y are integers.

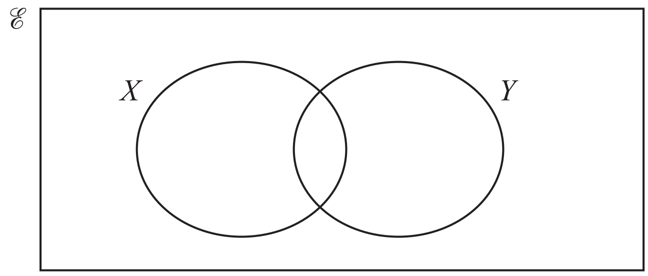
.... [1]

17 Write as a single fraction in its simplest form.

$$\frac{2x}{x+3} + \frac{x+3}{x-5}$$

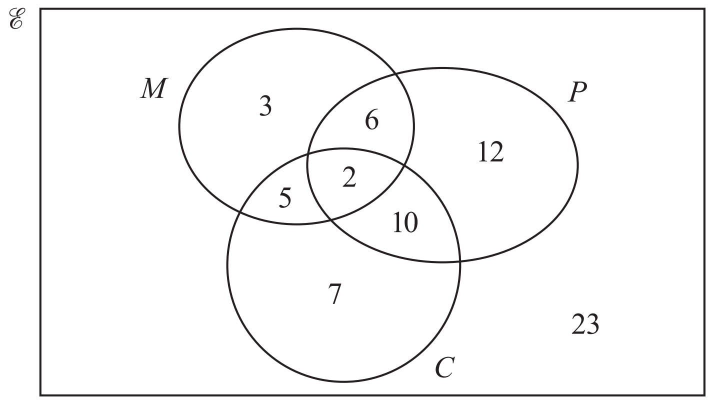
.... [3]

21 **(a)** In the Venn diagram, shade $X' \cap Y$.



[1]

(b) The Venn diagram below shows information about the number of gardeners who grow melons (M), potatoes (P) and carrots (C).



(i) A gardener is chosen at random from the gardeners who grow melons.

Find the probability that this gardener does not grow carrots.

.... [2]

(ii) Find $n((M \cap P) \cup C')$.

.... [1]

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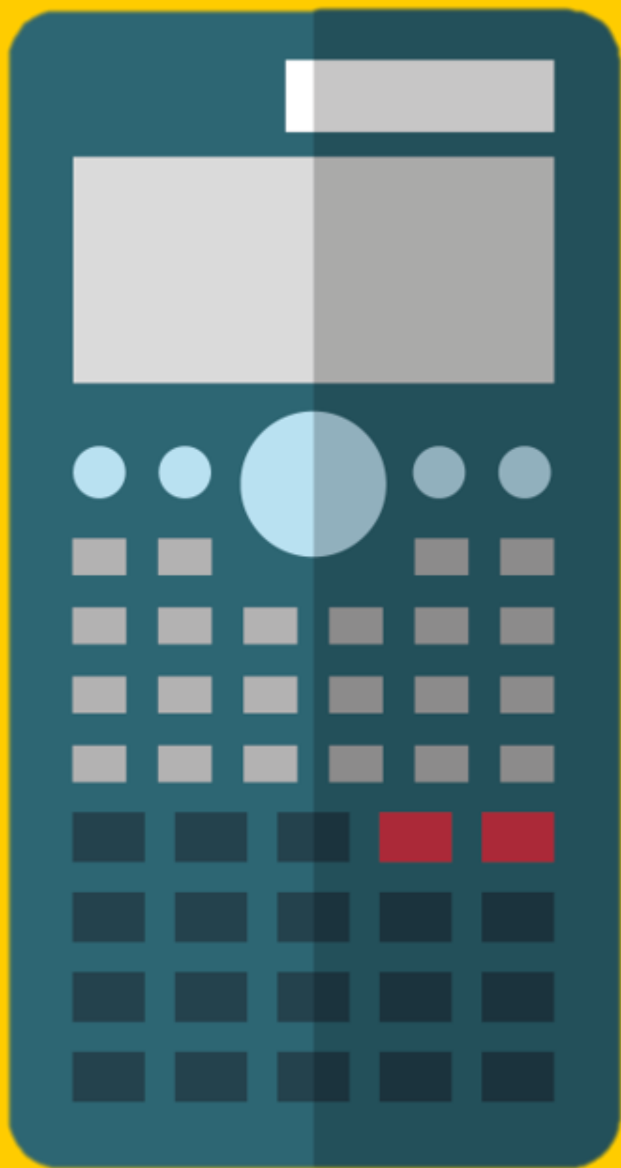

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3 The probability that Andrei cycles to school is r.

(a) Write down, in terms of r, the probability that Andrei **does not** cycle to school.

.... [1]

(b) The probability that Benoit **does not** cycle to school is $1.3 - r$.
The probability that both Andrei and Benoit **do not** cycle to school is 0.4 .

(i) Complete the equation in terms of r.

(.........................) × (.........................) = 0.4 [1]

(ii) Show that this equation simplifies to $10r^2 - 23r + 9 = 0$.

[3]

(iii) Solve by factorisation $10r^2 - 23r + 9 = 0$.

r = ... or r = ... [3]

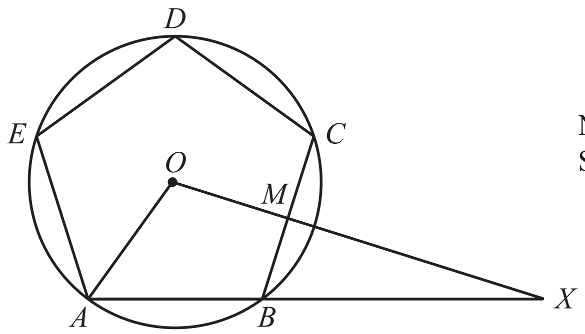
(iv) Find the probability that Benoit **does not** cycle to school.

.... [1]

7 **(a)** Show that each interior angle of a regular pentagon is 108°.

[2]

(b)



The diagram shows a regular pentagon *ABCDE*.
The vertices of the pentagon lie on a circle, centre *O*, radius 12 cm.
M is the midpoint of *BC*.

(i) Find *BM*.

BM = ... cm [3]

(ii) *OMX* and *ABX* are straight lines.

(a) Find *BX*.

BX = ... cm [3]

(b) Calculate the area of triangle *AOX*.

.... cm^2 [3]

10 **(a)** The volume of a solid metal sphere is $24\,430\,\text{cm}^3$.

(i) Calculate the radius of the sphere.

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

.... cm [3]

(ii) The metal sphere is placed in an empty tank.
The tank is a cylinder with radius 50 cm, standing on its circular base.
Water is poured into the tank to a depth of 60 cm.

Calculate the number of litres of water needed.

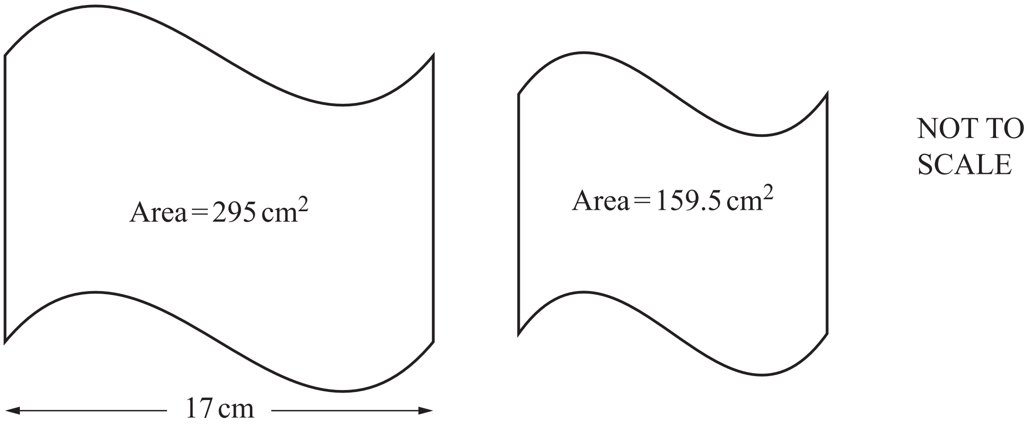
.... litres [3]

(b) A different tank is a cuboid measuring 1.8 m by 1.5 m by 1.2 m.
Water flows from a pipe into this empty tank at a rate of $200\,\text{cm}^3$ per second.

Find the time it takes to fill the tank.
Give your answer in hours and minutes.

.... hours .... minutes [4]

(c)



The diagram shows two mathematically similar shapes with areas $295\,\text{cm}^2$ and $159.5\,\text{cm}^2$.
The width of the larger shape is 17 cm.

Calculate the width of the smaller shape.

.... cm [3]

11

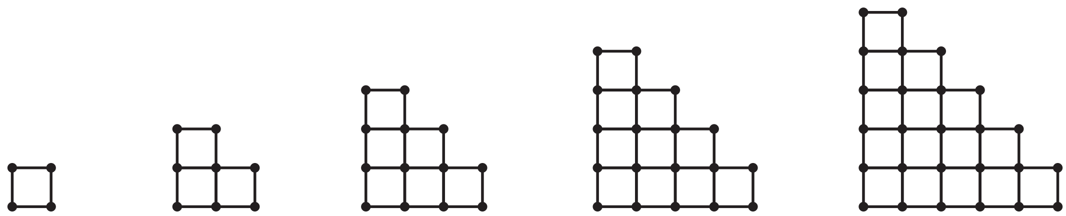


Diagram 1 Diagram 2 Diagram 3 Diagram 4 Diagram 5

The sequence of diagrams above is made up of small lines and dots.

