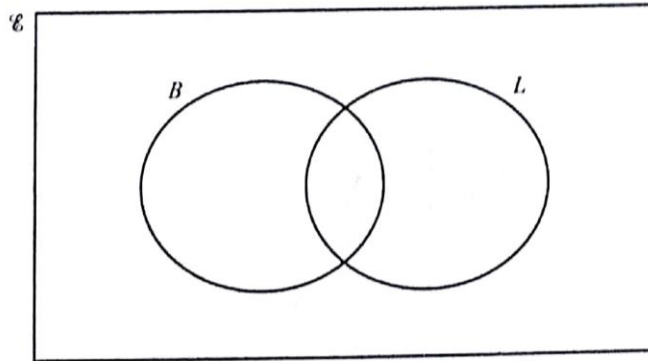# A / A* questions

2017

0580/22

Feb/March

2017

17 (a) A total of 20 trucks were tested at a checkpoint.

- 6 trucks failed the test for brakes (B)
- 7 trucks failed the test for lights (L)
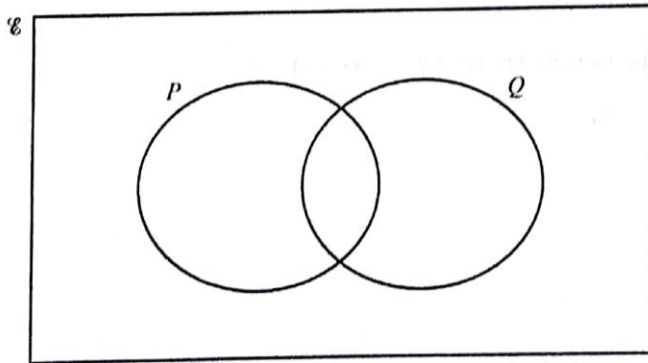- 9 trucks passed the tests for both brakes and lights.
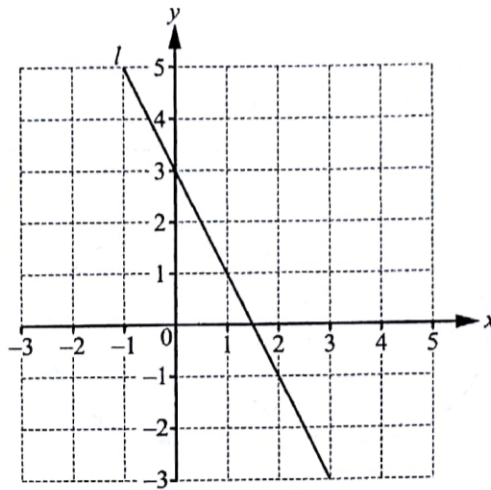

(i) Complete the Venn diagram. [2]

(ii) Find $n(B' \cap L')$.

.... [1]

(b) In the Venn diagram below, shade the region $(P \cup Q) \cap Q'$.

[1]

20

(a) Find the equation of the line l.
Give your answer in the form $y = mx + c$.

$y =$ .... [3]

(b) A line perpendicular to the line l passes through the point $(3, -1)$.

Find the equation of this line.

.... [3]

Question 21 is printed on the next page.

0580/42

Feb/March

2017

4

3   The table shows some values for $y = 1.5^x - 1$.

x	-2	-1	0	1	2	3	4	5
y	-0.56	-0.33				2.38	4.06	6.59

(a) Complete the table.   [3]

(b) Draw the graph of $y = 1.5^x - 1$ for $-2 \leqslant x \leqslant 5$.
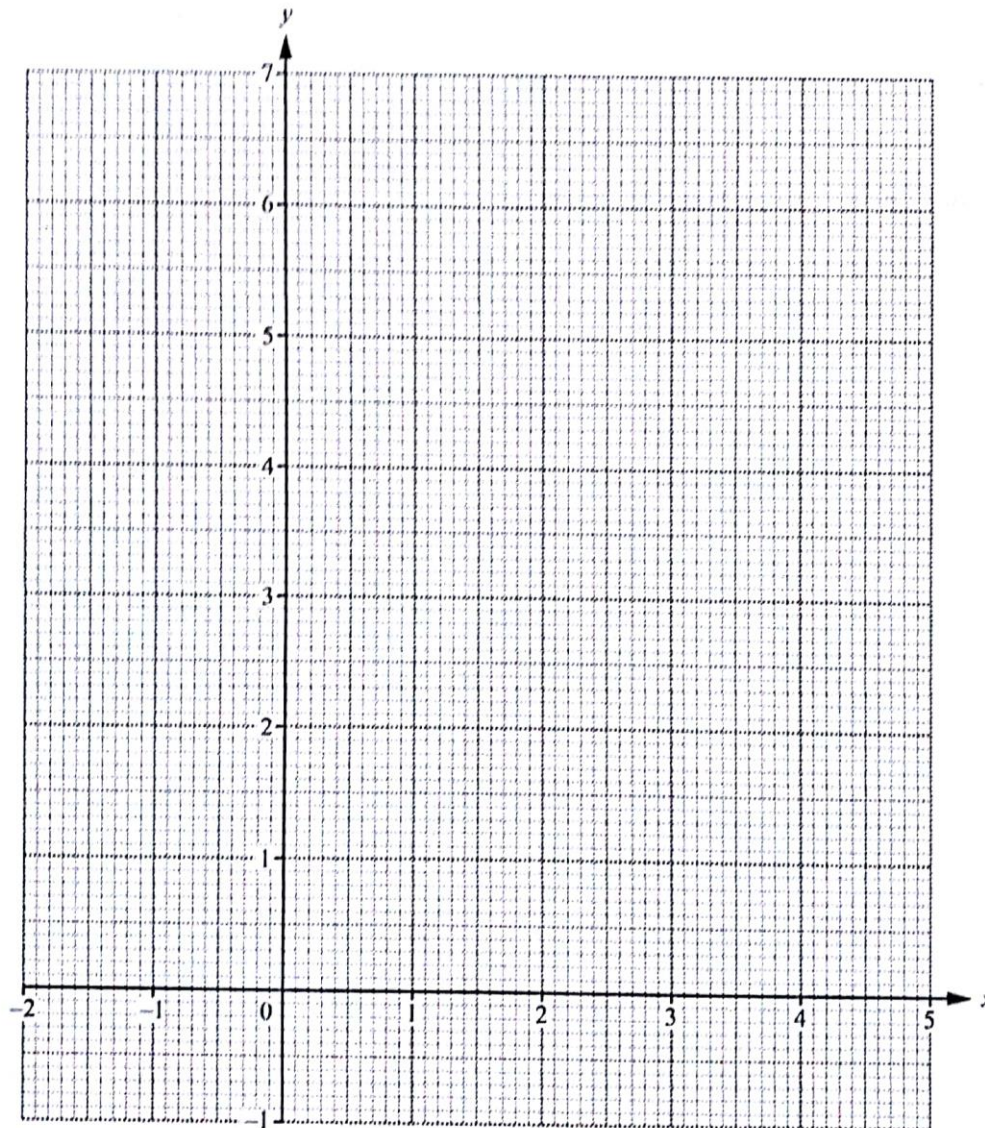
[4]

(c) Use your graph to solve the equation $1.5^x - 1 = 3.5$.

