UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3339652280

MATHEMATICS (SYLLABUS D) **4024/22**

Paper 2 **May/June 2012**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.
Omission of essential working will result in loss of marks.
You are expected to use an electronic calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

For Examiner's Use

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Section A [52 marks]

Answer **all** questions in this section.

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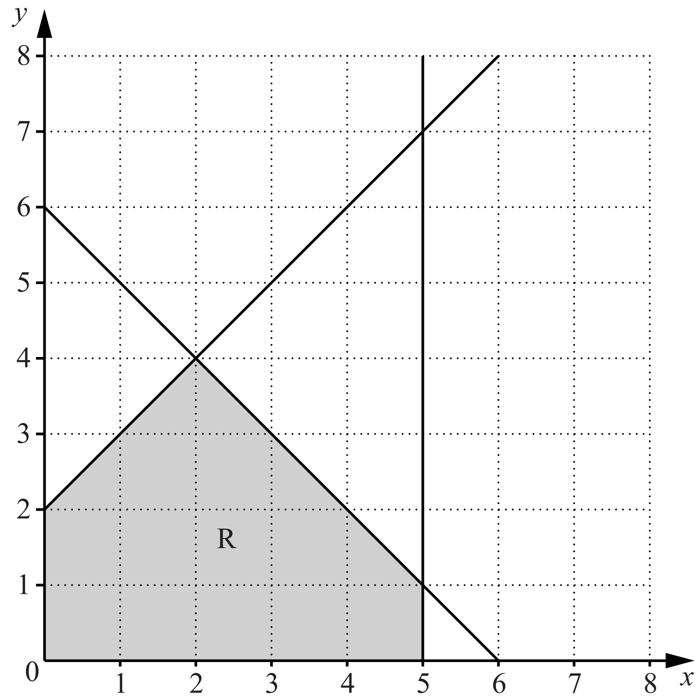
1



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 $x \geqslant 0$, $y \geqslant 0$ and $y \leqslant x + 2$.

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]

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

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Answer $x =$ .... [2]

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

Answer $y =$ .... or .... [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 $h =$ .... or .... [3]

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

Answer .... cm [1]

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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.

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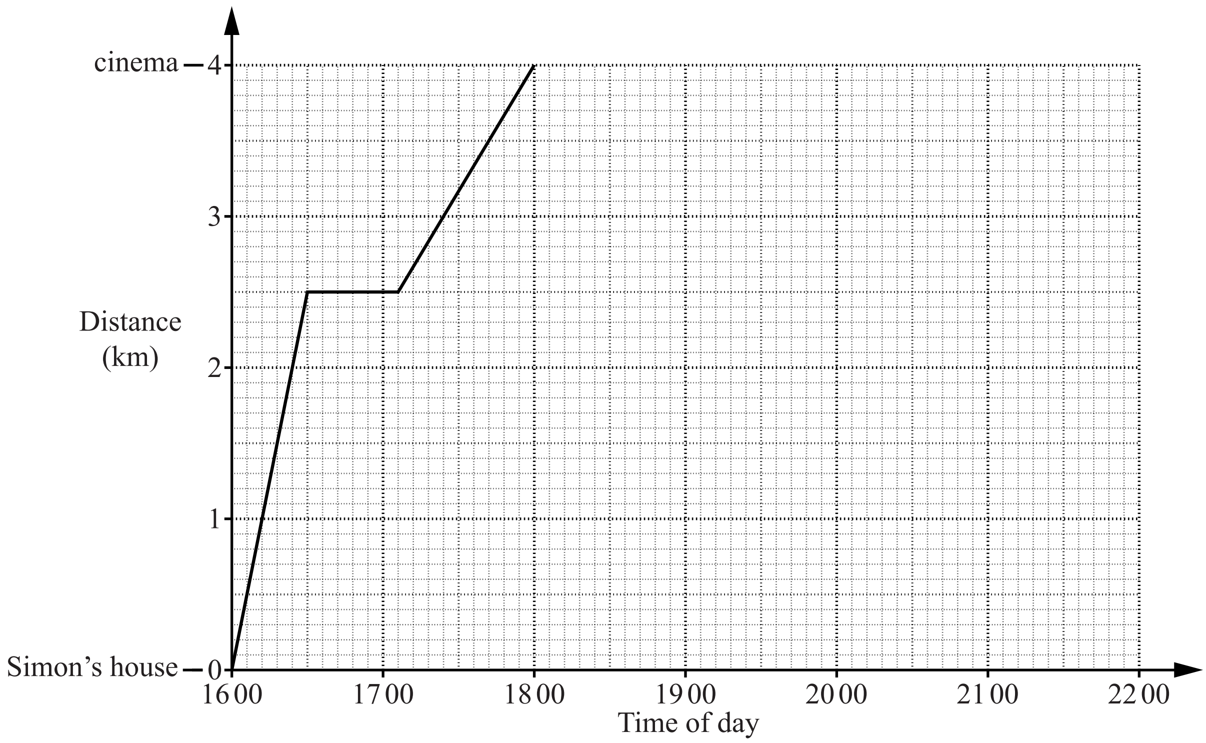

