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4024/22

May/June 2012

2 hours 30 minutes

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The total of the marks for this paper is 100.

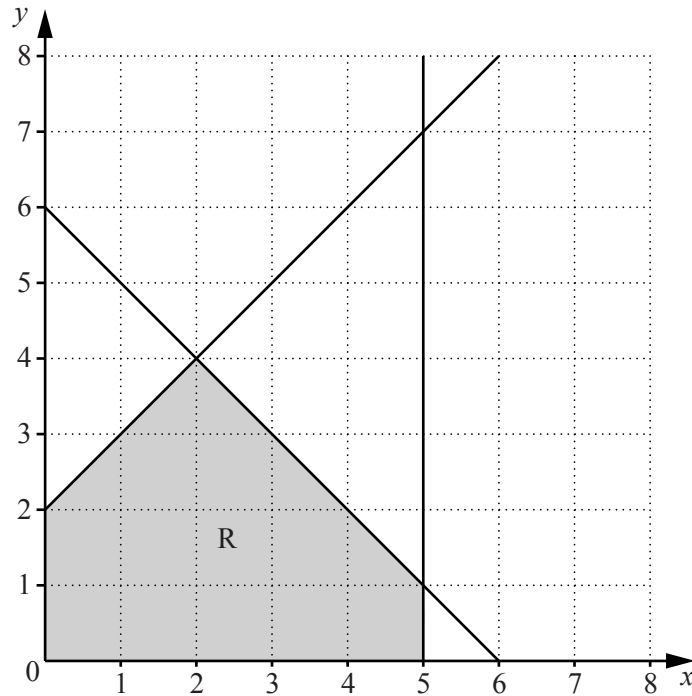
For Examiner's Use

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.Do not
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1



The diagram shows a shaded region R.

- (a) Write down the name of the shaded polygon.

Answer [1]

- (b) Three of the inequalities that define the region R are $x \geq 0$, $y \geq 0$ and $y \leq x + 2$.

Write down the other two inequalities that define this region.

Answer

..... [2]

- (c) On the diagram draw the line that is parallel to $y = x + 2$ and passes through the point (5, 0).

[1]

- (d) Find the gradient of the line that is perpendicular to $y = x + 2$.

Answer [1]

- 2 (a) Solve the equation $\frac{7x+1}{4} - \frac{x}{2} = 1$.

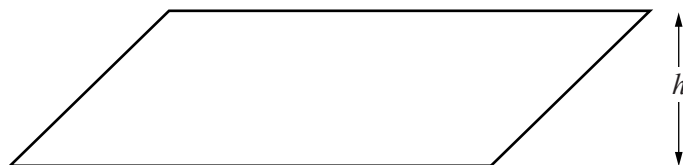
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Answer $x = \dots\dots\dots$ [2]

- (b) Solve the equation $y^2 - 81 = 0$.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [1]

(c)



The length of the base of a parallelogram is 6 cm more than its perpendicular height, h cm. The area of this parallelogram is 33.25 cm^2 .

- (i) Show that h satisfies the equation $4h^2 + 24h - 133 = 0$.

[2]