$x =$ .... [2]

(d) By drawing a suitable straight line, solve the equation $1.5^x - x - 2 = 0$.

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

(e) **(i)** On the grid, plot the point A at $(5, 5)$. [1]

    (ii) Draw the tangent to the graph of $y = 1.5^x - 1$ that passes through the point A. [1]

    (iii) Work out the gradient of this tangent.

.... [2]

5 (a) (i) Factorise $3x^2 + 11x - 4$.

.... [2]

(ii) Solve the equation $3x^2 + 11x - 4 = 0$.

$x =$ .... or $x =$ ....[1]
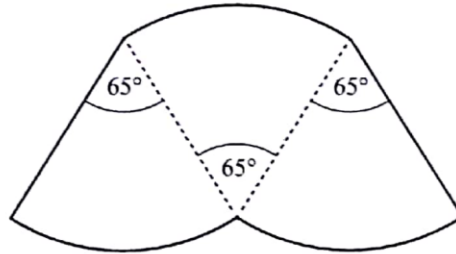
(b) (i) Show that $\dfrac{2}{2x+11} - \dfrac{1}{x-4} = \dfrac{1}{2}$ simplifies to $2x^2 + 3x - 6 = 0$.

[4]

(ii) Solve the equation $2x^2 + 3x - 6 = 0$.
You must show all your working and give your answers correct to 2 decimal places.

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

[Turn over

(b) The diagram shows a shape made up of three identical sectors of a circle, each with sector angle 65°.
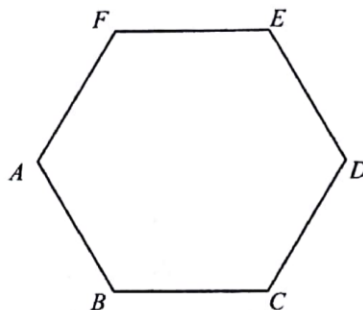The perimeter of the shape is 20.5 cm.

NOT TO
SCALE

Calculate the radius of the circle.

.... cm [4]

[Turn over

10 (a) The diagram shows a regular
hexagon $ABCDEF$ of side 10 cm.
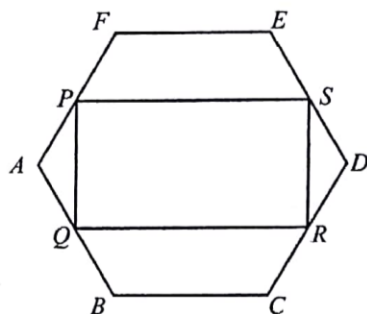
F   E

NOT TO
SCALE

A   D

B   C

(i)   Show that angle $BAF = 120°$.

[2]

(ii) The vertices of a rectangle $PQRS$
touch the sides FA, AB, CD and DE.

PS is parallel to FE and $AP = x$ cm.

F   E

P   S   NOT TO
SCALE

A   D

Q   R

B   C

Use trigonometry to find the length of PQ in terms of x.

$PQ =$ .... cm [3]

(iii) $PF = (10 - x)$ cm.

Show that $PS = (20 - x)$ cm.

[3]

(b)

17

NOT TO SCALE
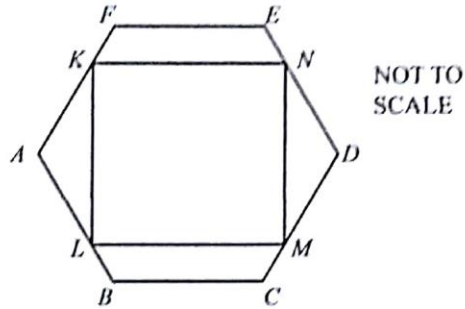
The diagram shows the vertices of a square *KLMN* touching the sides of the same hexagon *ABCDEF*, with *KN* parallel to *FE*.

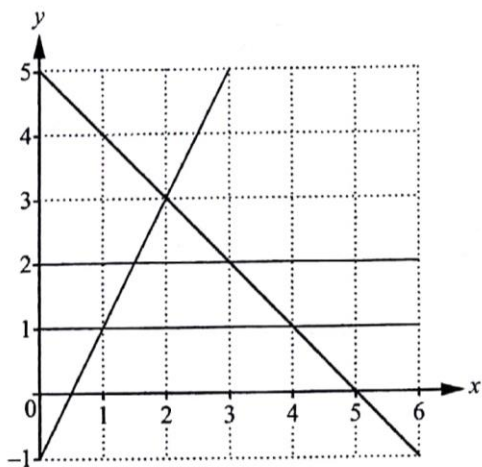Use your results from **part (a)(ii)** and **part (a)(iii)** to find the length of a side of the square.

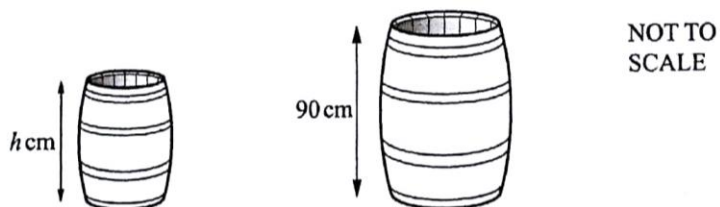.. cm [4]

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2017

10

By shading the **unwanted** regions of the grid, find and label the region R that satisfies the following four inequalities.

$$y \leqslant 2 \qquad y \geqslant 1 \qquad y \leqslant 2x - 1 \qquad y \leqslant 5 - x$$ [3]

11 The two barrels in the diagram are mathematically similar.
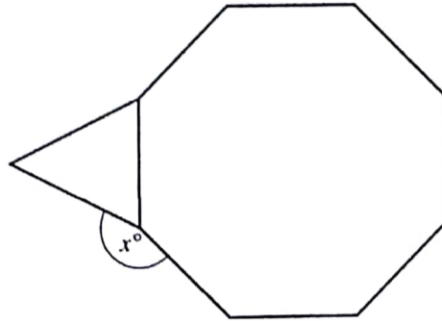
NOT TO SCALE

h cm

90 cm

The smaller barrel has a height of h cm and a capacity of 100 litres.
The larger barrel has a height of 90 cm and a capacity of 160 litres.

Work out the value of h.

$h = $ .... [3]

0580/21/M/J/17   **[Turn over**

14 The diagram shows a regular octagon joined to an equilateral triangle.

NOT TO
SCALE

Work out the value of x.

x = ...[3]

18   The diagram shows a parallelogram *OCEG*.
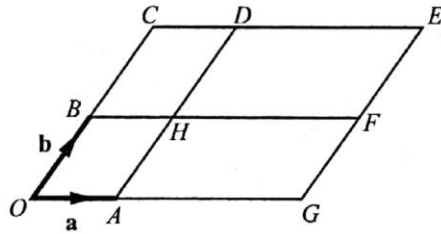
NOT TO
SCALE

O is the origin, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

BHF and *AHD* are straight lines parallel to the sides of the parallelogram.