(a) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of small lines	4	10	18	28		
Number of dots	4	8	13	19		

[4]

(b) For Diagram *n* find an expression, in terms of *n*, for the number of small lines.

.... [2]

(c) Diagram *r* has 10 300 small lines.

Find the value of *r*.

r = ... [2]

(d) The number of dots in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b.

a = ...

b = ... [2]

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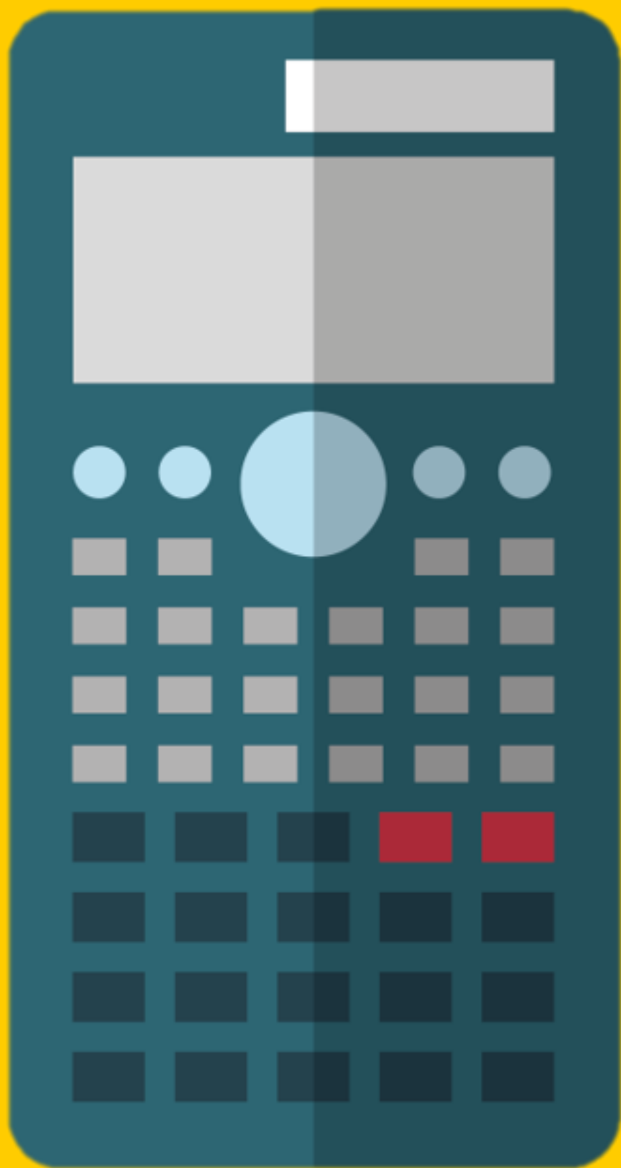

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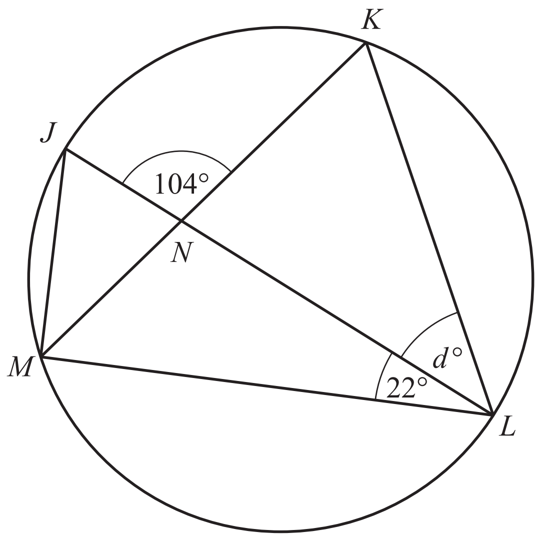


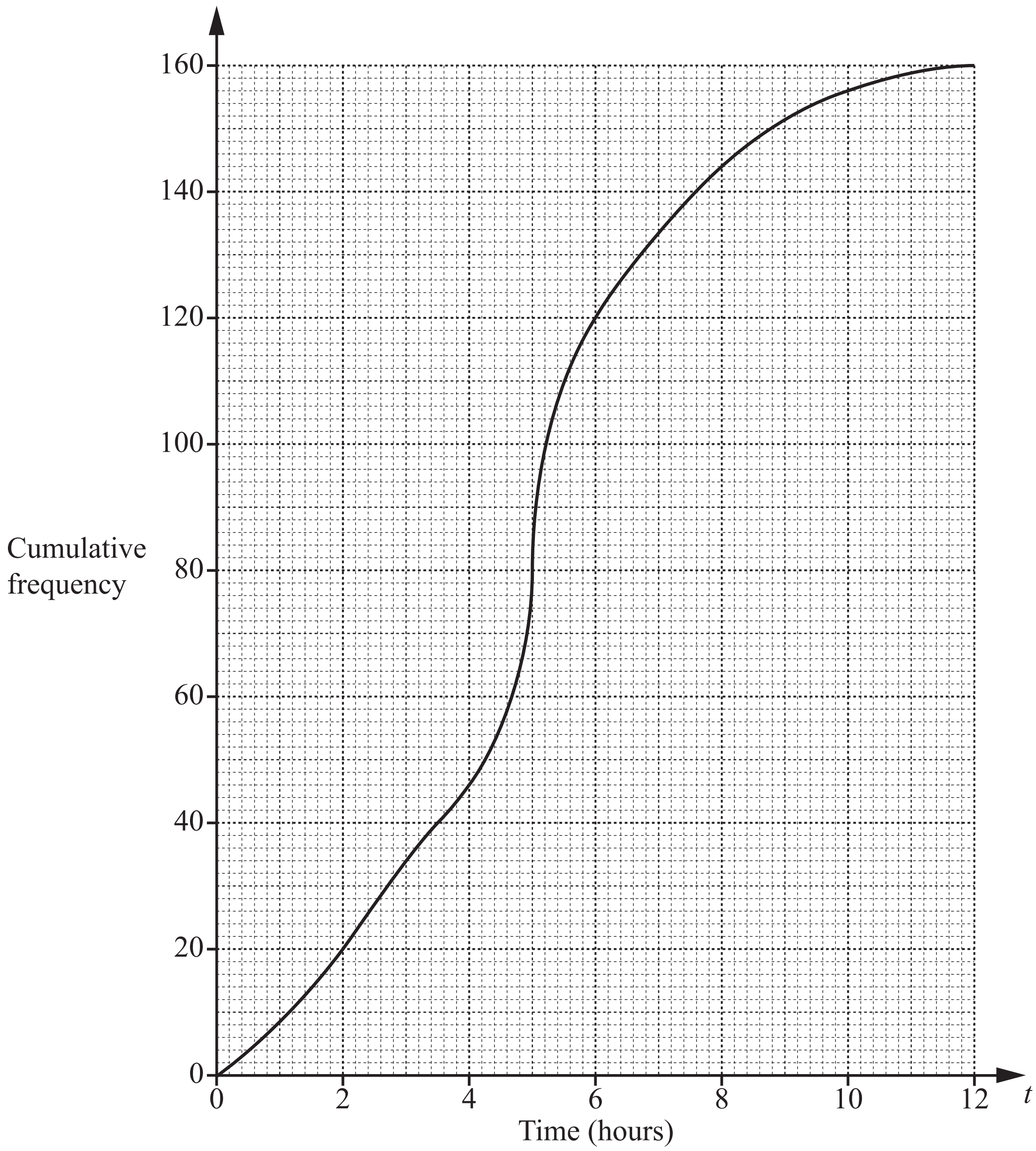
NOT TO SCALE

J, K, L and M are points on the circumference of a circle with diameter JL.
JL and KM intersect at N.
Angle $JNK = 104°$ and angle $MLJ = 22°$.

Work out the value of d.

$d =$ .... [4]

23 160 students record the amount of time, t hours, they each spend playing computer games in a week.
This information is shown in the cumulative frequency diagram.



(a) Use the diagram to find an estimate of

(i) the median,

.... hours [1]

(ii) the interquartile range.