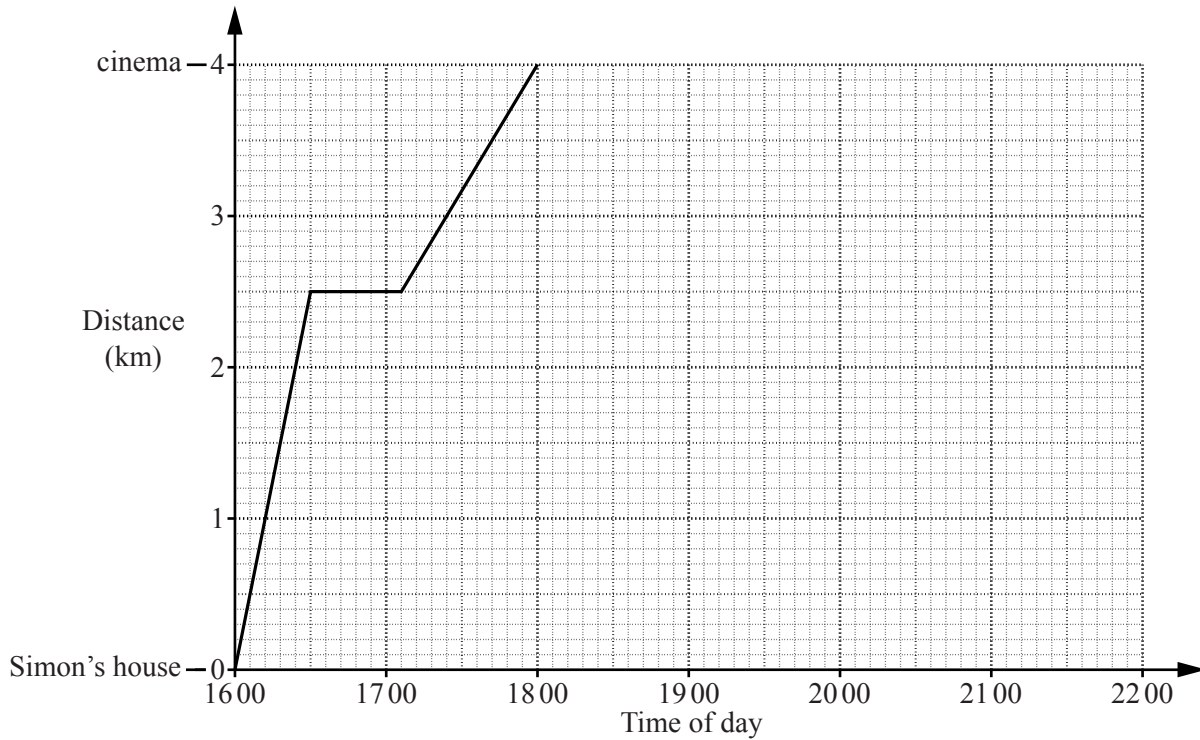
- (ii) Solve the equation $4h^2 + 24h - 133 = 0$.

Answer $h = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iii) Find the length of the base of the parallelogram.

Answer $\dots\dots\dots$ cm [1]

- 3 Simon walks from his house to Juan's house. He stays there for a short while before they walk together to the cinema. The graph represents the journey from Simon's house to the cinema.



- (a) For how many minutes does Simon stay at Juan's house?

Answer minutes [1]

- (b) At what speed does Simon walk to Juan's house?

Answer km/h [1]

- (c) Simon has a 15% discount voucher for his cinema ticket but Juan pays the full price. Simon pays \$4.42 for his ticket.

How much does Juan pay?

Answer \$..... [2]

- (d) They stay at the cinema for 2 hours before they each walk home at 3 km/h.

Complete the graph to show this information.

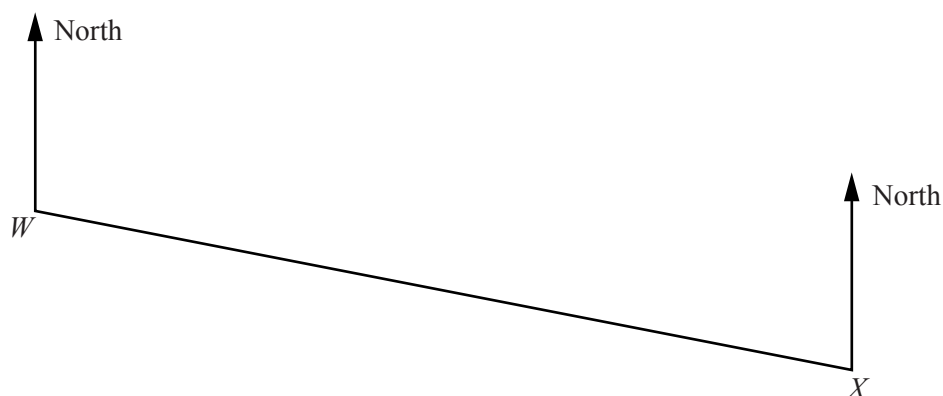
[2]

- (e) At what time do they arrive at **Juan's** house?

Answer [1]

- 4 The scale diagram shows the position of two hotels, W and X , drawn to a scale of 1 cm to 5 km.

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- (a) Find, by measurement, the bearing of W from X .

Answer [1]

- (b) Hotel Y is 40 km from W and 37 km from X .

