



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

CANDIDATE  
NAME

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



**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  $\pi$ , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$ .

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.

<b>For Examiner's Use</b>

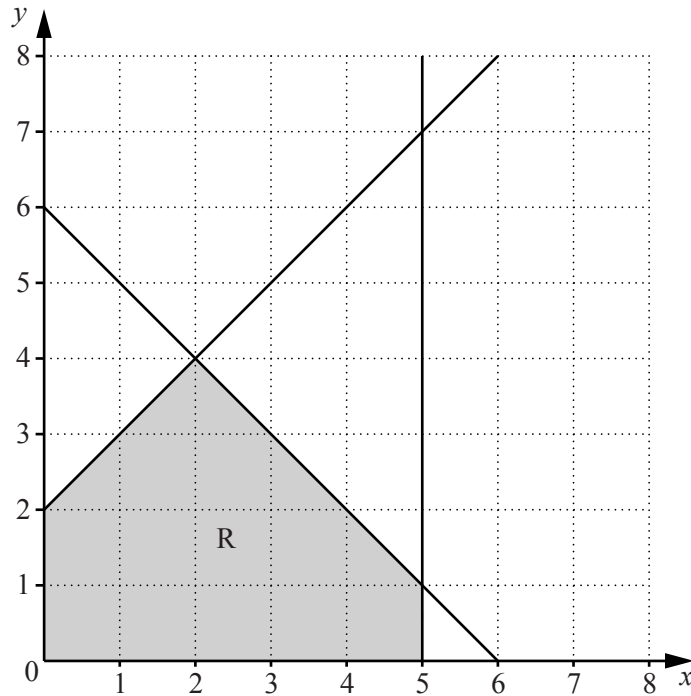
This document consists of **19** printed pages and **1** blank page.



## Section A [52 marks]

Answer **all** questions in this section.Do not  
write in this  
margin

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  $\frac{7x+1}{4} - \frac{x}{2} = 1$ .

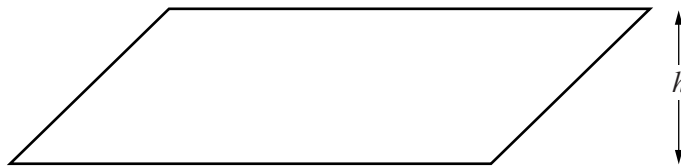
Do not  
write in this  
margin

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  $33.25 \text{ cm}^2$ .

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

[2]

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

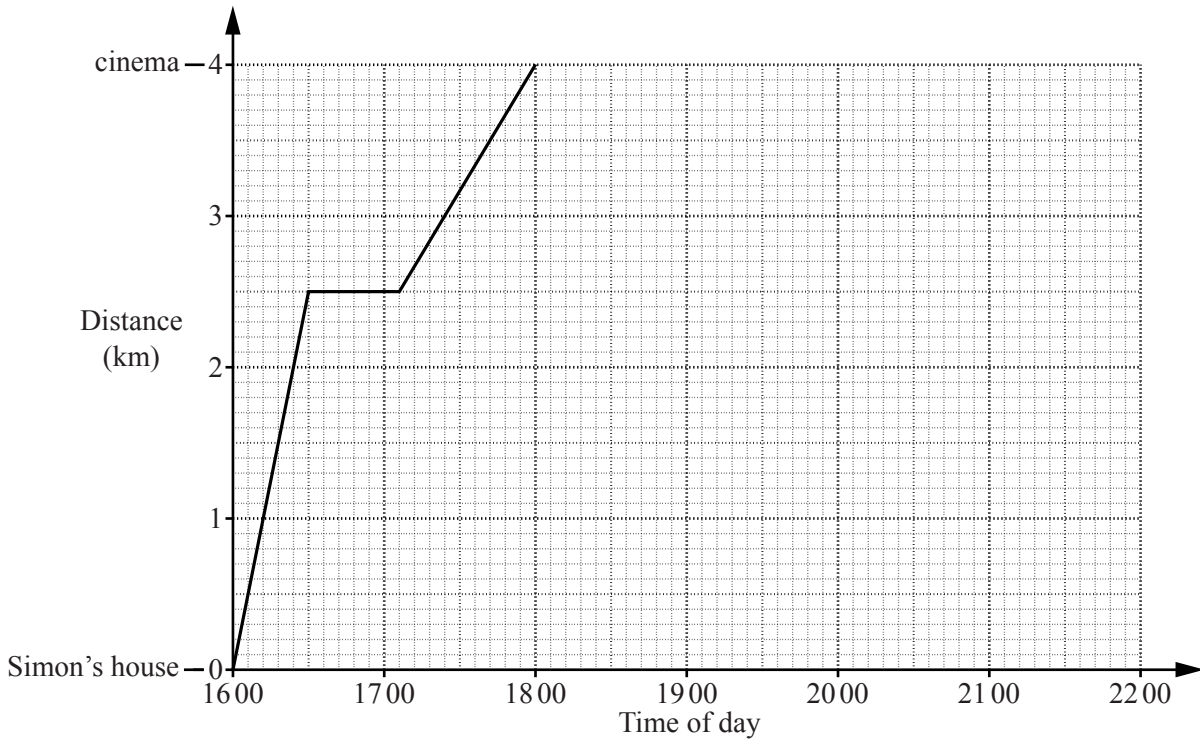
Answer  $h = \dots\dots\dots$  or  $\dots\dots\dots$  [3]