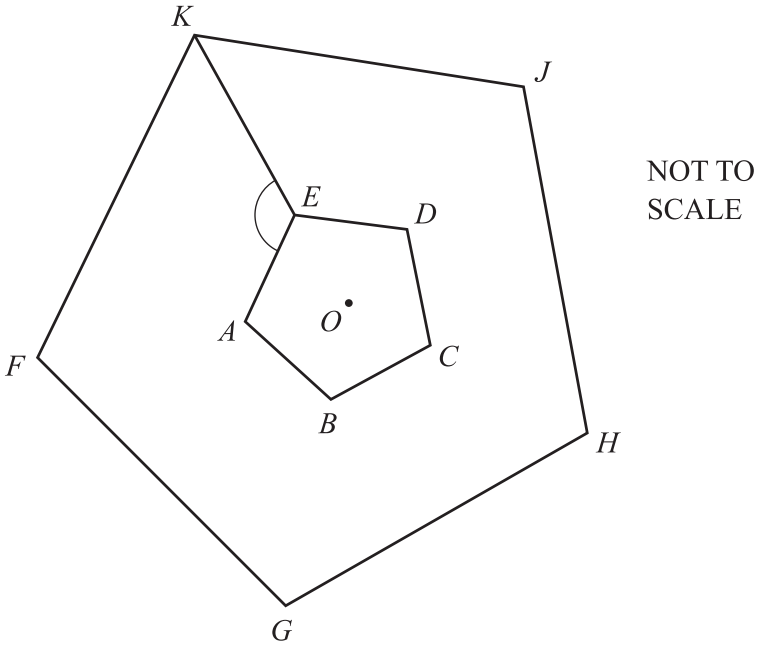
.... hours [2]

(b) Use the diagram to complete this frequency table.

Time (t hours)	$0 < t \leqslant 2$	$2 < t \leqslant 4$	$4 < t \leqslant 6$	$6 < t \leqslant 8$	$8 < t \leqslant 10$	$10 < t \leqslant 12$
Frequency	20			24	12	4

[2]

25



The diagram shows two regular pentagons.
Pentagon *FGHJK* is an enlargement of pentagon *ABCDE*, centre *O*.

(a) Find angle *AEK*.

Angle *AEK* = ... [4]

(b) The area of pentagon *FGHJK* is $73.5\,\text{cm}^2$.
The area of pentagon *ABCDE* is $6\,\text{cm}^2$.

Find the ratio perimeter of pentagon *FGHJK* : perimeter of pentagon *ABCDE* in its simplest form.

.... : .... [2]

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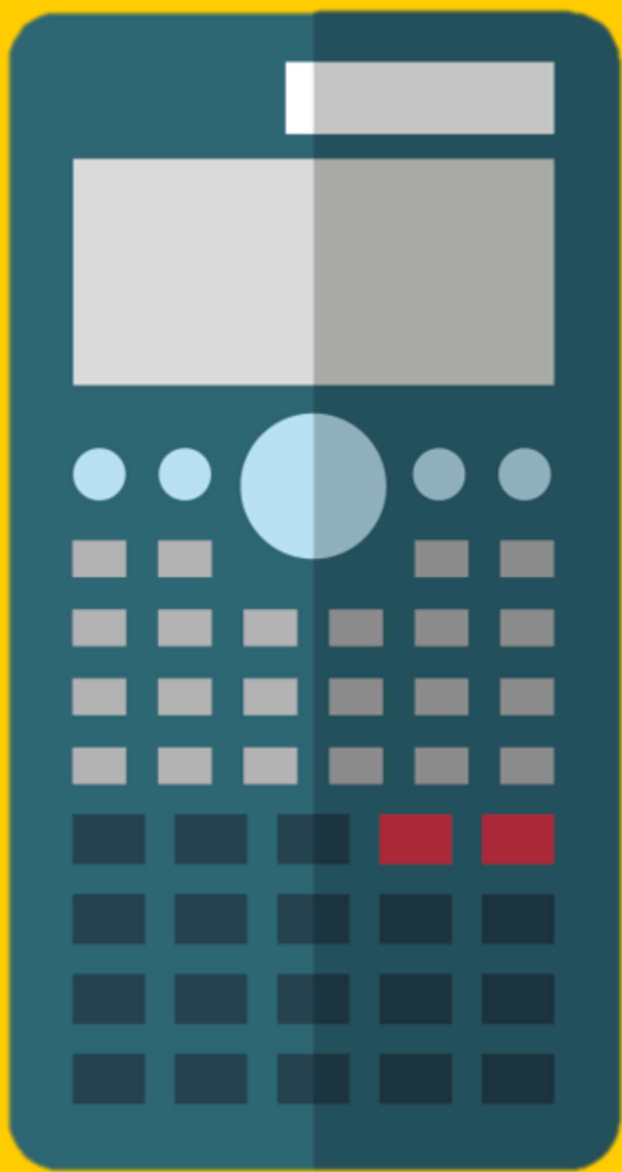
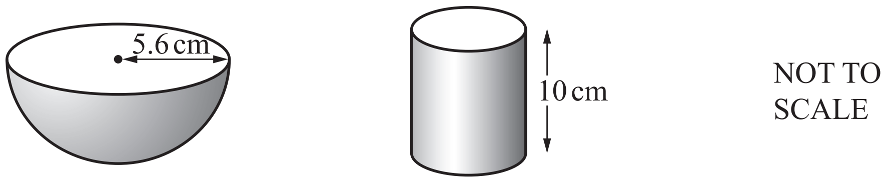


4 **(a)**



The diagram shows a hemispherical bowl of radius 5.6 cm and a cylindrical tin of height 10 cm.

(i) Show that the volume of the bowl is 368 cm^3, correct to the nearest cm^3.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

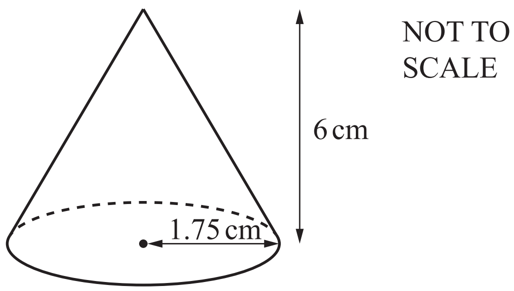
[2]

(ii) The tin is completely full of soup.
When all the soup is poured into the empty bowl, 80% of the volume of the bowl is filled.

Calculate the radius of the tin.

.... cm [4]

(b)

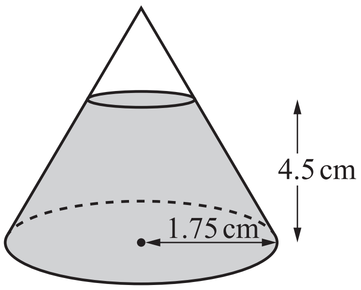


The diagram shows a cone with radius 1.75 cm and height 6 cm.

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

.... cm^2 [5]

(ii)



NOT TO SCALE

The cone contains salt to a depth of 4.5 cm.
The top layer of the salt forms a circle that is parallel to the base of the cone.

(a) Show that the volume of the salt inside the cone is 18.9 cm^3, correct to 1 decimal place.
[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

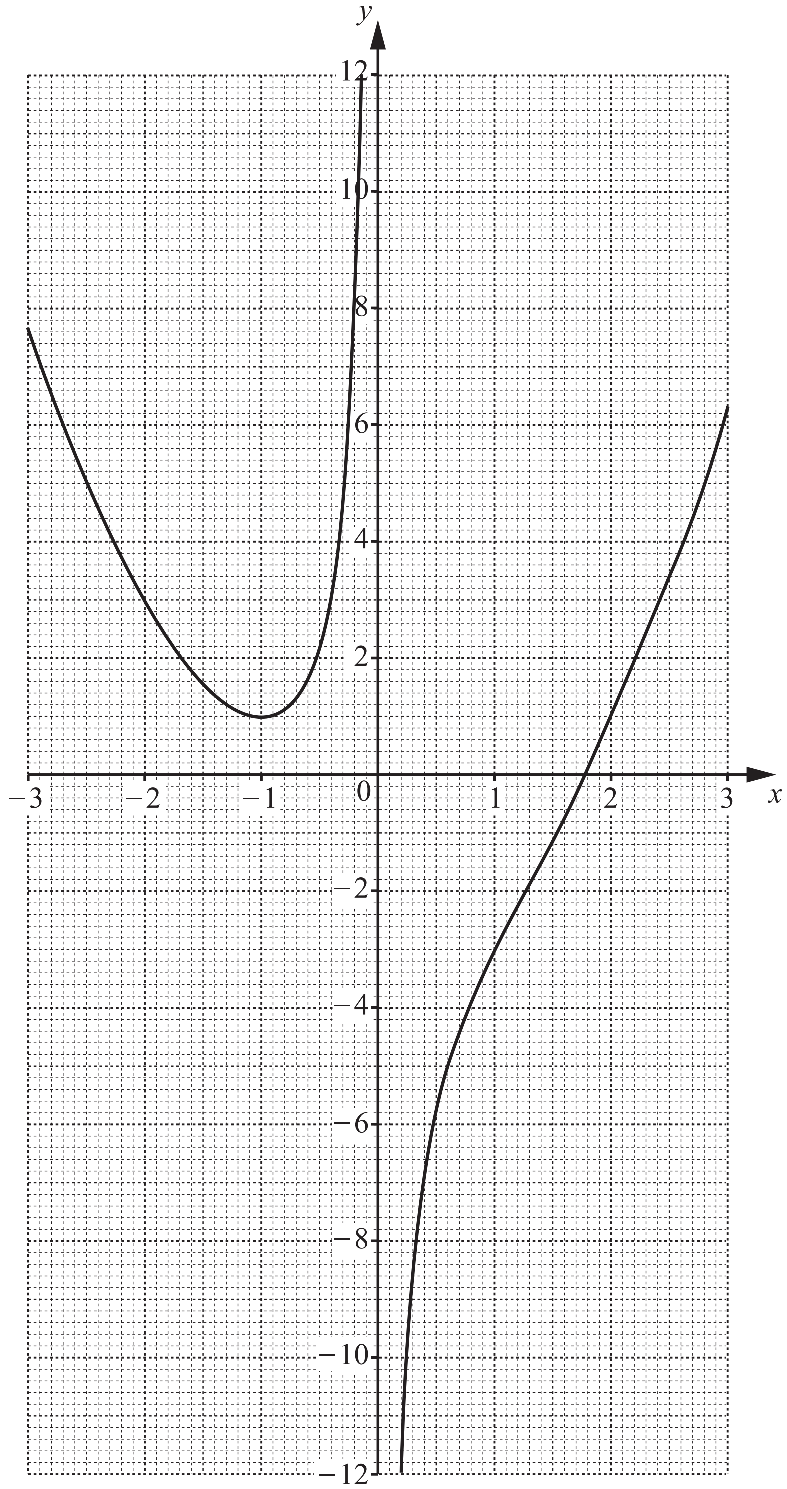
[4]

(b) The salt is removed from the cone at a constant rate of 200 mm^3 per second.