$\overrightarrow{OG} = 3\overrightarrow{OA}$ and $\overrightarrow{OC} = 2\overrightarrow{OB}$.

(a)   Write the vector $\overrightarrow{HE}$ in terms of **a** and **b**.

$\overrightarrow{HE} =$ .... [1]

(b)   Complete this statement.

a + 2**b** is the position vector of point .... [1]

(c)   Write down two vectors that can be written as 3**a** − **b**.

.... and .... [2]

19 *ABCD* is a rhombus with side length 10 cm.
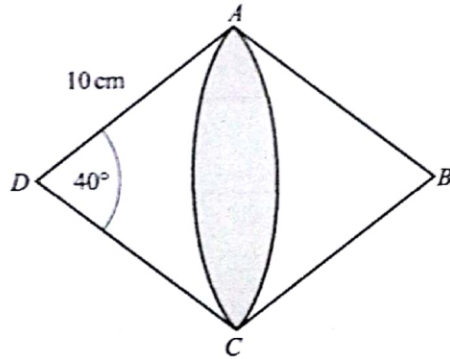
Angle *ADC* = 40°.
DAC is a sector of a circle with centre *D*.
BAC is a sector of a circle with centre *B*.

Calculate the shaded area.
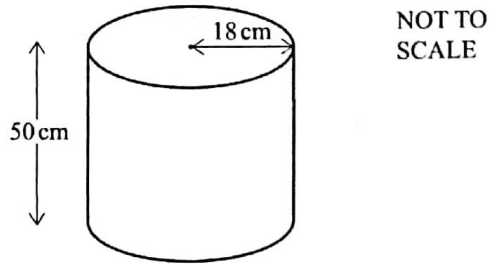
.... cm² [4]

0580/41
May/June
2017

5 (a) The diagram shows a cylindrical container used to serve coffee in a hotel.
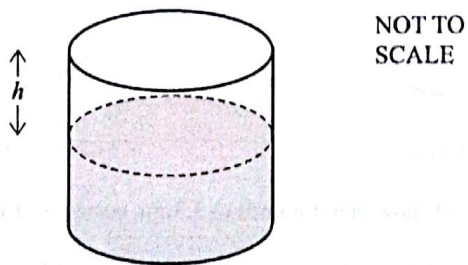

The container has a height of 50 cm and a radius of 18 cm.

(i) Calculate the volume of the cylinder and show that it rounds to 50 900 cm³, correct to 3 significant figures.
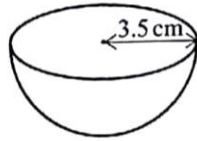
[2]

(ii) 30 litres of coffee are poured into the container.

Work out the height, h, of the empty space in the container.

$h =$ .... cm [3]

(iii) Cups in the shape of a hemisphere are filled with coffee from the container.
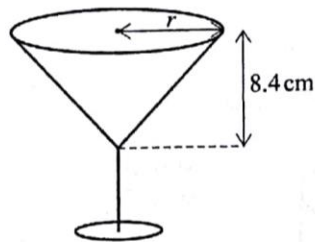The radius of a cup is 3.5 cm.

NOT TO
SCALE

3.5 cm

Work out the maximum number of these cups that can be completely filled from the 30 litres of coffee in the container.

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

.... [4]

(b) The hotel also uses glasses in the shape of a cone.

r

8.4 cm

NOT TO
SCALE

The capacity of each glass is 95 cm³.

(i) Calculate the radius, r, and show that it rounds to 3.3 cm, correct to 1 decimal place.

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

[3]

(ii) Calculate the curved surface area of the cone.

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

.... cm² [4]

[Turn over

13

7   A line joins the points $A(-3, 8)$ and $B(2, -2)$.

(a)   Find the co-ordinates of the midpoint of AB.

(...................... , ...) [2]

(b)   Find the equation of the line through A and B.
      Give your answer in the form $y = mx + c$.

$y = $ .... [3]

(c)   Another line is parallel to AB and passes through the point $(0, 7)$.

      Write down the equation of this line.

.... [2]

(d)   Find the equation of the line perpendicular to AB which passes through the point $(1, 5)$.
      Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

.... [4]

16

9 (a) The nth term of a sequence is $8n - 3$.

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

   .... , ... [1]

   (ii) Show that the number 203 is not in this sequence.

   [2]

   (b) Find the nth term of these sequences.

   (i) 13,   19,   25,   31,   ...

   .... [2]

   (ii) 4,   8,   14,   22,   ...

   .... [2]

   (c)   ... ,   20,   50,   ...

   The second term of this sequence is 20 and the third term is 50.
   The rule for finding the next term in this sequence is subtract y then multiply by 5.

   Find the value of y and work out the first term of this sequence.

   $y = $ ....

   First term = ... [4]

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25 (a) Simplify.

$$(16x^{16})^{\frac{1}{4}}$$

.... [2]

(b) $2p^{\frac{1}{3}} = 54$

Find the value of p.

$p = $ .... [2]

26
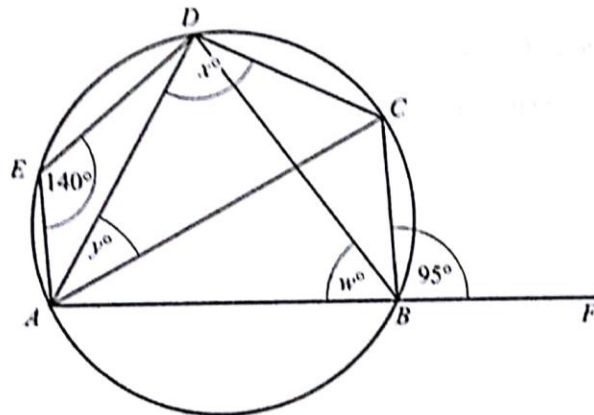
NOT TO
SCALE

A, B, C, D and E lie on the circle.
AB is extended to F.
Angle $AED = 140°$ and angle $CBF = 95°$.

Find the values of w, x and y.

$w = $ ....

$x = $ ....

$y = $ .... [5]

Question 27 is printed on the next page.

[Turn over

27
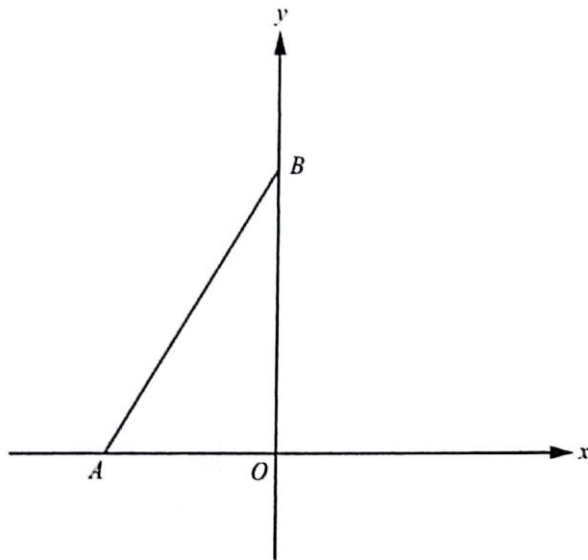
NOT TO
SCALE

A is the point (−2, 0) and *B* is the point (0, 4).