(a) For how many minutes does Simon stay at Juan's house?

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]

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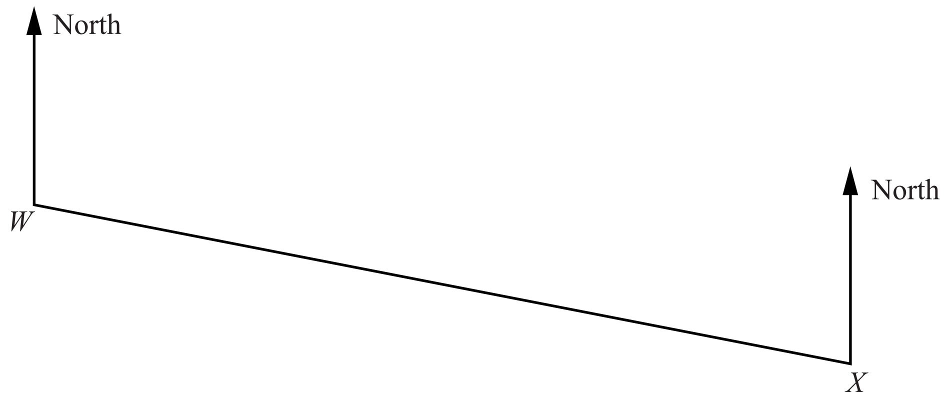
4 The scale diagram shows the position of two hotels, W and X, drawn to a scale of 1 cm to 5 km.



(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]