Calculate the time taken for the cone to be completely emptied.
Give your answer in seconds, correct to the nearest second.

.... s [3]

5 The diagram shows the graph of $y = \mathrm{f}(x)$ where $\mathrm{f}(x) = x^2 - \dfrac{2}{x} - 2,\ x \neq 0$.



(a) Use the graph to find

(i) $\mathrm{f}(1)$,

.... [1]

(ii) $\mathrm{ff}(-2)$.

.... [2]

(b) On the grid opposite, draw a suitable straight line to solve the equation
$x^2 - \frac{2}{x} - 7 = -3x$ for $-3 \leqslant x \leqslant 3$.

$x =$ .... or $x =$ .... [4]

(c) By drawing a suitable tangent, find an estimate of the gradient of the curve at $x = -2$.

.... [3]

(d) **(i)** Complete the table for $y = \mathrm{g}(x)$ where $\mathrm{g}(x) = 2^{-x}$ for $-3 \leqslant x \leqslant 3$.

x	-3	-2	-1	0	1	2	3
y			2	1	0.5		0.125

[3]

(ii) On the grid opposite, draw the graph of $y = \mathrm{g}(x)$. [3]

(iii) Use your graph to find the **positive** solution to the equation $\mathrm{f}(x) = \mathrm{g}(x)$.

$x =$ .... [1]

8 **(a)** Angelo has a bag containing 3 white counters and x black counters.
He takes two counters at random from the bag, without replacement.

(i) Complete the following statement.

The probability that Angelo takes two black counters is

$$\frac{x}{x+3} \times \frac{\dots\dots\dots\dots}{\dots\dots\dots\dots}.$$

[2]

(ii) The probability that Angelo takes two black counters is $\frac{7}{15}$.

(a) Show that $4x^2 - 25x - 21 = 0$.

[4]

(b) Solve by factorisation.

$$4x^2 - 25x - 21 = 0$$

$x =$ .... or $x =$ .... [3]

(c) Write down the number of black counters in the bag.

.... [1]

(b) Esme has a bag with 5 green counters and 4 red counters.
She takes three counters at random from the bag without replacement.

Work out the probability that the three counters are all the same colour.

.... [4]

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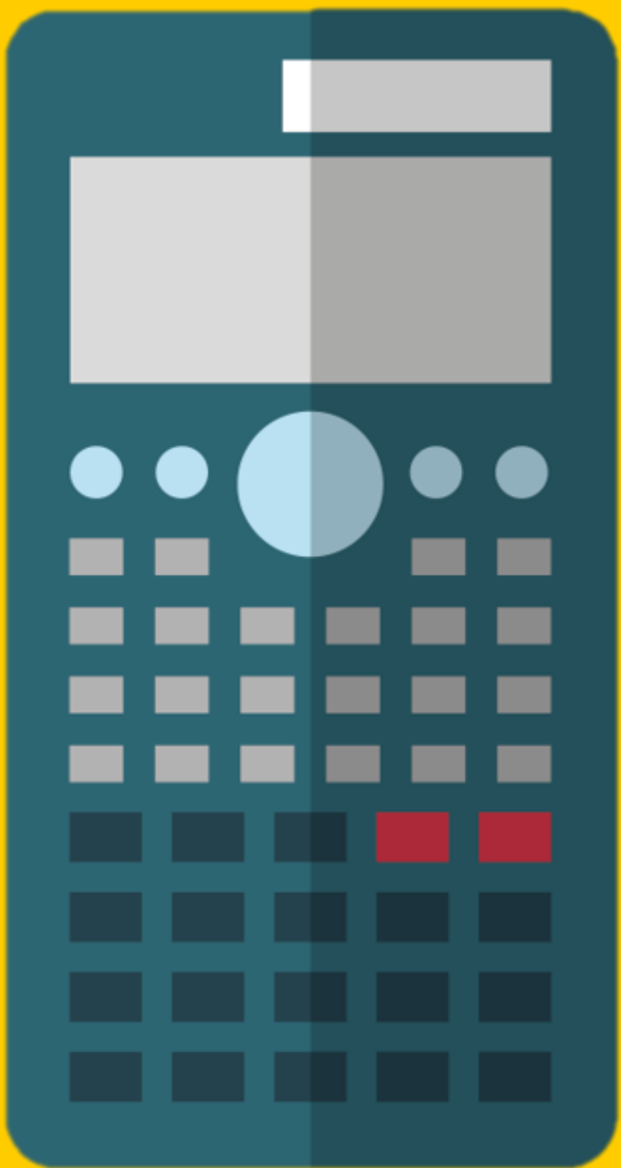


14 The scale of a map is 1 : 10 000 000.
On the map, the area of Slovakia is 4.9 cm^2.

Calculate the actual area of Slovakia.
Give your answer in square kilometres.

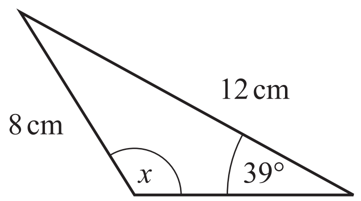
.... km^2 [3]

15 y is inversely proportional to x^2.
When $x = 4$, $y = 2$.

Find y when $x = \frac{1}{2}$.

$y =$ .... [3]

16



NOT TO SCALE

Calculate the **obtuse** angle x in this triangle.

$x =$ .... [3]

23 $\mathscr{E} = \{0, 1, 2, 3, 4, 5, 6\}$ $A = \{0, 2, 4, 5, 6\}$ $B = \{1, 2, 5\}$

Complete each of the following statements.

$A \cap B =$ {..}

$n(B) =$ ....

$\{0, 4, 6\} =$ .... $\cap$ ....

$\{2, 4\}$ .... A [4]

24 $f(x) = 3x - 5$ $g(x) = 2^x$

(a) Find fg(3).

.... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ .... [2]

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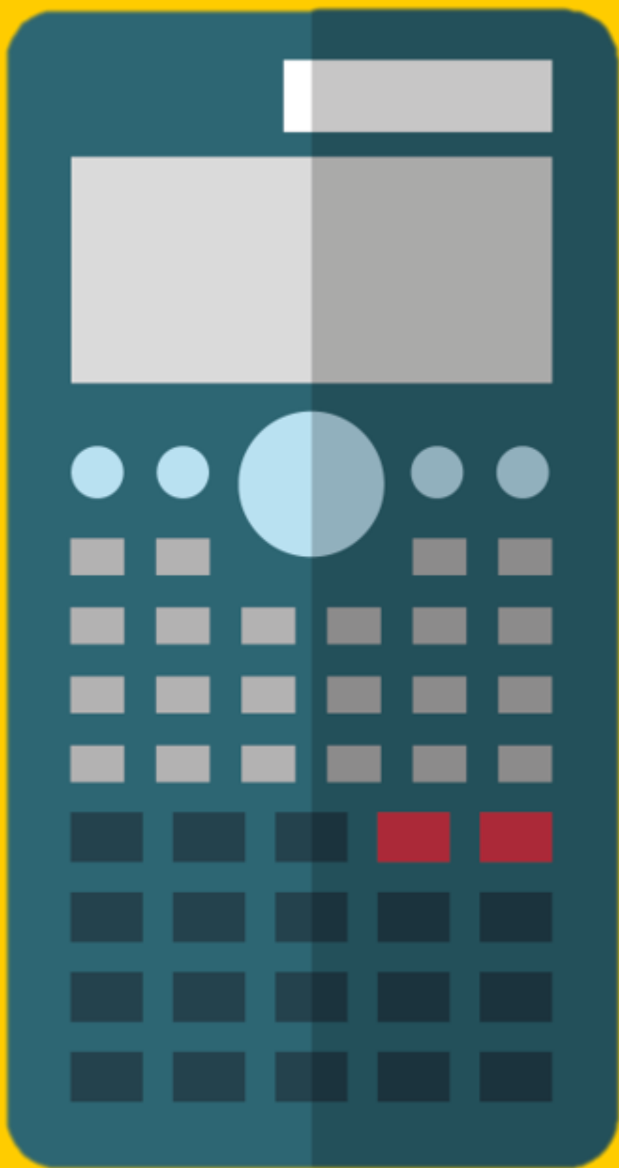