(a) Find the equation of the straight line joining *A* and *B*.

.... [3]

(b) Find the equation of the perpendicular bisector of *AB*.

.... [4]

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(c) Dermot has $70 to spend.
He spends $24.75 on a shirt.

(i) Find $24.75 as a fraction of $70.
Give your answer in its lowest terms.

.... [1]

(ii) The $24.75 is the sale price after reducing the original price by 10%.

Calculate the original price.

$ .... [3]

(d) After one year, the value of Annie's car had reduced by 20%.
At the end of the second year, the value of Annie's car had reduced by a further 15% of its value at the end of the first year.

(i) Calculate the overall percentage reduction after the two years.

.... % [2]

(ii) After three years the overall percentage reduction in the value of Annie's car is 40.84%.

Calculate the percentage reduction in the third year.

.... % [2]

4        $f(x) = 2x^2 - 1$

The graph of $y = f(x)$, for $-2 \leqslant x \leqslant 2$, is drawn on the grid.
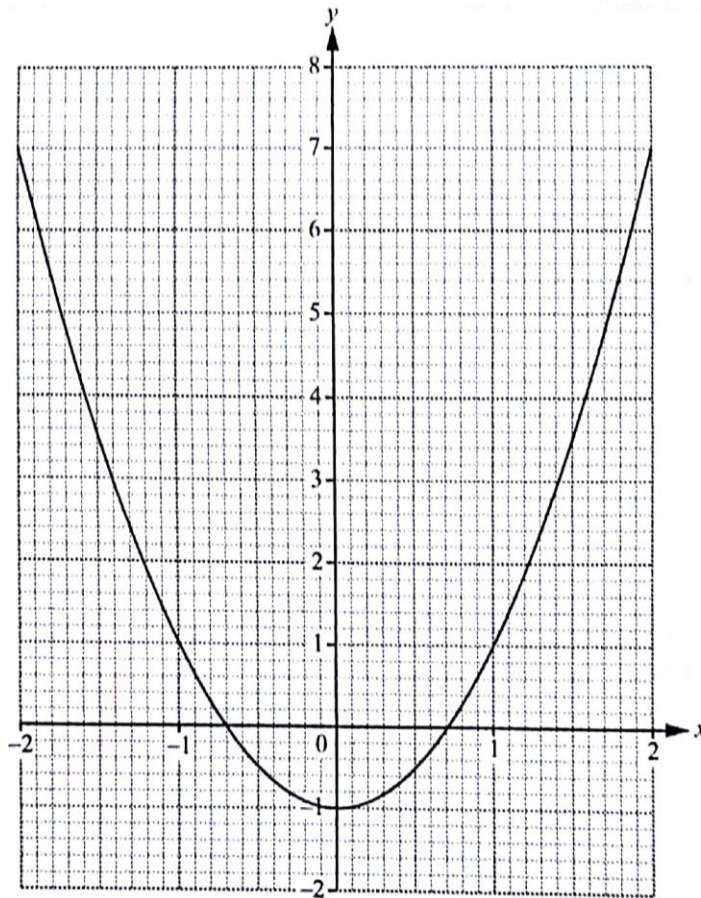
(a) Use the graph to solve the equation $f(x) = 5$.

$x =$ .... or $x =$ .... [2]

(b) (i) Draw the tangent to the graph of $y = f(x)$ at the point $(-1.5, 3.5)$.   [1]

(ii) Use your tangent to estimate the gradient of $y = f(x)$ when $x = -1.5$.

.... [2]

0580/42/M/J/17

(c) $\qquad$ $g(x) = 2^x$

(i) Complete the table for $y = g(x)$.

x	-2	-1	0	1	2
y	0.25	0.5		2	4

[1]

(ii) On the grid opposite, draw the graph of $y = g(x)$ for $-2 \leqslant x \leqslant 2$. [3]

(d) Use your graphs to solve

(i) the equation $f(x) = g(x)$,

$x =$ .... or $x =$ .... [2]

(ii) the inequality $f(x) < g(x)$.

.... [1]

(e) **(i)** Write down the three values.

$g(-3) =$ .... $g(-5) =$ .... $g(-10) =$ .... [1]

(ii) Complete the statement.

As x decreases, $g(x)$ approaches the value .... [1]

5

NOT TO SCALE

10 cm

←—3 cm—→
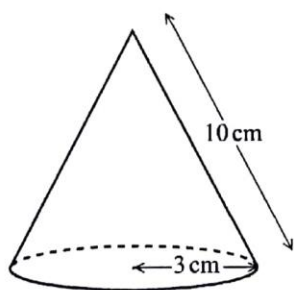
The diagram shows a hollow cone with radius 3 cm and slant height 10 cm.

(a) (i) Calculate the curved surface area of the cone.

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

.... cm² [2]

(ii) Calculate the perpendicular height of the cone.

.... cm [3]

(iii) Calculate the volume of the cone.

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

.... cm³ [2]

(b)
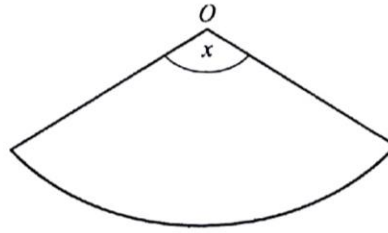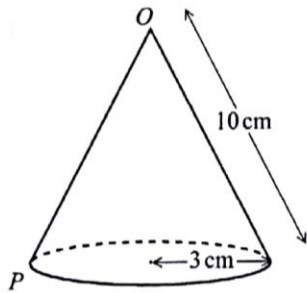
NOT TO SCALE

The cone is cut along the line OP and is opened out into a sector as shown in the diagram.

Calculate the sector angle x.

$x =$ .... [4]

(c)
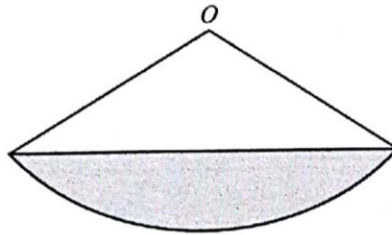
NOT TO SCALE

The diagram shows the same sector as in **part (b)**.

Calculate the area of the shaded segment.

.... cm² [4]

[Turn over

0580/23 May/June 2017

13 Two bottles and their labels are mathematically similar.
The smaller bottle contains 0.512 litres of water and has a label with area 96 cm².
The larger bottle contains 1 litre of water.

Calculate the area of the larger label.