Given that Y is the furthest south, construct the position of Y on the diagram. [2]

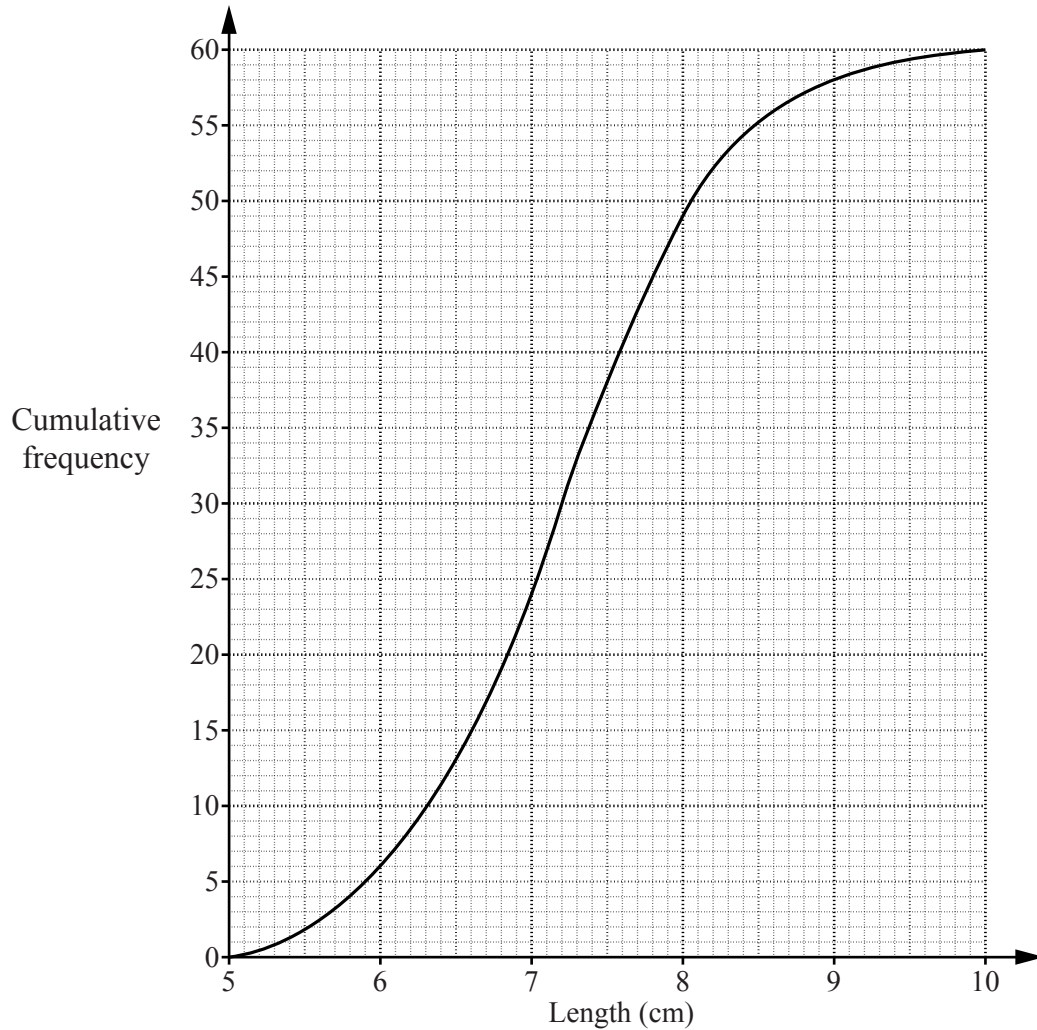
- (c) The bearing of hotel Z from W is 072° and Z is due North of X .

By making an accurate drawing, mark the position of Z on the diagram.
Find the actual distance, in kilometres, between Z and X .

Answer km [3]

- 5 (a) The cumulative frequency graph shows the distribution of the lengths of 60 leaves.

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- (i) Complete the table to show the distribution of the lengths of the leaves.

Length (l cm)	$5 < l \leq 6$	$6 < l \leq 7$	$7 < l \leq 8$	$8 < l \leq 9$	$9 < l \leq 10$
Frequency	6	18			2

[1]

- (ii) Use the graph to estimate the median.

Answer cm [1]

- (iii) Use the graph to estimate the interquartile range.

Answer cm [2]

- (iv) One of these leaves is chosen at random.

Estimate the probability that it has a length of **more than** 7.5 cm.

Answer [2]

(b) The distribution of the widths of these leaves is shown in the table below.