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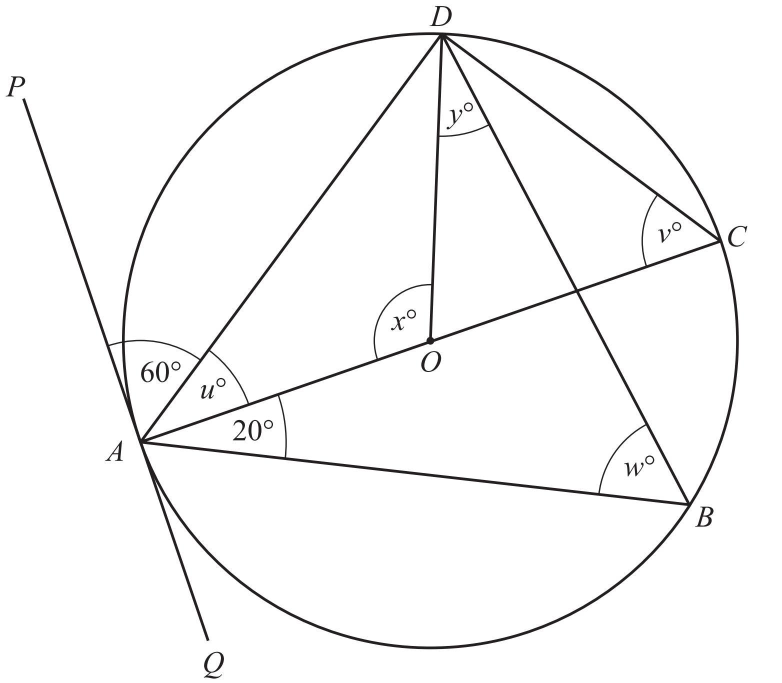
(d)



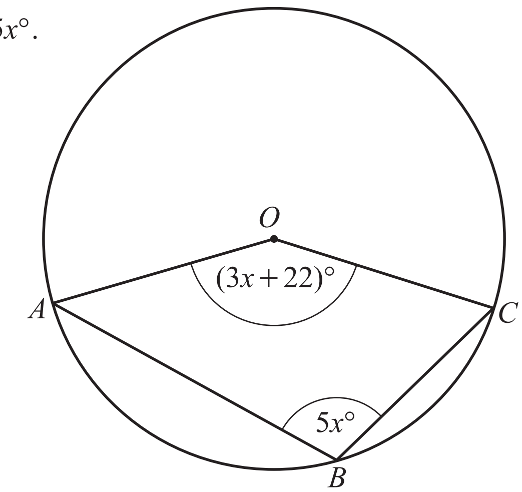
A, B, C and D lie on the circle, centre O, with diameter AC.
PQ is a tangent to the circle at A.
Angle $PAD = 60°$ and angle $BAC = 20°$.

Find the values of u, v, w, x and y.

$u =$ ...., $v =$ ...., $w =$ ...., $x =$ ...., $y =$ .... [6]

(e) A, B and C lie on the circle, centre O.
Angle $AOC = (3x + 22)°$ and angle $ABC = 5x°$.

Find the value of x.



$x =$ .... [4]

4 **(a)** **(i)** Calculate the **external curved** surface area of a cylinder with radius 8 m and height 19 m.

.... m^2 [2]

(ii) This surface is painted at a cost of \$0.85 per square metre.

Calculate the cost of painting this surface.

\$ .... [2]

(b) A solid metal sphere with radius 6 cm is melted down and all of the metal is used to make a solid cone with radius 8 cm and height h cm.

(i) Show that $h = 13.5$.

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

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

[2]

(ii) Calculate the slant height of the cone.

.... cm [2]

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

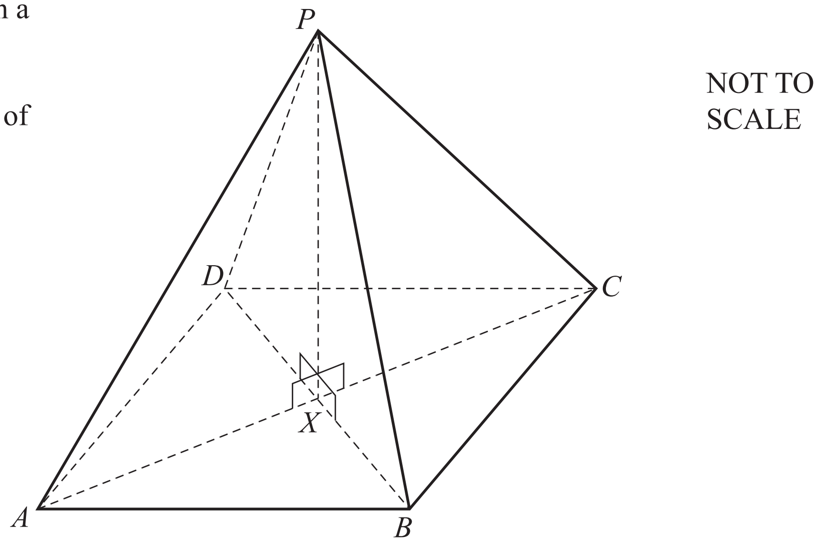
.... cm^2 [1]

(c) Two cones are mathematically similar.
The total surface area of the smaller cone is $80\,\text{cm}^2$.
The total surface area of the larger cone is $180\,\text{cm}^2$.
The volume of the smaller cone is $168\,\text{cm}^3$.

Calculate the volume of the larger cone.

.... cm^3 [3]

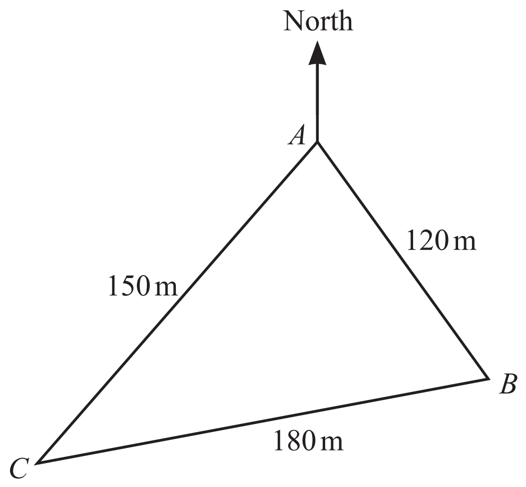
(d) The diagram shows a pyramid with a square base *ABCD*.
$DB = 8\,\text{cm}$.
P is vertically above the centre, *X*, of the base and $PX = 5\,\text{cm}$.



Calculate the angle between *PB* and the base *ABCD*.

.... [3]

5



NOT TO SCALE

The diagram shows a triangular field, *ABC*, on horizontal ground.

(a) Olav runs from *A* to *B* at a constant speed of 4 m/s and then from *B* to *C* at a constant speed of 3 m/s.
He then runs at a constant speed from *C* to *A*.
His average speed for the whole journey is 3.6 m/s.

Calculate his speed when he runs from *C* to *A*.

.... m/s [3]

(b) Use the cosine rule to find angle *BAC*.

Angle *BAC* = ... [4]

(c) The bearing of C from A is 210°.

(i) Find the bearing of B from A.

.... [1]

(ii) Find the bearing of A from B.

.... [2]

(d) D is the point on AC that is nearest to B.

Calculate the distance from D to A.

.... m [2]

10 **(a)** Complete the table for the 5th term and the nth term of each sequence.

1st term	2nd term	3rd term	4th term	5th term		nth term
9	5	1	-3			
4	9	16	25			
1	8	27	64			
8	16	32	64			

[11]

(b) 0, 1, 1, 2, 3, 5, 8, 13, 21, …

This sequence is a Fibonacci sequence.
After the first two terms, the rule to find the next term is "add the two previous terms".
For example, $5+8=13$.

Use this rule to complete each of the following Fibonacci sequences.

2	4	....	....	....
1	....	....	....	11
....	-1	....	....	1

[3]

(c) $\frac{1}{3}$, $\frac{3}{4}$, $\frac{4}{7}$, $\frac{7}{11}$, $\frac{11}{18}$, …

(i) One term of this sequence is $\frac{p}{q}$.

Find, in terms of p and q, the next term in this sequence.

.... [1]

(ii) Find the 6th term of this sequence.