....cm² [3]

14 Write the recurring decimal $0.6\dot{3}$ as a fraction in its lowest terms.
You must show all your working.

.... [3]

15

39 cm

NOT TO
SCALE

$x°$

24 cm

71.8°
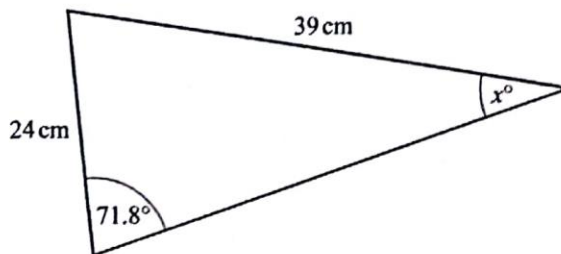
Find the value of x.

$x =$ .... [3]

24 Marcel invests $2500 for 3 years at a rate of 1.6% per year simple interest.
Jacques invests $2000 for 3 years at a rate of x% per year compound interest.
At the end of the 3 years Marcel and Jacques receive the same amount of interest.

Calculate the value of x correct to 3 significant figures.

$x =$ .... [5]

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2017

9
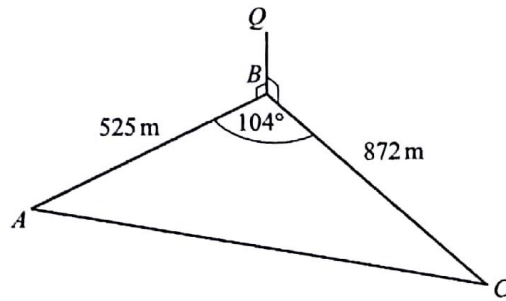
NOT TO
SCALE

ABC is a triangular field on horizontal ground.
There is a vertical pole *BQ* at *B*.
AB = 525 m, *BC* = 872 m and angle *ABC* = 104°.

(a) Use the cosine rule to calculate the distance *AC*.

AC = ... m [4]

(b) The angle of elevation of *Q* from *C* is 1.0°.

Showing all your working, calculate the angle of elevation of *Q* from *A*.

.... [4]

(c) (I) Calculate the area of the field.

.... m² [2]

(II) The field is drawn on a map with the scale 1 : 20 000.

Calculate the area of the field on the map in cm².

....cm² [2]

0580/43/M/J/17 **[Turn over**
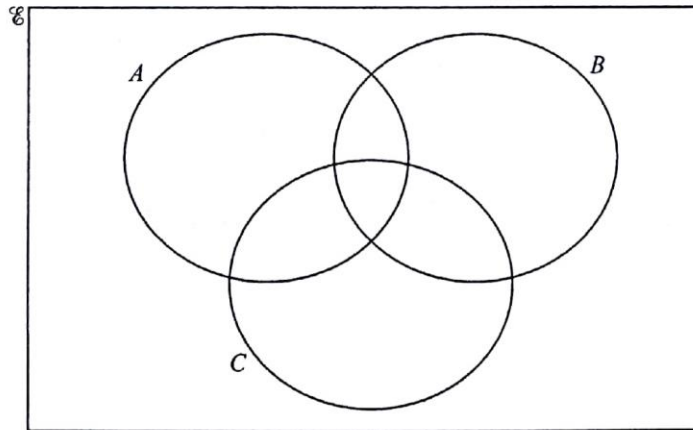
10 $\mathscr{E}$ = {21, 22, 23, 24, 25, 26, 27, 28, 29, 30}
A = { $x : x$ is a multiple of 3}
B = { $x : x$ is prime}
C = { $x : x \leqslant 25$}

(a) Complete the Venn diagram.

[4]

(b) Use set notation to complete the statements.

(i) 26 .... B [1]

(ii) $A \cap B$ = ... [1]

(c) List the elements of $B \cup (C \cap A)$.

.... [2]

(d) Find

(i) n(C),

.... [1]

(ii) n($B' \cup (B \cap C)$).

.... [1]

(e) $(A \cap C)$ is a subset of $(A \cup C)$.

Complete this statement using set notation.

$(A \cap C)$ .... $(A \cup C)$ [1]

11 The table shows the first four terms in sequences A, B, C and D.

Complete the table.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	16	25	36	49			
B	5	8	11	14			
C	11	17	25	35			
D	$\dfrac{3}{2}$	$\dfrac{4}{3}$	$\dfrac{5}{4}$	$\dfrac{6}{5}$			

[12]

0580/43/M/J/17

0580/21

Oct/Nov

2017

20 (a)

20 cm

NOT TO SCALE
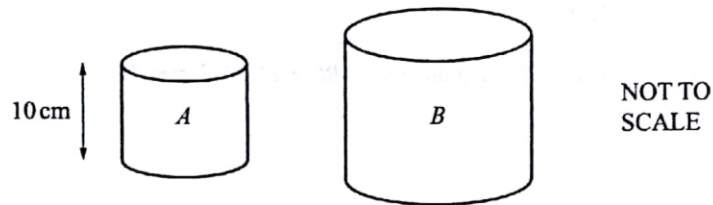
A cylinder has height 20 cm.
The area of the circular cross section is 74 cm².

Work out the volume of this cylinder.

....cm³ [1]

(b) Cylinder *A* is mathematically similar to cylinder *B*.

10 cm

A

B

NOT TO SCALE

The height of cylinder *A* is 10 cm and its surface area is 440 cm².
The surface area of cylinder *B* is 3960 cm².

Calculate the height of cylinder *B*.

.... cm [3]

21
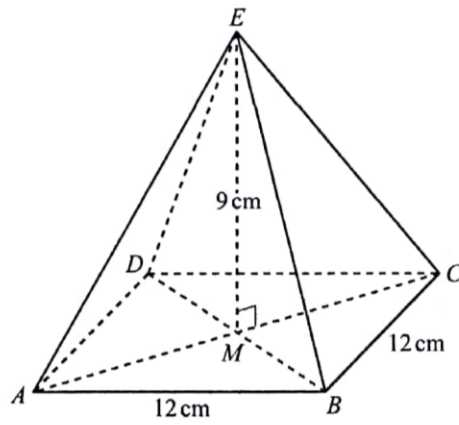
NOT TO
SCALE

The diagram shows a square-based pyramid $ABCDE$.
The diagonals of the square meet at M.
E is vertically above M.
$AB = BC = 12\,\text{cm}$ and $EM = 9\,\text{cm}$.

Calculate the angle between the edge EC and the base, $ABCD$, of the pyramid.

.. [4]

12

23   In one week, Neha spends x hours cooking and y hours cleaning.
The time she spends cleaning is at least equal to the time she spends cooking.
This can be written as $y \geqslant x$.

She spends no more than 16 hours in total cooking and cleaning.
She spends at least 4 hours cooking.

(a)   Write down two more inequalities in x and/or y to show this information.

....