(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.

Do not write in this margin



- (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.

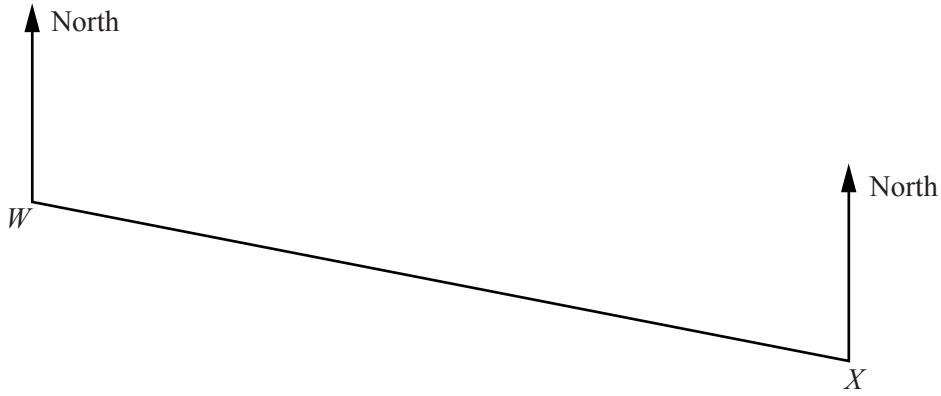
[2]

- (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.

*Do not  
write in this  
margin*



(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]

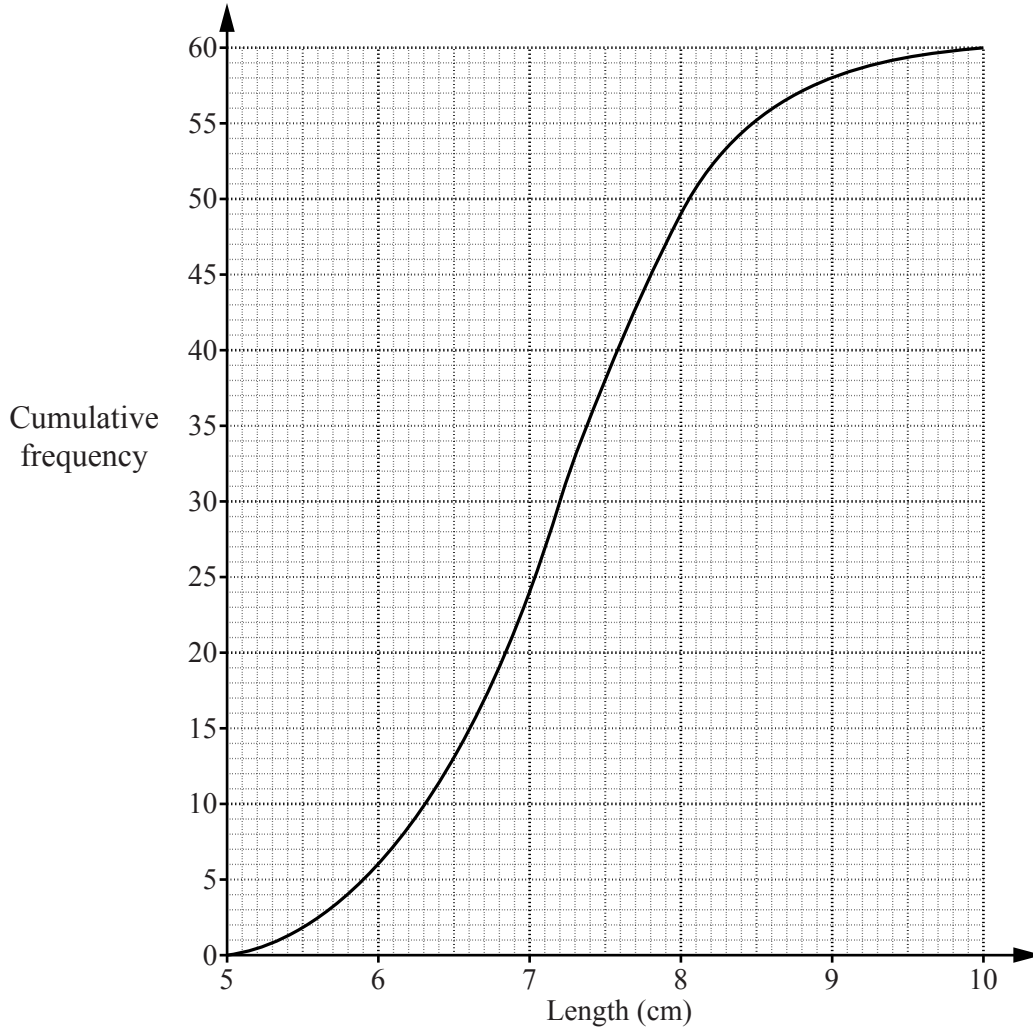
(c) The bearing of hotel  $Z$  from  $W$  is  $072^\circ$  and  $Z$  is due North of  $X$ .