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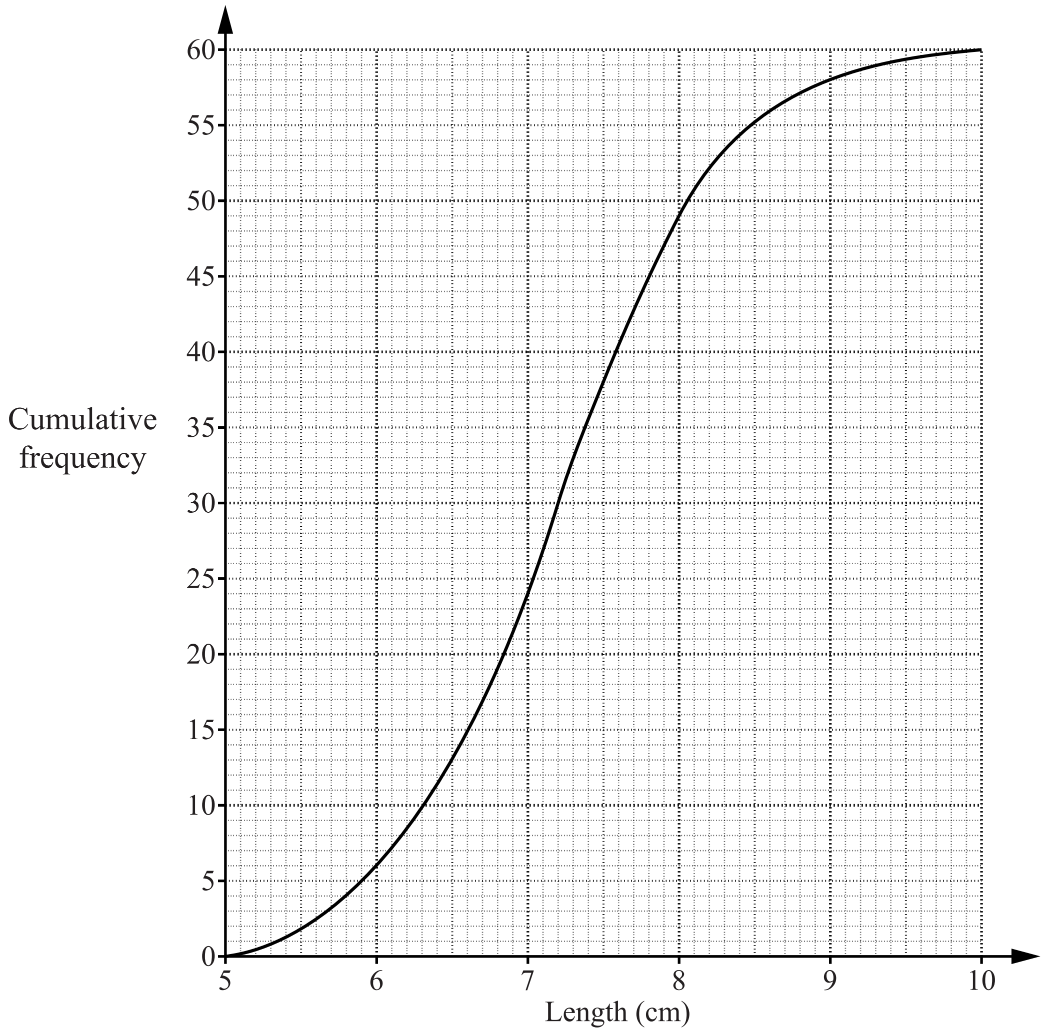
5 **(a)** The cumulative frequency graph shows the distribution of the lengths of 60 leaves.



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

Length (l cm)	$5 < l \leqslant 6$	$6 < l \leqslant 7$	$7 < l \leqslant 8$	$8 < l \leqslant 9$	$9 < l \leqslant 10$
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]

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

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

(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]

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

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

Answer .... [1]

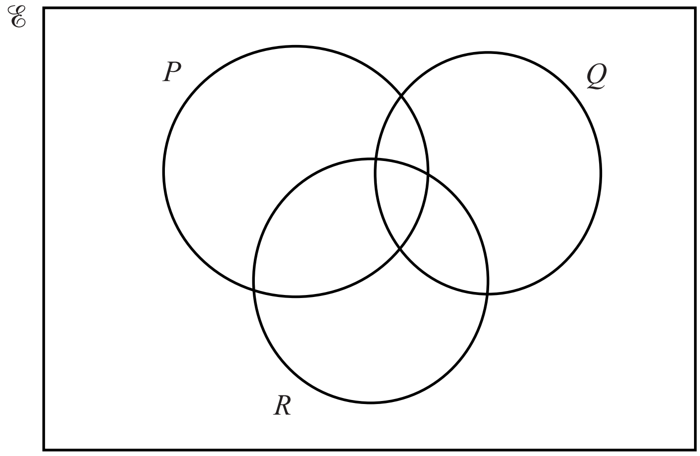
(ii) Find $n(A \cap B)$.