.... [2]

(b)   Complete the diagram to show the three inequalities.
Shade the **unwanted** regions.
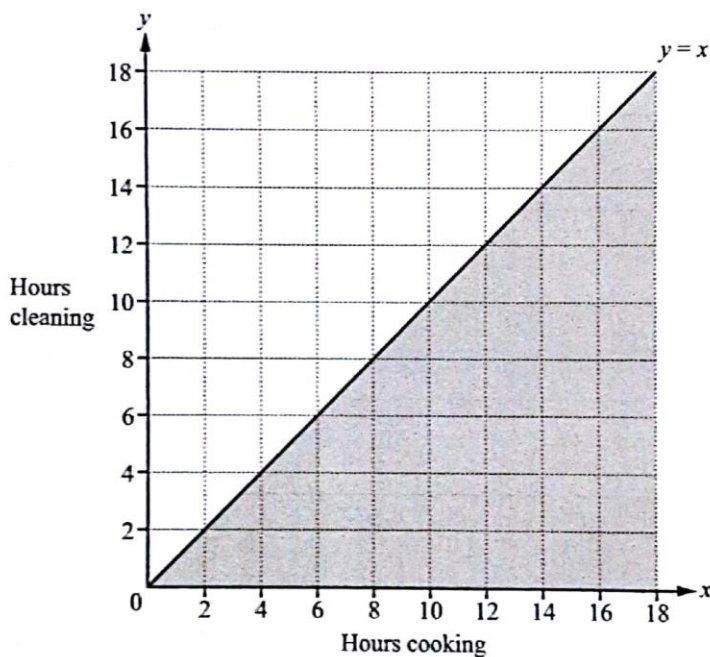
Hours cooking

[3]

(c)   Neha receives \$10 for each hour she spends cooking and \$8 for each hour she spends cleaning.

Work out the largest amount she could receive.

\$ .... [2]

0580/41

Oct/Nov

2017

5 The histogram shows the distribution of the masses, m grams, of 360 apples.

Key: the shaded square represents 10 apples

Frequency density

Mass (grams)
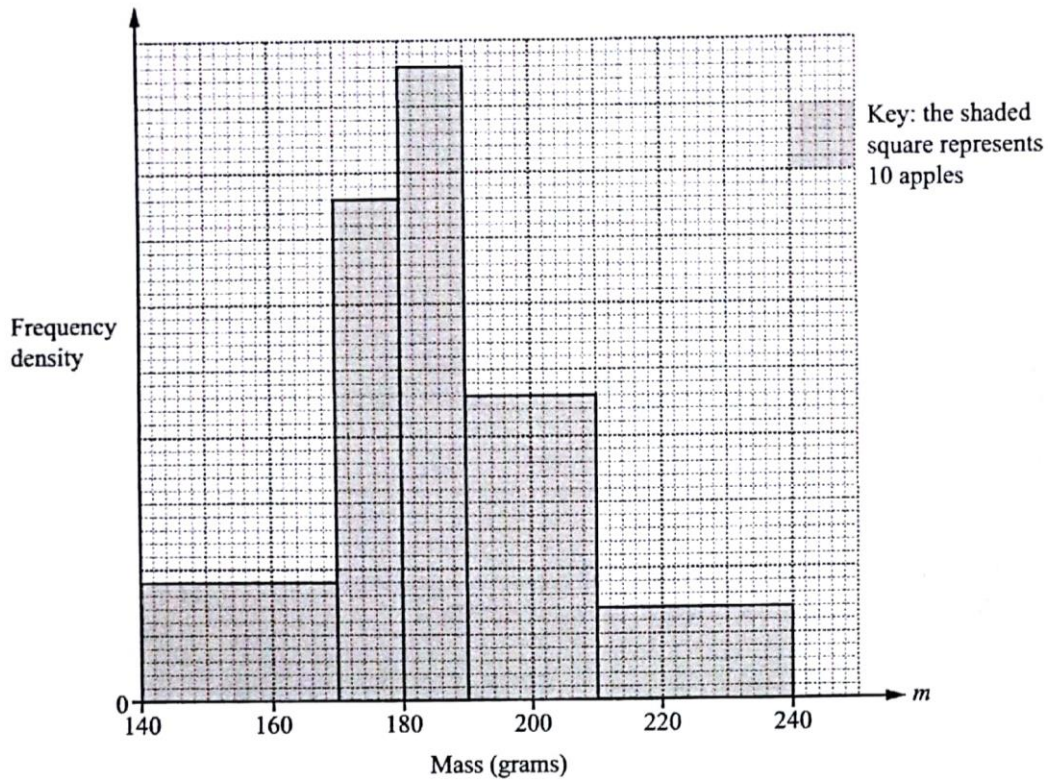
(a) Use the histogram to complete the frequency table.

Mass (m grams)	Number of apples
$140 < m \leqslant 170$	
$170 < m \leqslant 180$	
$180 < m \leqslant 190$	
$190 < m \leqslant 210$	92
$210 < m \leqslant 240$	42

[3]

8
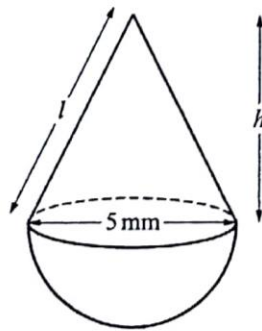
The diagram shows a solid made from a hemisphere and a cone.
The base diameter of the cone and the diameter of the hemisphere are each 5 mm.

(a) The total surface area of the solid is $\dfrac{115\pi}{4}$ mm².

Show that the slant height, l, is 6.5 mm.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi r l$.]
[The surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

[4]

(b) Calculate the height, h, of the cone.

$h =$ .... mm [3]

(c) Calculate the volume of the solid.

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

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

....mm^3 [4]

(d) The solid is made from gold.
1 **cubic centimetre** of gold has a mass of 19.3 grams.
The value of 1 gram of gold is $38.62 .

Calculate the value of the gold used to make the solid.

$.. [3]

(d)
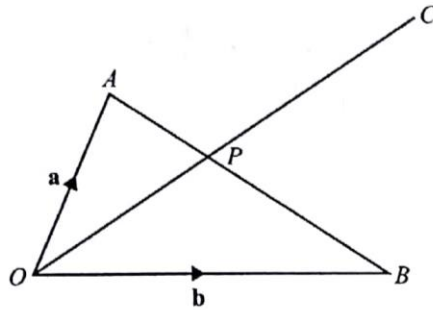
In the diagram, O is the origin and P lies on AB such that $AP : PB = 3 : 4$.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(i) Find $\overrightarrow{OP}$, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form.

$$\overrightarrow{OP} = \text{...} \text{ [3]}$$

(ii) The line OP is extended to C such that $\overrightarrow{OC} = m\overrightarrow{OP}$ and $\overrightarrow{BC} = k\mathbf{a}$.