Width (w cm)	$3 < w \leq 4$	$4 < w \leq 5$	$5 < w \leq 6$	$6 < w \leq 7$	$7 < w \leq 8$	$8 < w \leq 9$
Frequency	4	15	20	13	5	3

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(i) Calculate an estimate of the mean width.

Answer cm [3]

(ii) Calculate the percentage of leaves with a width of more than 6 cm.

Answer% [2]

- 6 (a) $\mathcal{E} = \{x : x \text{ is an integer, } 2 \leq x \leq 14\}$
 $A = \{x : x \text{ is a prime number}\}$
 $B = \{x : x \text{ is a multiple of } 3\}$

(i) List the members of $(A \cup B)'$.

Answer [1]

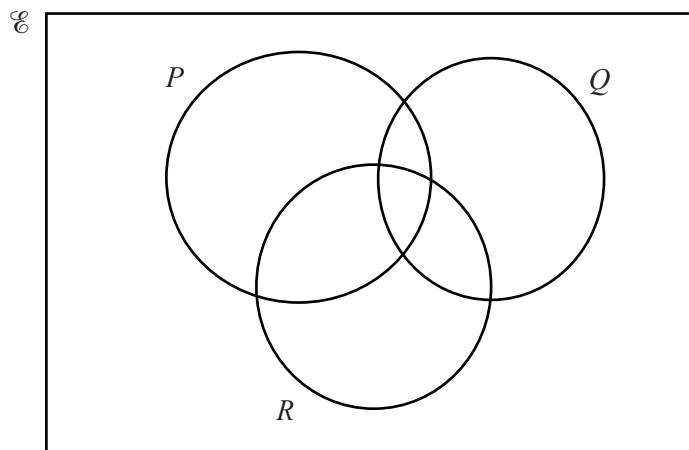
(ii) Find $n(A \cap B)$.

Answer [1]

(iii) Given that $C \subset A$, $n(C) = 3$ and $B \cap C = \emptyset$, list the members of a possible set C .

Answer [1]

(b) On the Venn diagram, shade the set $(P \cup R) \cap Q'$.



[1]

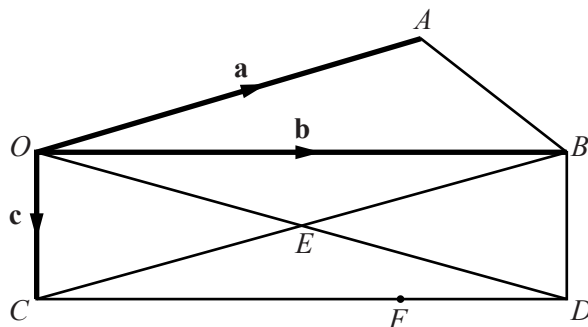
- (c) A group of 80 people attended a recreation centre on one day.
 Of these people, 48 used the gym
 31 used the swimming pool
 17 used neither the gym nor the swimming pool.

By drawing a Venn diagram, or otherwise, find the number of people who used both the gym and the swimming pool.

Answer [2]

- 7 OAB is a triangle and $OBDC$ is a rectangle where OD and BC intersect at E .
 F is the point on CD such that $CF = \frac{3}{4} CD$.
 $\vec{OA} = \mathbf{a}$, $\vec{OB} = \mathbf{b}$ and $\vec{OC} = \mathbf{c}$.

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- (a) Express, as simply as possible, in terms of one or more of the vectors $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$,

(i) $\vec{AB}$,

Answer [1]

(ii) $\vec{OE}$,

Answer [1]

(iii) $\vec{EF}$.

Answer [2]

- (b) G is the point on AB such that $\vec{OG} = \frac{3}{5} \mathbf{a} + \frac{2}{5} \mathbf{b}$.

- (i) Express $\vec{AG}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
 Give your answer as simply as possible.

Answer [1]

- (ii) Find $AG : GB$.

Answer : [1]

- (iii) Express $\vec{FG}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$.
 Give your answer as simply as possible.

Answer [2]

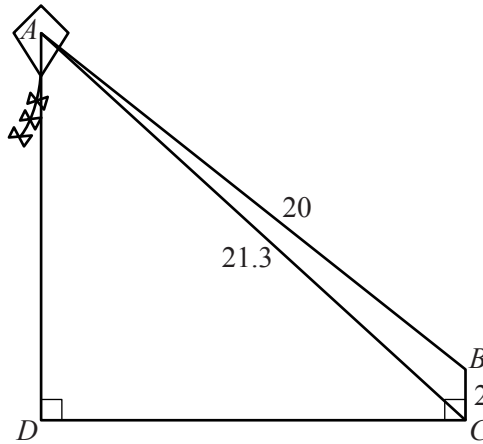
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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8



A kite is attached at A to a 20 m length of string and the other end of the string is held at B so that the string is a straight line.