Answer .... [1]

(iii) Given that $C \subset A$, $n(C) = 3$ and $B \cap C = \varnothing$, 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]

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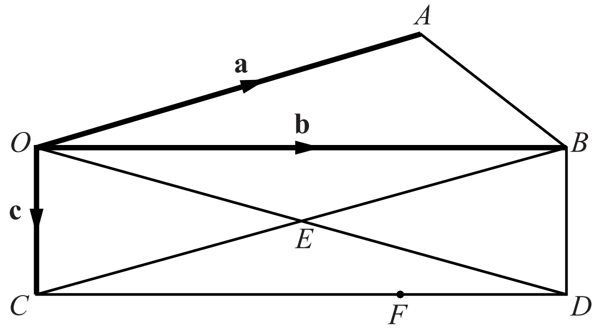
7 OAB is a triangle and $OBDC$ is a rectangle where OD and BC intersect at E.
F is the point on CD such that $CF = \frac{3}{4}CD$.
$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$.



(a) Express, as simply as possible, in terms of one or more of the vectors **a**, **b** and **c**,

(i) $\overrightarrow{AB}$,

Answer .... [1]

(ii) $\overrightarrow{OE}$,

Answer .... [1]

(iii) $\overrightarrow{EF}$.

Answer .... [2]

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

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

Answer .... [1]

(ii) Find $AG : GB$.

Answer .... : .... [1]

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

Answer .... [2]

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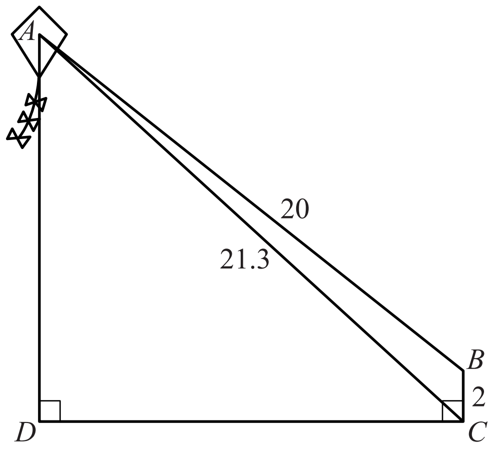
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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 $A\hat{D}C = B\hat{C}D = 90°$.

(a) Calculate

(i) $A\hat{B}C$,

Answer .... [3]

(ii) AD.

Answer .... m [3]

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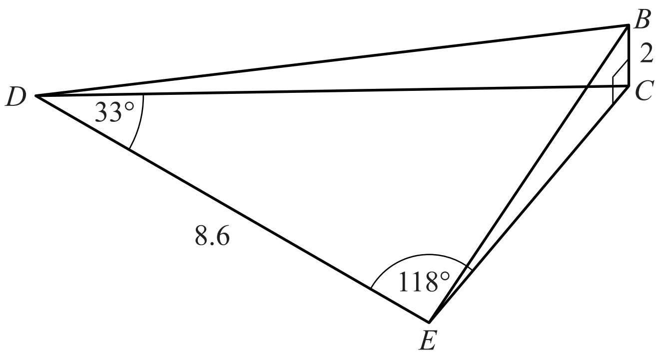
(b)



E is another point on the level ground such that $DE = 8.6\,\text{m}$, $E\hat{D}C = 33°$ and $C\hat{E}D = 118°$.

Calculate

(i) $D\hat{C}E$

Answer .... [1]

(ii) *CE*,

Answer .... m [3]

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

Answer .... [2]

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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 **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 $8\,\text{m}^2$, $15\,\text{m}^2$ and $20\,\text{m}^2$ respectively.
This information is represented by matrix **Q** below.

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

(i) Find **PQ**.

Answer [2]

(ii) Explain what the matrix **PQ** represents.

Answer ....