Find the value of m and the value of k.

$$m = \text{...}$$

$$k = \text{...} \text{ [2]}$$

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22
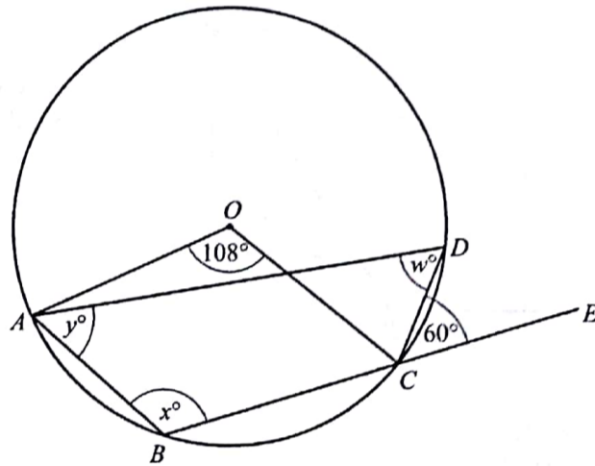
NOT TO SCALE

A, B, C and D are points on the circle, centre O.
BCE is a straight line.
Angle AOC = 108° and angle DCE = 60°.

Calculate the values of w, x and y.

w = ...

x = ...

y = ... [3]

23
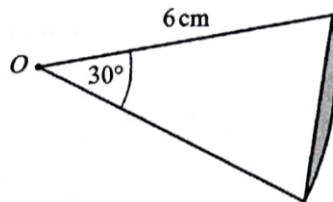
NOT TO SCALE

The diagram shows a sector of a circle, centre O and radius 6 cm.
The sector angle is 30°.
The area of the shaded segment is $(k\pi - c)$ cm², where k and c are integers.

Find the value of k and the value of c.

k = ...

c = ... [3]

[Turn over

26
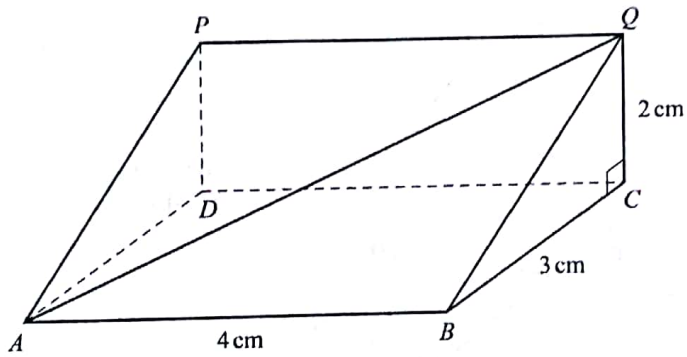
The diagram shows a prism of length 4 cm.
The cross section is a right-angled triangle.
$BC = 3$ cm and $CQ = 2$ cm.

Calculate the angle between the line AQ and the base, $ABCD$, of the prism.

.... [4]

27 Simplify.

(a) $81^{\frac{3}{4}}$

.... [1]

(b) $x^{\frac{2}{3}} \div x^{-\frac{4}{3}}$

.... [1]

(c) $\left(\dfrac{8}{y^6}\right)^{-\frac{1}{3}}$

.... [2]

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2 (a)

NOT TO
SCALE
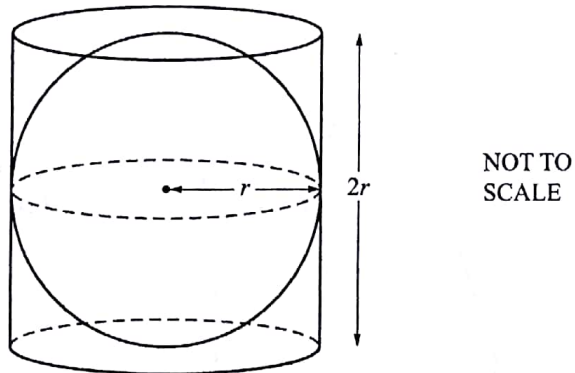
A sphere of radius r is inside a closed cylinder of radius r and height $2r$.

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

(i) When $r = 8$ cm, calculate the volume inside the cylinder which is **not** occupied by the sphere.

.... cm^3 [3]

(ii) Find r when the volume inside the cylinder **not** occupied by the sphere is 36 cm^3.

$r = $ .... cm [3]

5

(b)
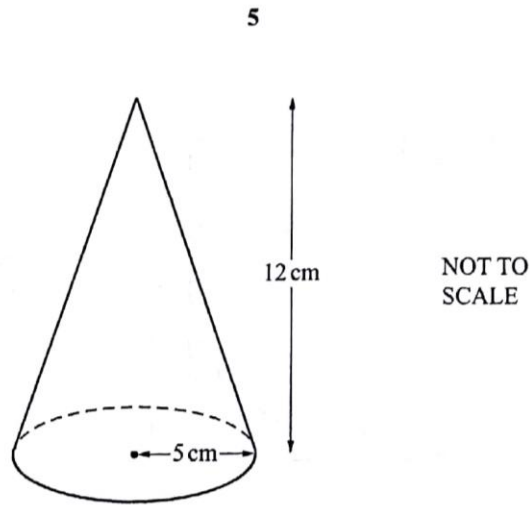
The diagram shows a solid cone with radius 5 cm and perpendicular height 12 cm.

(i) The **total** surface area is painted at a cost of $0.015 per cm².

Calculate the cost of painting the cone.

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

$ .... [4]

(ii) The cone is made of metal and is melted down and made into smaller solid cones with radius 1.25 cm and perpendicular height 3 cm.

Calculate the number of smaller cones that can be made.

.... [3]

(b) There are 100 students in group *B*.
The teacher records the distance, *d* metres, each of these students runs in one minute.
The results are shown in the frequency table.

Distance (*d* metres)	$100 < d \leqslant 200$	$200 < d \leqslant 250$	$250 < d \leqslant 280$	$280 < d \leqslant 320$	$320 < d \leqslant 400$
Number of students	20	22	30	16	12

(i) Calculate an estimate of the mean distance for group *B*.

.... m [4]

(ii) Complete the histogram to show the information in the frequency table.

Distance (metres)
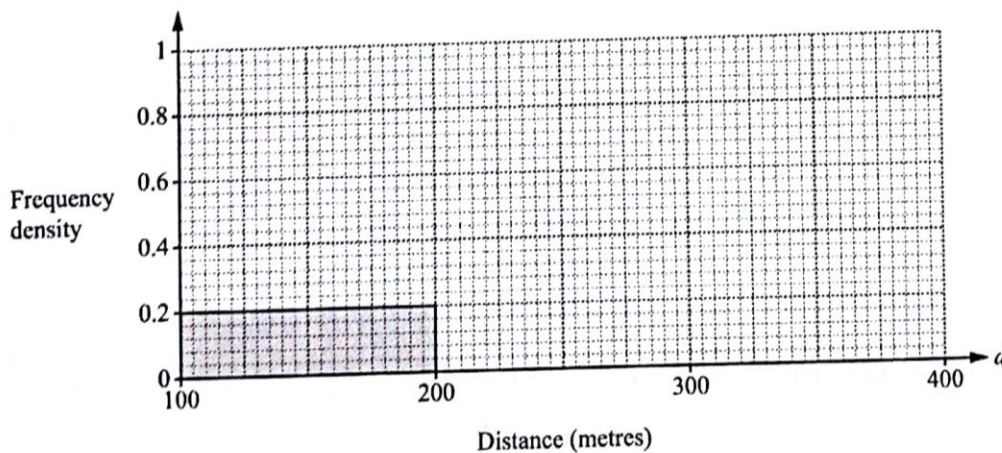
[4]

(c) For the 100 students in group *B*, the median is 258 m.