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.

*Do not write in this margin*



(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.

*Do not  
write in this  
margin*

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

(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]

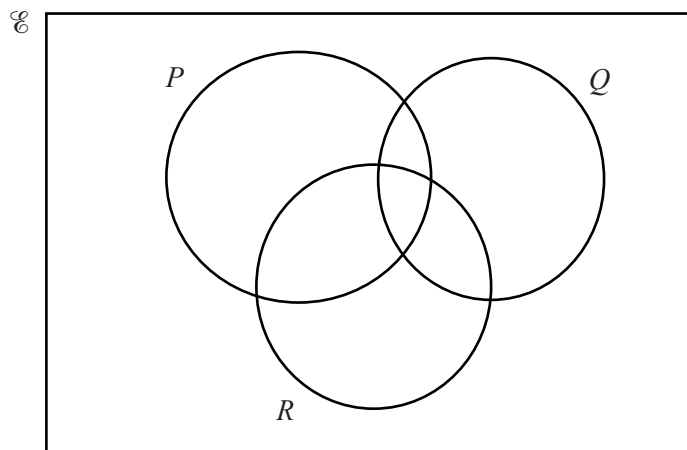
(ii) Find  $n(A \cap B)$ .

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]

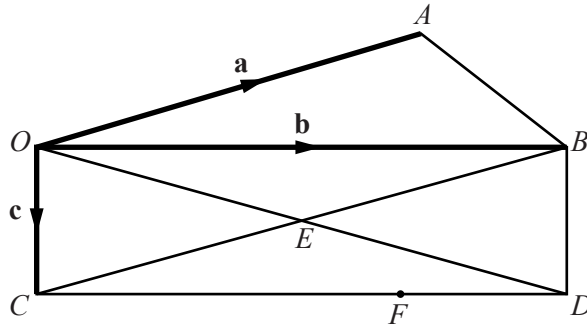
- (c) A group of 80 people attended a recreation centre on one day.  
 Of these people, 48 used the gym  
 31 used the swimming pool  
 17 used neither the gym nor the swimming pool.

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  $\vec{OC} = \mathbf{c}$ .



- (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]

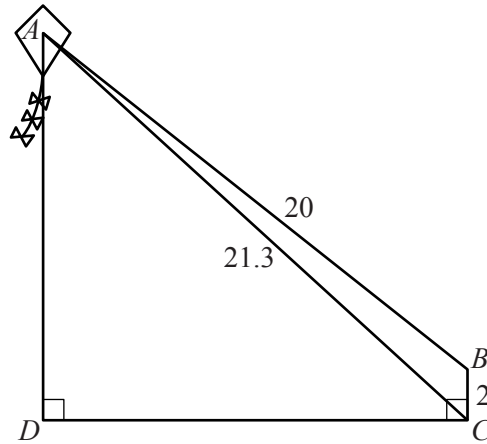
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

Do not  
write in this  
margin

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

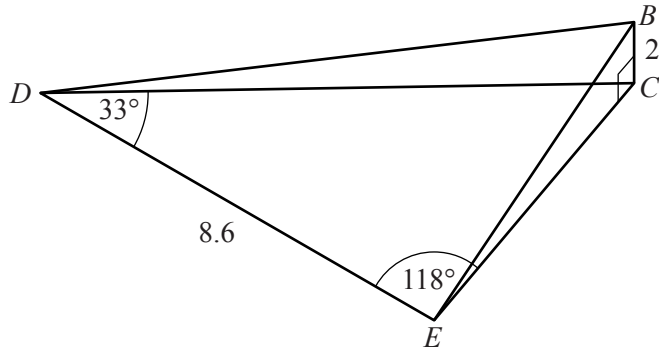
(i)  $\hat{ABC}$ ,

Answer ..... [3]

(ii)  $AD$ .