.... [1]

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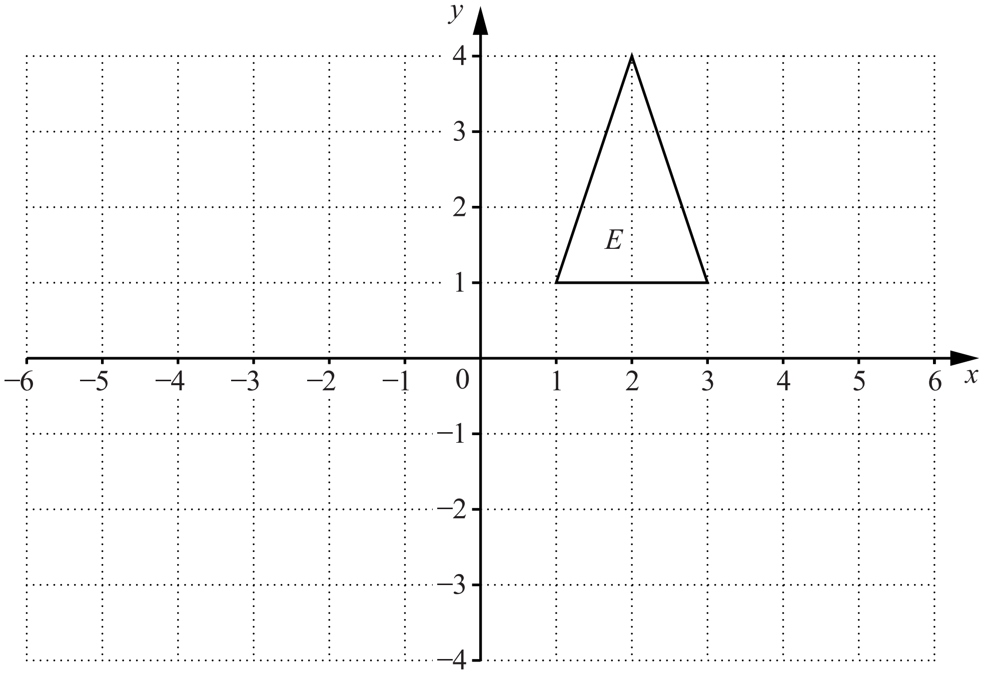
(c)



(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 units^2.

(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]

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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 $A\hat{O}B = 60°$.

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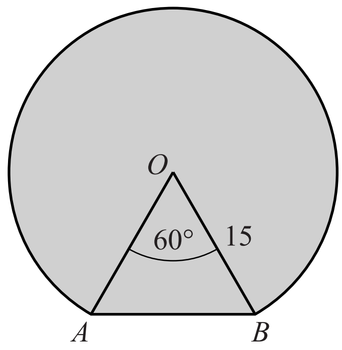

(a) Calculate

(i) the area of the major segment,

Answer .... cm^2 [4]

(ii) the perimeter of the major segment.

Answer .... cm [2]

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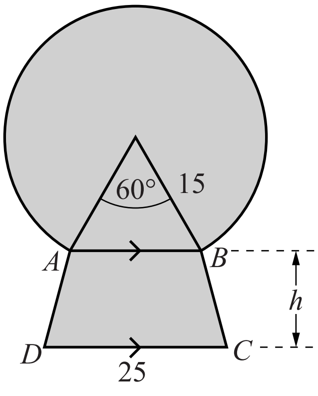
(b) **Shape I** is formed by joining this segment to a trapezium, $ABCD$, along AB.
AB is parallel to DC, $DC = 25$ cm and the perpendicular height of the trapezium is h cm.
The area of the trapezium is 248 cm^2.

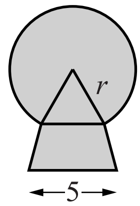
Calculate h.