B is 2 m above the ground at C and $AC = 21.3$ m.

D is the point at ground level directly below A such that $\hat{ADC} = \hat{BCD} = 90^\circ$.

(a) Calculate

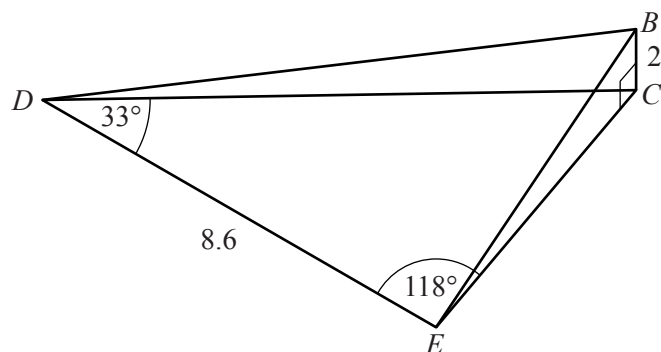
(i) $\hat{ABC}$,

Answer [3]

(ii) AD .

Answer m [3]

(b)



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E is another point on the level ground such that $DE = 8.6$ m, $\angle EDC = 33^\circ$ and $\angle CED = 118^\circ$.

Calculate

(i) $\angle DCE$

Answer [1]

(ii) CE ,

Answer m [3]

(iii) the angle of elevation of B from E .

Answer [2]

9 (a) $\mathbf{A} = \begin{pmatrix} 1 & 2 \\ -3 & 0 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 3 & 1 \\ -2 & -1 \end{pmatrix}$

(i) Find $\mathbf{A} - 2\mathbf{B}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

(ii) Find $\mathbf{A}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (b) Zara is going to put carpet and underlay in three rooms, A , B and C , of her house. The cost per square metre for the carpet in A is \$18, in B is \$22 and in C is \$25. The cost per square metre for the underlay is \$6 in A and \$8 in the other two rooms. This information is represented by matrix $\mathbf{P}$ below.

$$\mathbf{P} = \begin{pmatrix} 18 & 22 & 25 \\ 6 & 8 & 8 \end{pmatrix}$$

The amount of carpet and underlay required for A , B and C is 8 m^2 , 15 m^2 and 20 m^2 respectively.

This information is represented by matrix $\mathbf{Q}$ below.

$$\mathbf{Q} = \begin{pmatrix} 8 \\ 15 \\ 20 \end{pmatrix}$$

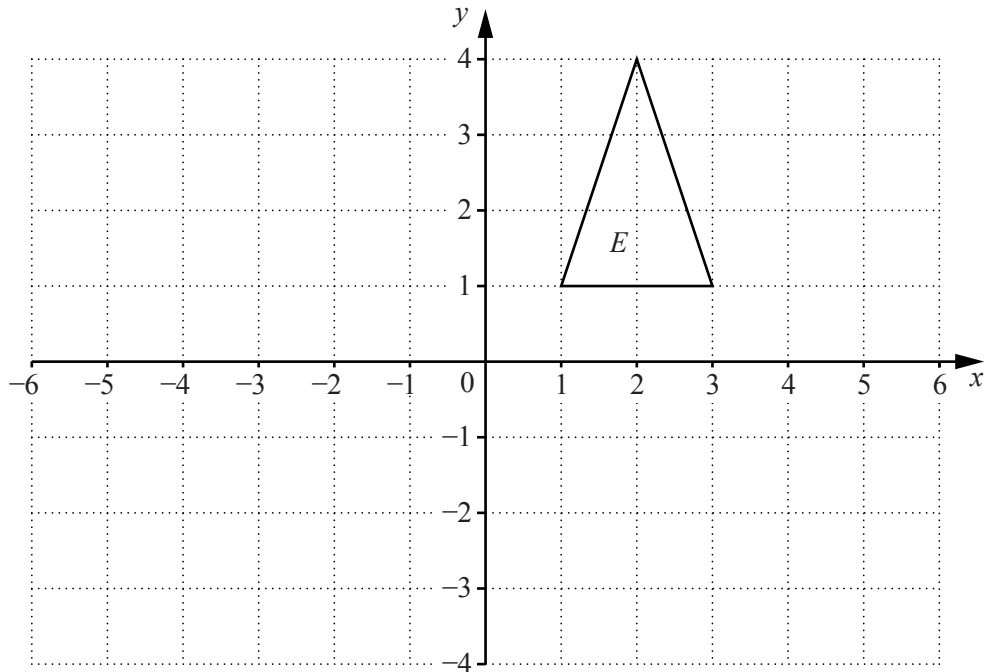
(i) Find $\mathbf{PQ}$.