Answer ..... m [3]

(b)



Do not write in this margin

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

Calculate

(i)  $\hat{DCE}$

Answer ..... [1]

(ii)  $CE$ ,

Answer ..... m [3]

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

Answer ..... [2]

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

Do not  
write in this  
margin

(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  $8 \text{ m}^2$ ,  $15 \text{ m}^2$  and  $20 \text{ m}^2$  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]

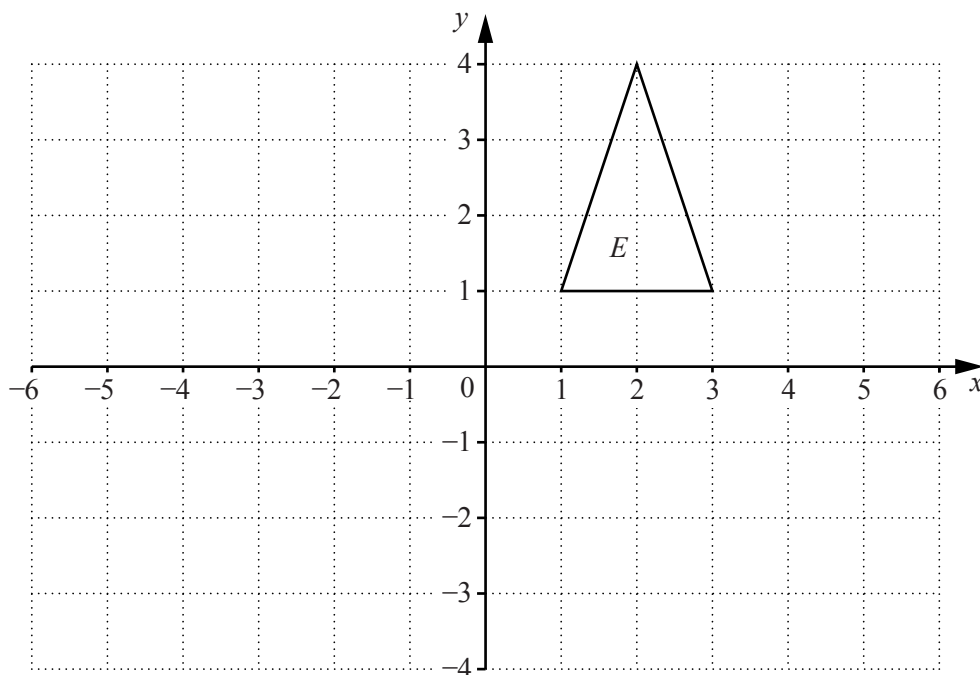
(ii) Explain what the matrix  $\mathbf{PQ}$  represents.

Answer .....

..... [1]

(c)

Do not  
write in this  
margin



(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<sup>2</sup>.

(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  $H$ .

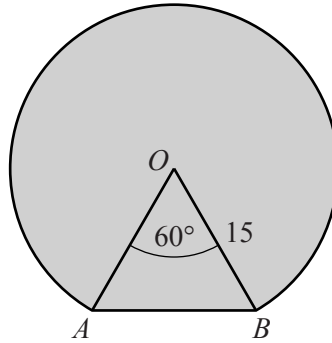
Find  $m$  and  $n$ .

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  $\widehat{AOB} = 60^\circ$ .

Do not  
write in this  
margin



- (a) Calculate
- (i) the area of the major segment,

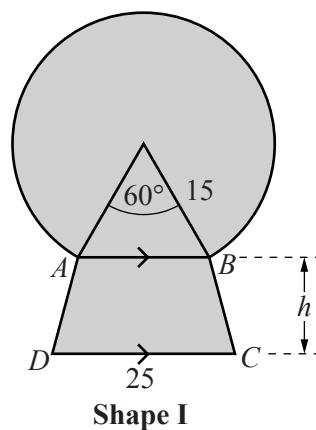
Answer ..... cm<sup>2</sup> [4]

- (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<sup>2</sup>.

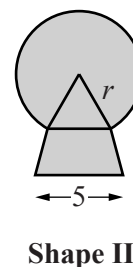
Calculate  $h$ .