Shape I

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]

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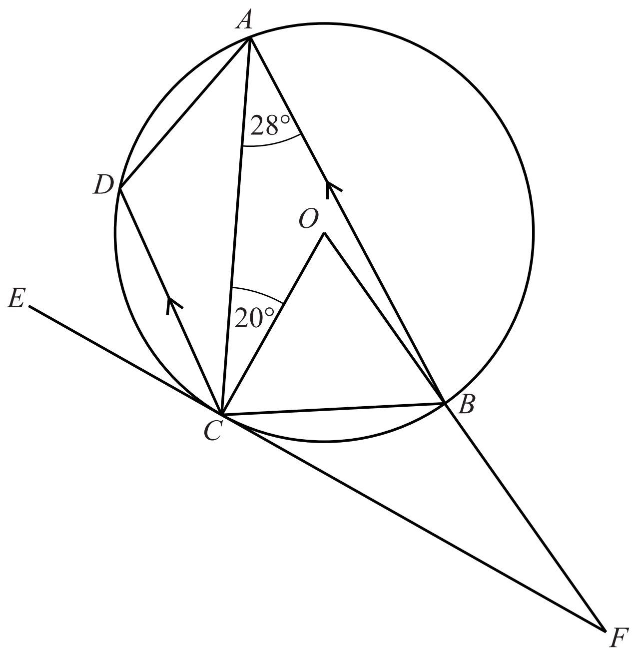
11 (a)



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

Find

(i) $C\hat{O}B$,

Answer .... [1]

(ii) $O\hat{F}C$,

Answer .... [1]

(iii) $O\hat{C}B$,

Answer .... [1]

(iv) $D\hat{C}E$,

Answer .... [2]

(v) $A\hat{D}C$.

Answer .... [2]

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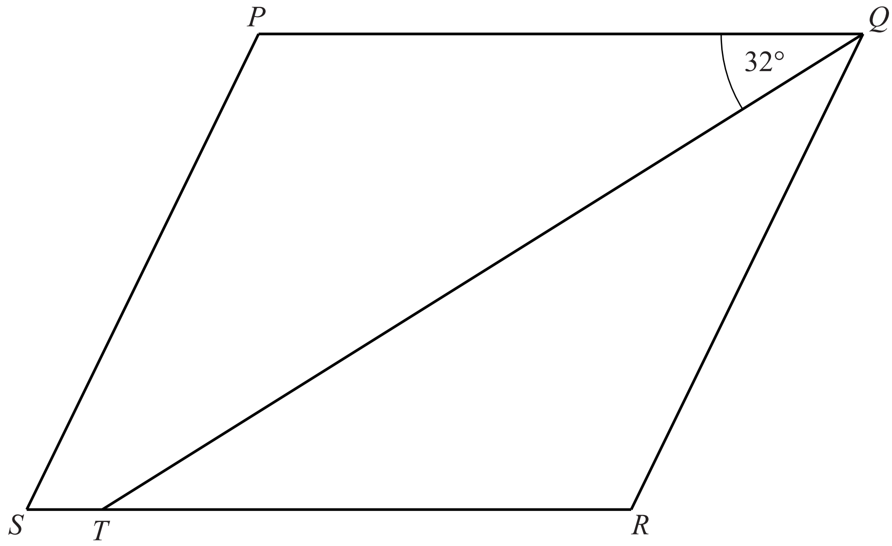
(b)



PQRS is a parallelogram.
QT is the bisector of $P\hat{Q}R$ and $P\hat{Q}T = 32°$.

(i) Giving a reason for your answer, find

(a) $Q\hat{T}R$,

Answer $Q\hat{T}R$ = ... because ....

.... [1]

(b) $S\hat{P}Q$.

Answer $S\hat{P}Q$ = ... because ....

.... [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]

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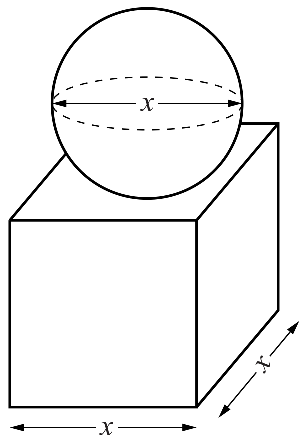
12 [The volume of a sphere = $\frac{4}{3}\pi r^3$]



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 cm^3, 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 $1 \leqslant x \leqslant 7$. [3]

(iii) Use your graph to find the **height of the cuboid** when the volume of the solid is 120 cm^3.

Answer .... cm [2]

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(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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