.... [1]

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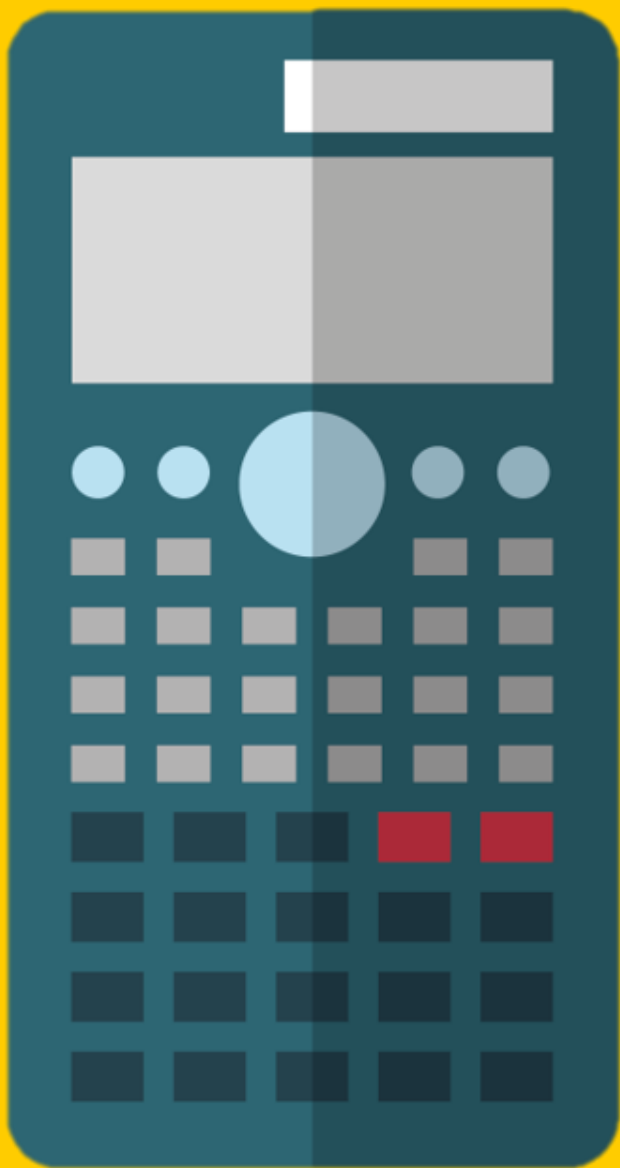

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20 **(a)** Factorise.

$$18y - 3ay + 12x - 2ax$$

.... [2]

(b) Factorise.

$$3x^2 - 48y^2$$

.... [3]

21 **(a)** $3^{-2} \times 3^x = 81$

Find the value of x.

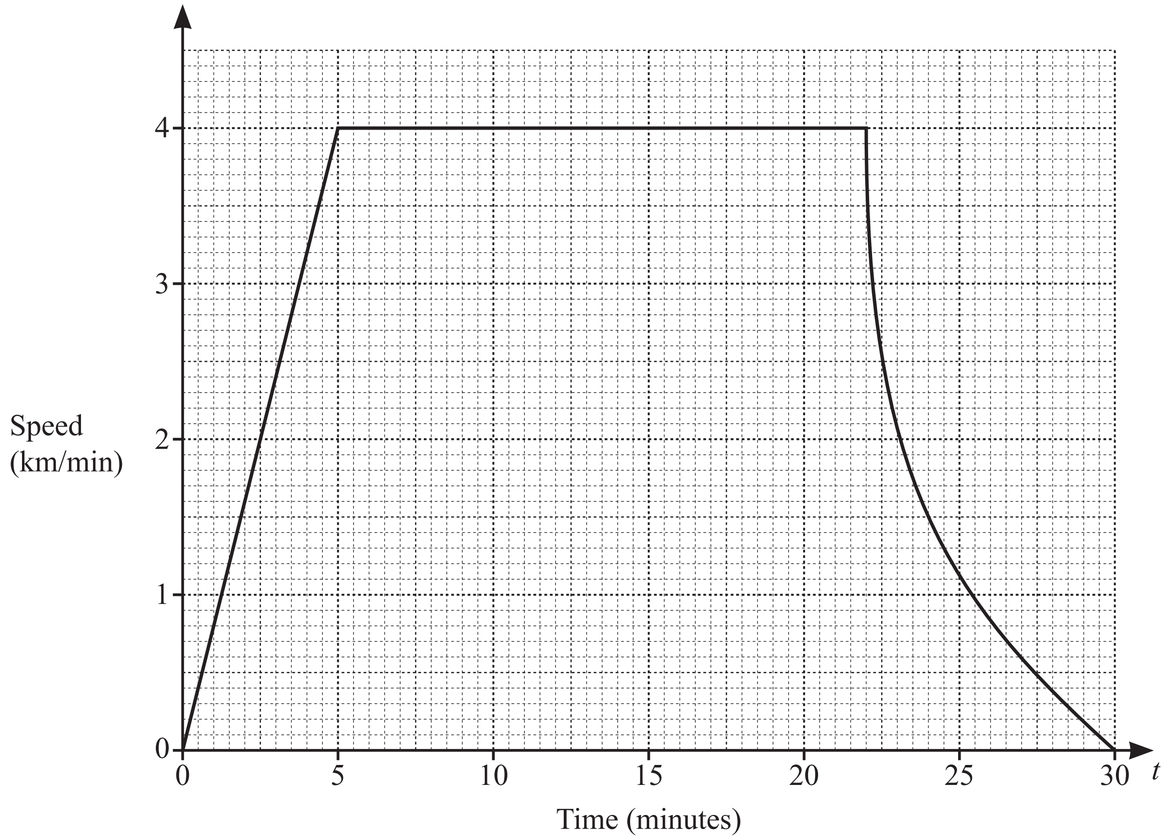
$x =$ .... [2]

(b) $x^{-\frac{1}{3}} = 32x^{-2}$

Find the value of x.

$x =$ .... [3]

23



The speed–time graph shows information about a train journey.

(a) By drawing a suitable tangent to the graph, estimate the gradient of the curve at $t = 24$.

.... [3]

(b) What does this gradient represent?

.... [1]

(c) Work out the distance travelled by the train when it is travelling at constant speed.

.... km [2]

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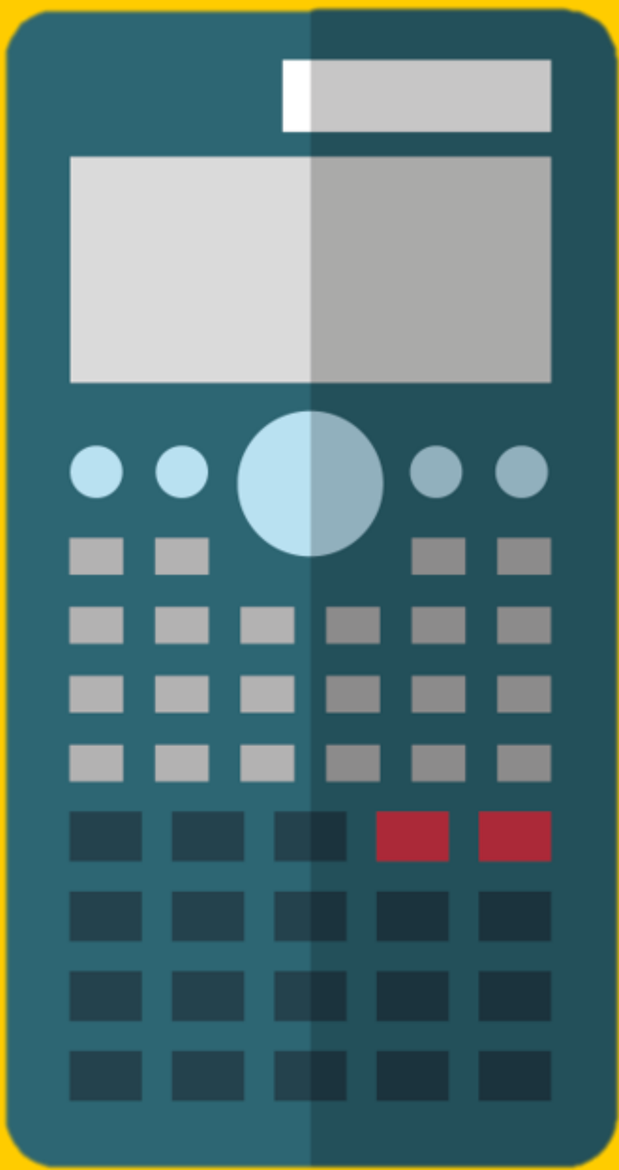
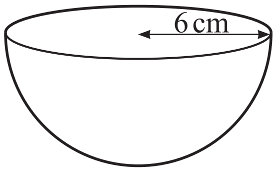


4 **(a)**



NOT TO SCALE

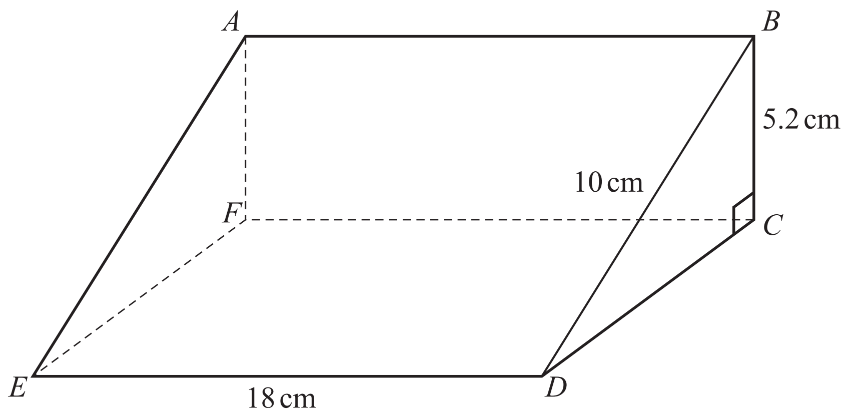
The diagram shows a hemisphere with radius 6 cm.

Calculate the volume.
Give the units of your answer.

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

.... [3]

(b)



NOT TO SCALE

The diagram shows a prism *ABCDEF*.
The cross-section is a right-angled triangle *BCD*.
$BD = 10$ cm, $BC = 5.2$ cm and $ED = 18$ cm.