Complete the statement.

On average, the students in group *A* run .... than the students in group *B*.   [1]
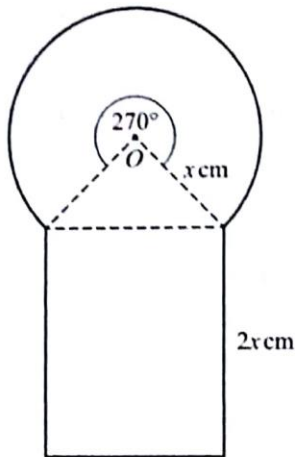
The diagram shows a sector of a circle, a triangle and a rectangle.
The sector has centre O, radius x cm and angle 270°.
The rectangle has length $2x$ cm.

The total area of the shape is kx^2 cm².

(a) Find the value of k.

$k =$ .... [5]

(b) Find the value of x when the total area is 110 cm².

$x =$ .... [2]

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10 A model of a house is made using a scale of 1 : 30.
    The model has a volume of 2400 cm³.

    Calculate the volume of the actual house.
    Give your answer in cubic metres.

.... m³ [3]

11 Calculate the size of one interior angle of a regular 12-sided polygon.

.... [3]

12 The cost of one litre of fuel in May 2015 was $0.88 .
    This was a decrease of 20% on the cost in May 2014.

    Calculate the cost of one litre of fuel in May 2014.

S .... [3]

22
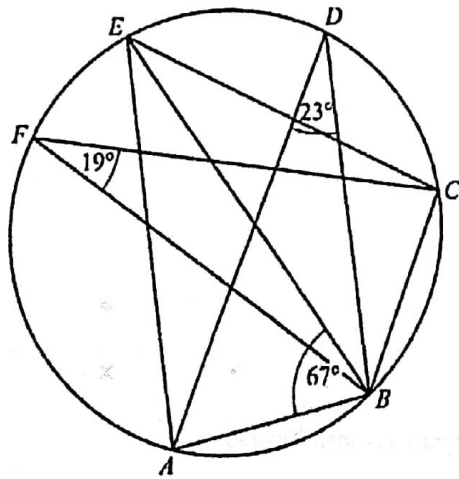
NOT TO
SCALE

In the diagram, points A, B, C, D, E and F lie on the circumference of the circle.
Angle $BFC = 19°$, angle $ADB = 23°$ and angle $ABE = 67°$.

Work out

(a) angle BEC,

Angle $BEC =$ .... [1]

(b) angle ABC,

Angle $ABC =$ .... [3]

(c) angle BCE.

Angle $BCE =$ .... [2]

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1 **(a)** The angles of a triangle are in the ratio 2 : 3 : 5.

(i) Show that the triangle is right-angled.

[1]

(ii) The length of the hypotenuse of the triangle is 12 cm.

Use trigonometry to calculate the length of the shortest side of this triangle.

.... cm [3]

(b) The sides of a different right-angled triangle are in the ratio 3 : 4 : 5.

(i) The length of the shortest side is 7.8 cm.

Calculate the length of the longest side.

.... cm [2]

(ii) Calculate the smallest angle in this triangle.

.... [3]

(b) (i) Show that 126 km/h is the same speed as 35 m/s.

[1]

(ii) The train has a total length of 220 m.
At 09 30, the train crossed a bridge of length 1400 m.

Calculate the time, in seconds, that the train took to completely cross the bridge.

....s [3]

(c) On a different journey, the train took 73 minutes, correct to the nearest minute, to travel 215 km, correct to the nearest 5 km.

Calculate the upper bound of the average speed of the train for this journey.
Give your answer in km/h.

....km/h [4]

[Turn over

4   The table shows information about the time, t minutes, taken for each of 150 girls to complete an essay.

Time (t minutes)	$60 < t \leqslant 65$	$65 < t \leqslant 70$	$70 < t \leqslant 80$	$80 < t \leqslant 100$	$100 < t \leqslant 150$
Frequency	10	26	34	58	22

(a)   Write down the interval that contains the median time.

.... $< t \leqslant$ .... [1]

(b)   Calculate an estimate of the mean time.

.... min [4]

(c)   Rafay looks at the frequency table.

(i)   He says that it is not possible to work out the range of the times.

Explain why he is correct.

....

.... [1]

(ii)   He draws a pie chart to show this information.

Calculate the sector angle for the interval $65 < t \leqslant 70$ minutes.

.... [2]

(d)   A girl is chosen at random.

Work out the probability that she took more than 100 minutes to complete the essay.

.... [1]

8 Line A has equation $y = 5x - 4$.
Line B has equation $3x + 2y = 18$.

(a) Find the gradient of

    (i) line A,

                                         .... [1]

    (ii) line B.

                                           .... [1]

(b) Write down the co-ordinates of the point where line A crosses the x-axis.

                         (........................ , ...) [2]

(c) Find the equation of the line perpendicular to line A which passes through the point $(10, 9)$.
Give your answer in the form $y = mx + c$.

                       $y =$ .... [4]

(d) Work out the co-ordinates of the point of intersection of line A and line B.

                         (........................ , ...) [3]

(e) Work out the area enclosed by line A, line B and the y-axis.

                                           .... [3]

9 Luigi and Alfredo run in a 10km race.
Luigi's average speed was x km/h.
Alfredo's average speed was 0.5 km/h slower than Luigi's average speed.

(a) Luigi took $\frac{10}{x}$ hours to run the race.

Write down an expression, in terms of x, for the time that Alfredo took to run the race.

....h [1]

(b) Alfredo took 0.25 hours longer than Luigi to run the race.

(i) Show that $2x^2 - x - 40 = 0$.

[4]

(ii) Use the quadratic formula to solve $2x^2 - x - 40 = 0$.
Show all your working and give your answers correct to 2 decimal places.

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

(iii) Work out the time that Luigi took to run the 10km race.
Give your answer in hours and minutes, correct to the nearest minute.

.... h .... min [3]

Question 10 is printed on the next page.

10 (a) (i) Write 180 as a product of its prime factors.

.... [2]

(ii) Find the lowest common multiple (LCM) of 180 and 54.

.... [2]

(b) An integer, X, written as a product of its prime factors is $a^2 \times 7^{b+2}$.
An integer, Y, written as a product of its prime factors is $a^3 \times 7^2$.

The highest common factor (HCF) of X and Y is 1225.
The lowest common multiple (LCM) of X and Y is 42 875.

Find the value of X and the value of Y.

$X =$ ....

$Y =$ .... [4]