Answer [2]

(ii) Explain what the matrix $\mathbf{PQ}$ represents.

Answer
..... [1]

(c)



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- (i) Triangle E is mapped onto triangle F by a reflection in the line $y = -x$.
Draw and label triangle F . [2]

- (ii) The transformation that maps triangle E onto triangle G is represented by the
matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.
Draw and label triangle G . [2]

- (iii) Triangle E is mapped onto triangle H by a stretch with the x -axis as the invariant line.
The area of triangle H is 12 units².

- (a) For this stretch, state the scale factor.

Answer [1]

- (b) The vertex (1, 1) of triangle E is mapped onto the vertex (m , n) of triangle H .

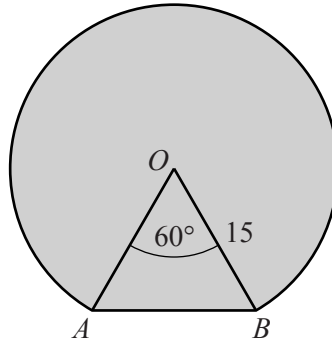
Find m and n .

Answer $m =$

$n =$ [1]

- 10 The diagram shows a major segment of a circle with centre O and radius 15 cm. A and B are two points on the circumference such that $\angle AOB = 60^\circ$.

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(a) Calculate

- (i) the area of the major segment,

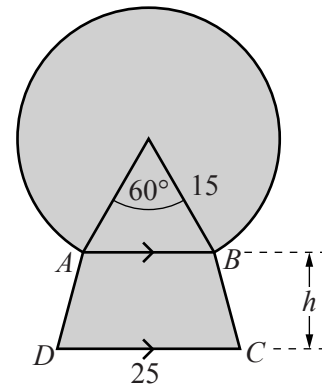
Answer cm² [4]

- (ii) the perimeter of the major segment.

Answer cm [2]

- (b) **Shape I** is formed by joining this segment to a trapezium, $ABCD$, along AB .
 AB is parallel to DC , $DC = 25$ cm and the perpendicular height of the trapezium is h cm.
 The area of the trapezium is 248 cm^2 .

Calculate h .

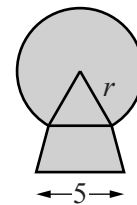


Shape I

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Answer [2]

- (c) **Shape II** is geometrically similar to **Shape I**.
 The longest side of the trapezium in **Shape II** is 5 cm.



Shape II

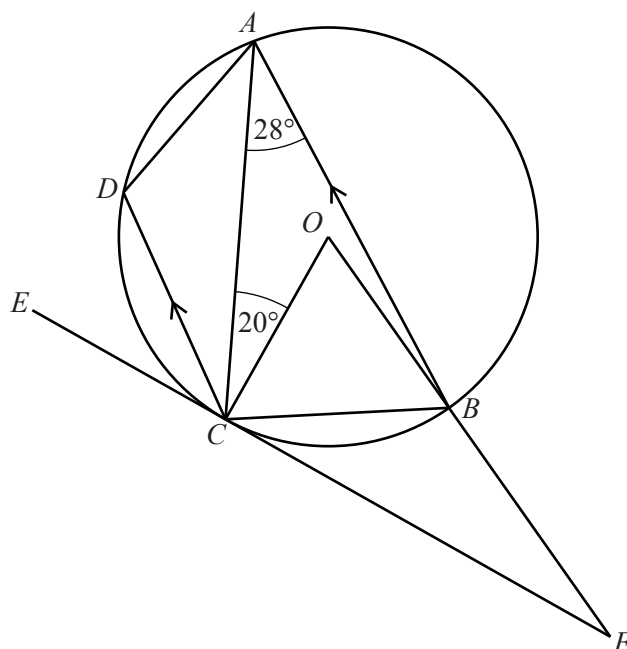
- (i) Find the radius, r , of the segment in **Shape II**.