(i) **(a)** Work out the volume of the prism.

.... cm^3 [6]

(b) Calculate angle BEC.

Angle BEC = ... [4]

(ii) The point G lies on the line ED and $GD = 7$ cm.

Work out angle BGE.

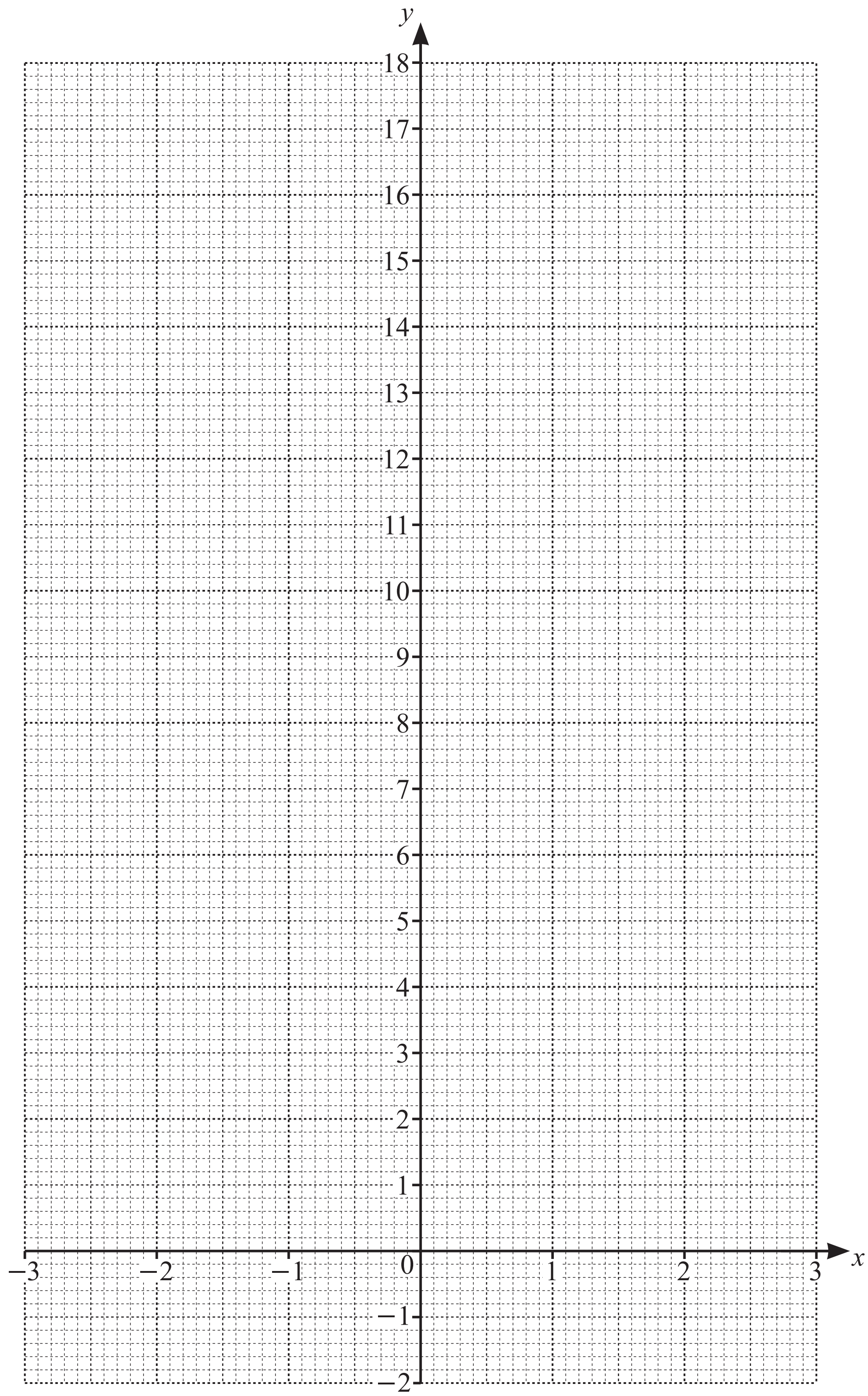
Angle BGE = ... [3]

5 The table shows some values of $y = \frac{x^2}{2} + \frac{1}{x^2} - \frac{2}{x}$, $x \neq 0$.

x	−3	−2	−1	−0.5	−0.3		0.2	0.3	0.5	1	2	3
y	5.3	3.3		8.1	17.8			4.5	0.1	−0.5	1.3	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = \frac{x^2}{2} + \frac{1}{x^2} - \frac{2}{x}$ for $-3 \leqslant x \leqslant -0.3$ and $0.2 \leqslant x \leqslant 3$.



[5]

(c) Use your graph to solve $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}\leqslant 0$.

.... $\leqslant x \leqslant$ .... [2]

(d) Find the smallest positive integer value of k for which $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=k$ has two solutions for $-3\leqslant x\leqslant -0.3$ and $0.2\leqslant x\leqslant 3$.

.... [1]

(e) **(i)** By drawing a suitable straight line, solve $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=3x+1$ for $-3\leqslant x\leqslant -0.3$ and $0.2\leqslant x\leqslant 3$.

$x =$ .... [3]

(ii) The equation $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=3x+1$ can be written as $x^4+ax^3+bx^2+cx+2=0$.

Find the values of a, b and c.

$a =$ ....

$b =$ ....

$c =$ .... [3]

9 Car A and car B take part in a race around a circular track.
One lap of the track measures 7.6 km.

Car A takes 2 minutes and 40 seconds to complete each lap of the track.
Car B takes 2 minutes and 25 seconds to complete each lap of the track.
Both cars travel at a constant speed.

(a) Calculate the speed of car A.
Give your answer in kilometres per hour.

.... km/h [3]

(b) Both cars start the race from the same position, S, at the same time.

(i) Find the time taken when both car A and car B are next at position S **at the same time**.
Give your answer in minutes and seconds.

.... min .... s [4]

(ii) Find the distance that car A has travelled at this time.

.... km [2]

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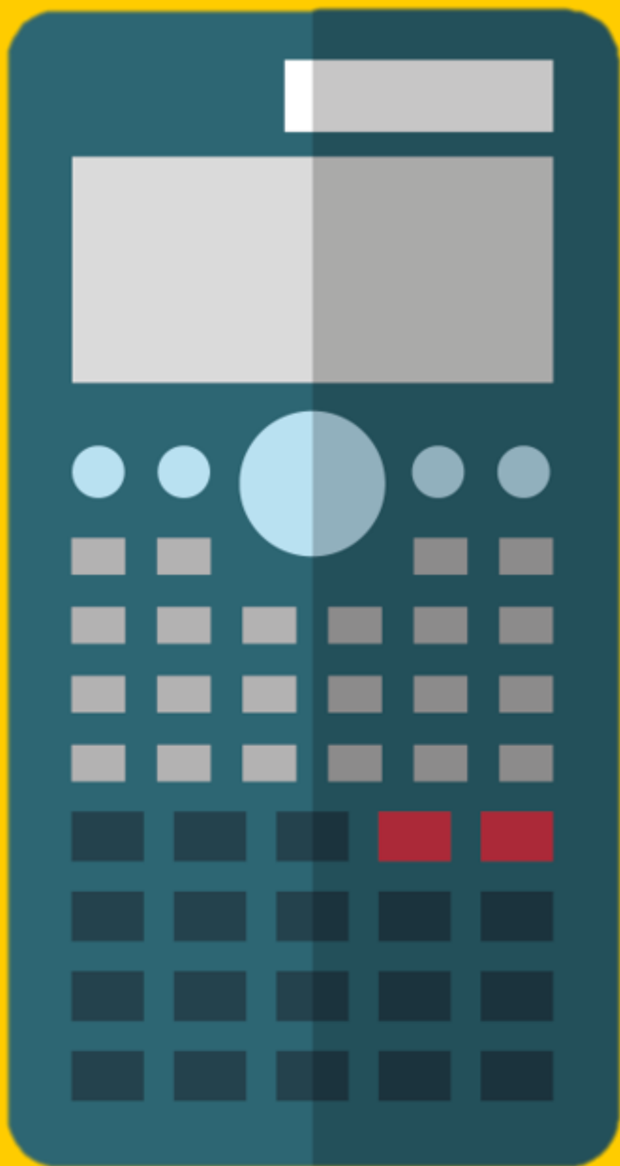

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13 A straight line joins the points $(3k, 6)$ and $(k, -5)$.
The line has a gradient of 2.

Find the value of k.

$k =$ .... [3]

14 Find the nth term of each sequence.

(a) $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \frac{1}{10}, \ldots$

.... [1]

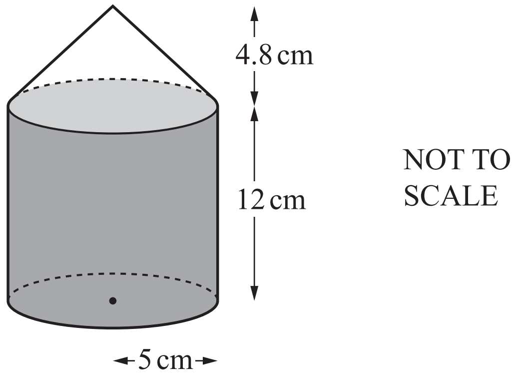
(b) 1, 5, 25, 125, 625, ...