Answer cm [1]

- (ii) Find the **total** area of **Shape II**.

Answer cm^2 [3]

11 (a)

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A, B, C and D are points on the circumference of a circle, centre O .
 $\hat{CAB} = 28^\circ$, $\hat{ACO} = 20^\circ$ and CD is parallel to BA .
 EF is a tangent to the circle at C and OBF is a straight line.

Find

(i) $\hat{COB}$,

Answer [1]

(ii) $\hat{OFC}$,

Answer [1]

(iii) $\hat{OCB}$,

Answer [1]

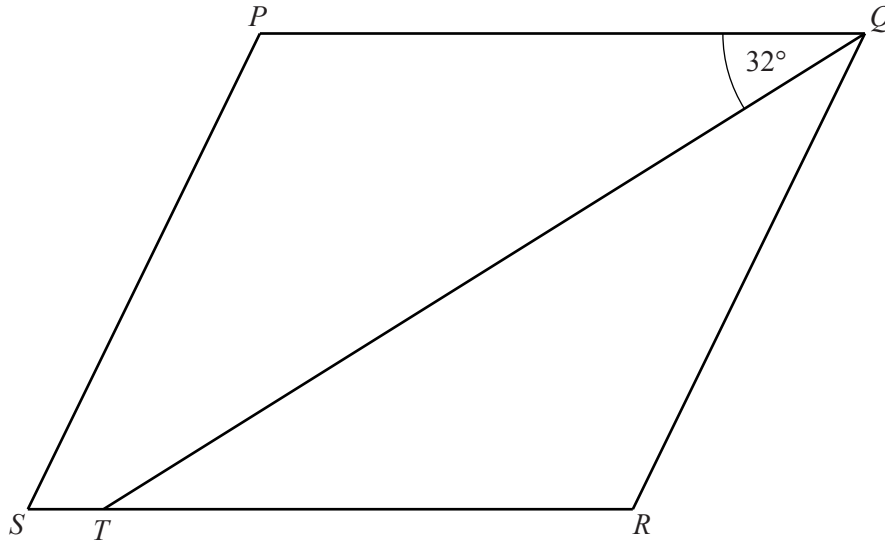
(iv) $\hat{DCE}$,

Answer [2]

(v) $\hat{ADC}$.

Answer [2]

(b)



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$PQRS$ is a parallelogram.

QT is the bisector of $\angle PQR$ and $\angle PQT = 32^\circ$.

(i) Giving a reason for your answer, find

(a) $\angle QTR$,

Answer $\angle QTR = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [1]

(b) $\angle SPQ$.

Answer $\angle SPQ = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [1]

(ii) On the diagram, construct the locus of points inside the parallelogram $PQRS$ which are

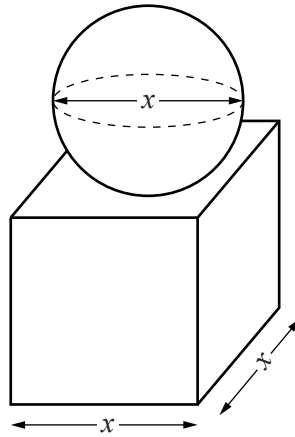
- I 4 cm from PS ,
- II 5 cm from R .

[2]

(iii) The point V is inside $PQRS$,
 less than 4 cm from PS ,
 less than 5 cm from R ,
 nearer to QR than PQ .

Shade the region containing the possible positions of V .

[1]

12 [The volume of a sphere = $\frac{4}{3} \pi r^3$]Do not
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A solid consists of a sphere on top of a square-based cuboid.

The **diameter** of the sphere is x cm.

The base of the cuboid has sides of length x cm.

The sum of the height of the cuboid and one of the sides of the base is 8 cm.

- (a) By considering the height of the cuboid, explain why it is not possible for this sphere to have a radius of 5 cm.

Answer

..... [1]

- (b) By taking the value of π as 3, show that the approximate volume, y cm³, of the solid is given by

$$y = 8x^2 - \frac{x^3}{2}.$$

[2]

- (c) The table below shows some values of x and the corresponding values of y for

$$y = 8x^2 - \frac{x^3}{2}.$$

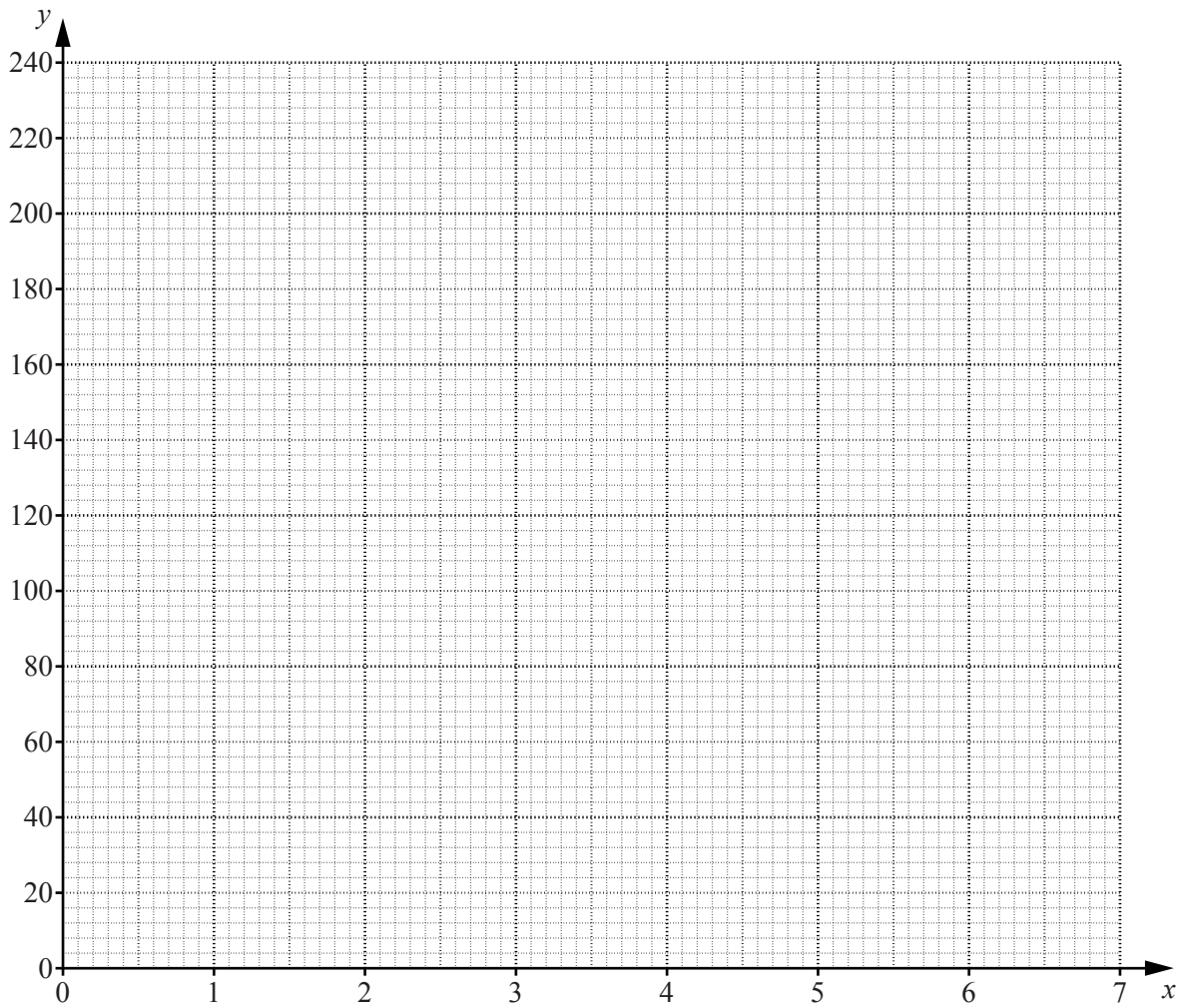
x	1	2	3	4	5	6	7
y	7.5	28		96	137.5	180	220.5

- (i) Complete the table. [1]

- (ii) On the grid opposite, plot the graph of $y = 8x^2 - \frac{x^3}{2}$ for $1 \leq x \leq 7$. [3]

- (iii) Use your graph to find the **height of the cuboid** when the volume of the solid is 120 cm³.

Answer cm [2]



- (d) A cylinder has radius 3 cm and length x cm.
By drawing a suitable graph on the grid, estimate the value of x when the solid and the cylinder have the same volume.
Take the value of π as 3.

Answer [3]

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