.... [2]

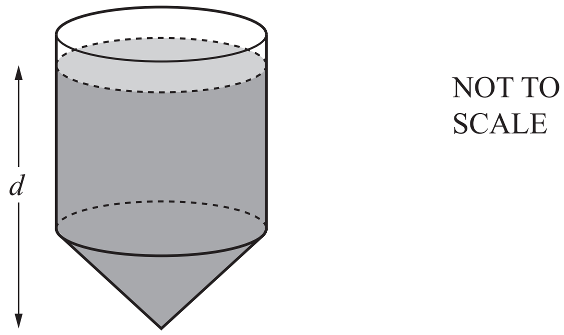
15 **Without using a calculator**, work out $\frac{2}{3}+\frac{1}{4}\times\frac{2}{3}$.
Write down all the steps of your working and give your answer as a fraction in its simplest form.

.... [4]

22 A container is made from a cylinder and a cone, each of radius 5 cm.
The height of the cylinder is 12 cm and the height of the cone is 4.8 cm.



The cylinder is filled completely with water.
The container is turned upside down as shown below.



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

d = ... cm [5]

Question 23 is printed on the next page.

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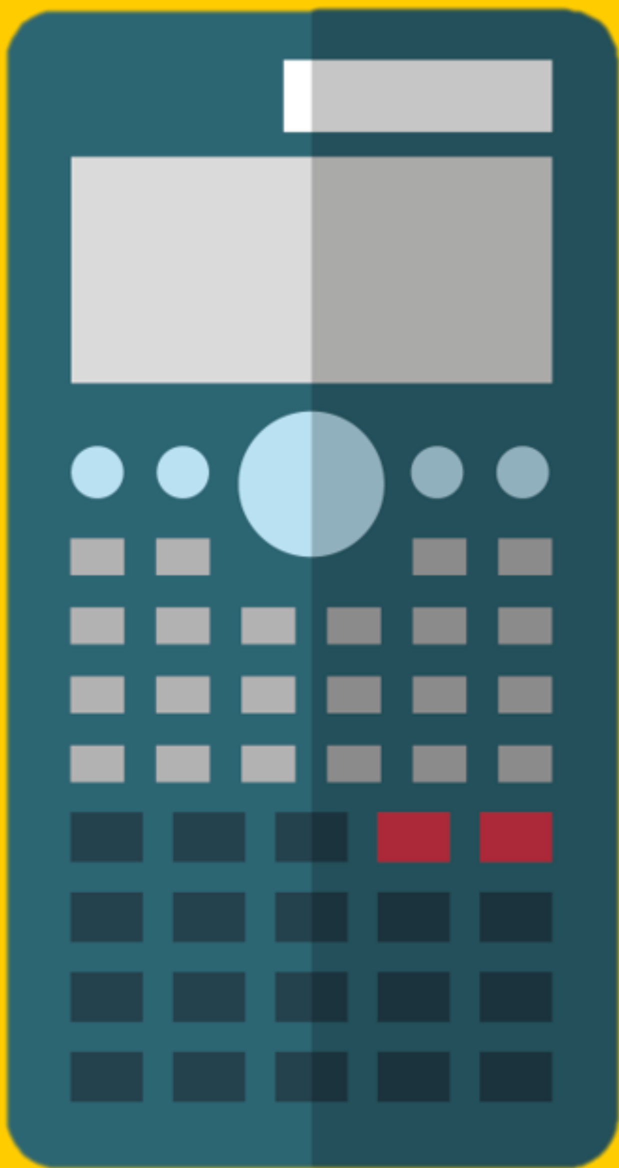

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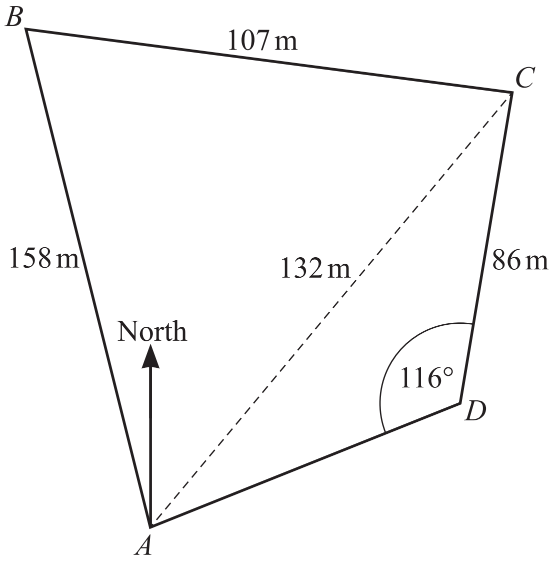


The diagram shows a field, $ABCD$, on horizontal ground.

(a) There is a vertical post at C.
From B, the angle of elevation of the top of the post is 19°.

Find the height of the post.

.... m [2]

(b) Use the cosine rule to find angle BAC.

Angle BAC = ... [4]

(c) Use the sine rule to find angle *CAD*.

Angle *CAD* = ... [3]

(d) Calculate the area of the field.

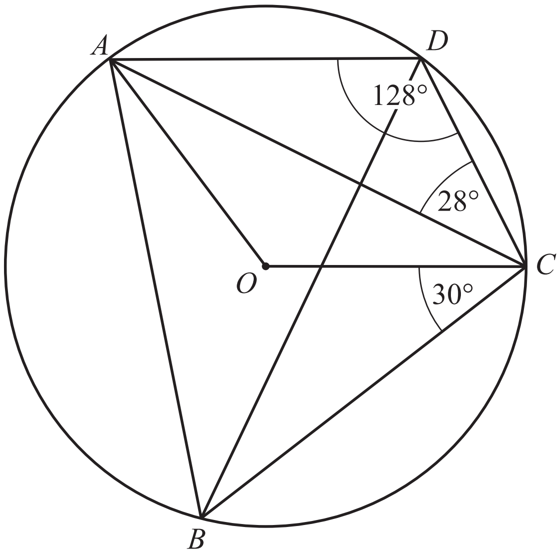
.... m^2 [3]

(e) The bearing of *D* from *A* is 070°.

Find the bearing of *A* from *C*.

.... [2]

6 **(a)**



NOT TO SCALE

In the diagram, A, B, C and D lie on the circle, centre O.
Angle $ADC = 128°$, angle $ACD = 28°$ and angle $BCO = 30°$.

(i) Show that obtuse angle $AOC = 104°$.
Give a reason for each step of your working.

[3]

(ii) Find angle BAO.

Angle BAO = ... [2]

(iii) Find angle ABD.

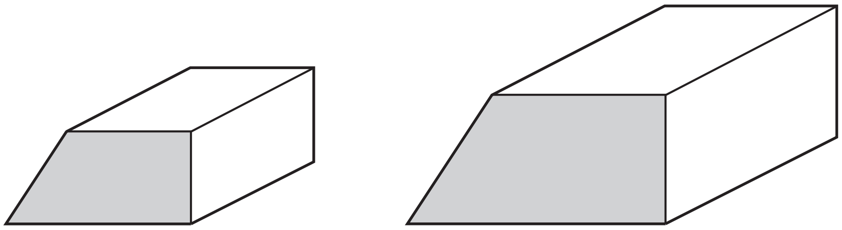
Angle ABD = ... [1]

(iv) The radius, OC, of the circle is 9.6 cm.

Calculate the total perimeter of the sector $OADC$.

.... cm [3]

(b)



The diagram shows two mathematically similar solid metal prisms.
The volume of the smaller prism is 648 cm^3 and the volume of the larger prism is 2187 cm^3.
The area of the cross-section of the smaller prism is 36 cm^2.

(i) Calculate the area of the cross-section of the larger prism.

.... cm^2 [3]

(ii) The larger prism is melted down into a sphere.

Calculate the radius of the sphere.

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

.... cm [3]

8 **(a)** A bag contains 4 red marbles and 2 yellow marbles.
Behnaz picks two marbles at random without replacement.

Find the probability that

(i) the marbles are both red,

.... [2]

(ii) the marbles are not both red.

.... [1]

(b) Another bag contains 5 blue marbles and 2 green marbles.
Bryn picks one marble at random without replacement.
If this marble is not green, he picks another marble at random without replacement.
He continues until he picks a green marble.

Find the probability that he picks a green marble on his first, second or third attempt.

.... [4]

9 $\mathrm{f}(x) = 2x - 3$ $\mathrm{g}(x) = 9 - x^2$ $\mathrm{h}(x) = 3^x$

(a) Find

(i) $\mathrm{f}(4)$,

.... [1]

(ii) $\mathrm{hg}(3)$,

.... [2]

(iii) $\mathrm{g}(2x)$ in its simplest form,

.... [1]

(iv) $\mathrm{fg}(x)$ in its simplest form.

.... [2]

(b) Find $\mathrm{f}^{-1}(x)$.

$\mathrm{f}^{-1}(x) =$ .... [2]

(c) Find x when $5\mathrm{f}(x) = 3$.

$x =$ .... [2]

(d) Solve the equation $\mathrm{gf}(x) = -16$.

$x =$ .... or $x =$ .... [4]

(e) Find x when $\mathrm{h}^{-1}(x) = -2$.

$x =$ .... [1]