*Do not write in this margin*

*Answer* ..... [2]

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



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

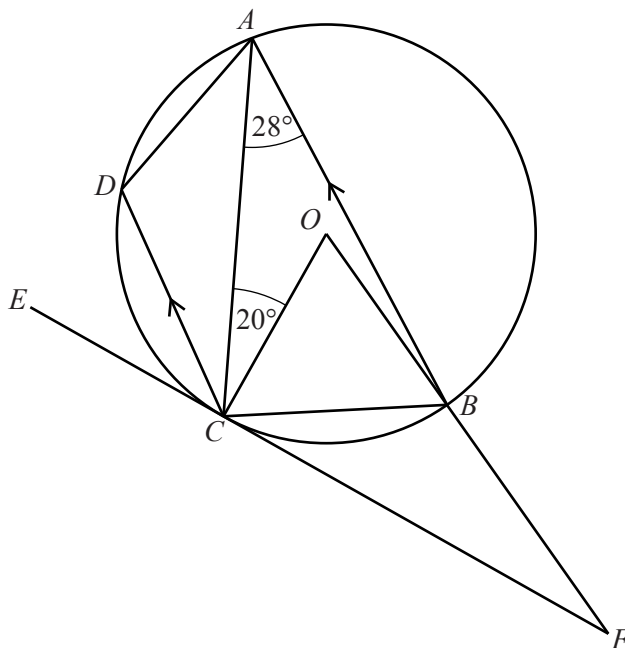
*Answer* ..... cm [1]

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

*Answer* ..... cm<sup>2</sup> [3]

11 (a)

Do not write in this margin



$A, B, C$  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)  $\hat{DCE}$ ,

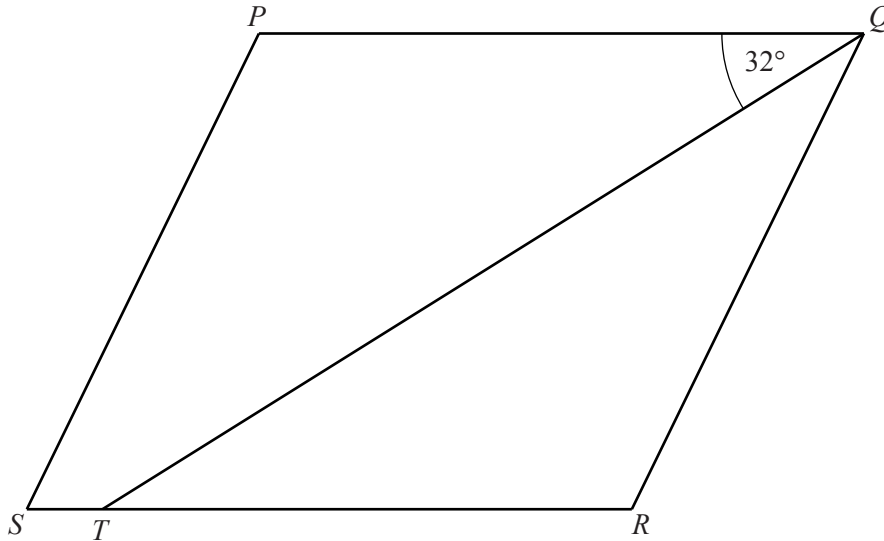
Answer ..... [2]

(v)  $\hat{ADC}$ .

Answer ..... [2]



(b)



Do not write in this margin

$PQRS$  is a parallelogram.  
 $QT$  is the bisector of  $\hat{PQR}$  and  $\hat{PQT} = 32^\circ$ .

(i) Giving a reason for your answer, find

(a)  $\hat{QTR}$ ,

Answer  $\hat{QTR} = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [1]

(b)  $\hat{SPQ}$ .

Answer  $\hat{SPQ} = \dots\dots\dots$  because  $\dots\dots\dots$   
 $\dots\dots\dots$  [1]

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

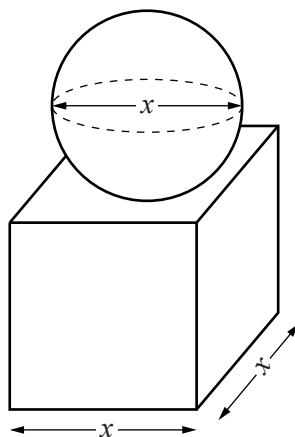
- I 4 cm from  $PS$ ,
  - II 5 cm from  $R$ .
- [2]

(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  
write in this  
margin



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  $\pi$  as 3, show that the approximate volume,  $y$  cm<sup>3</sup>, 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

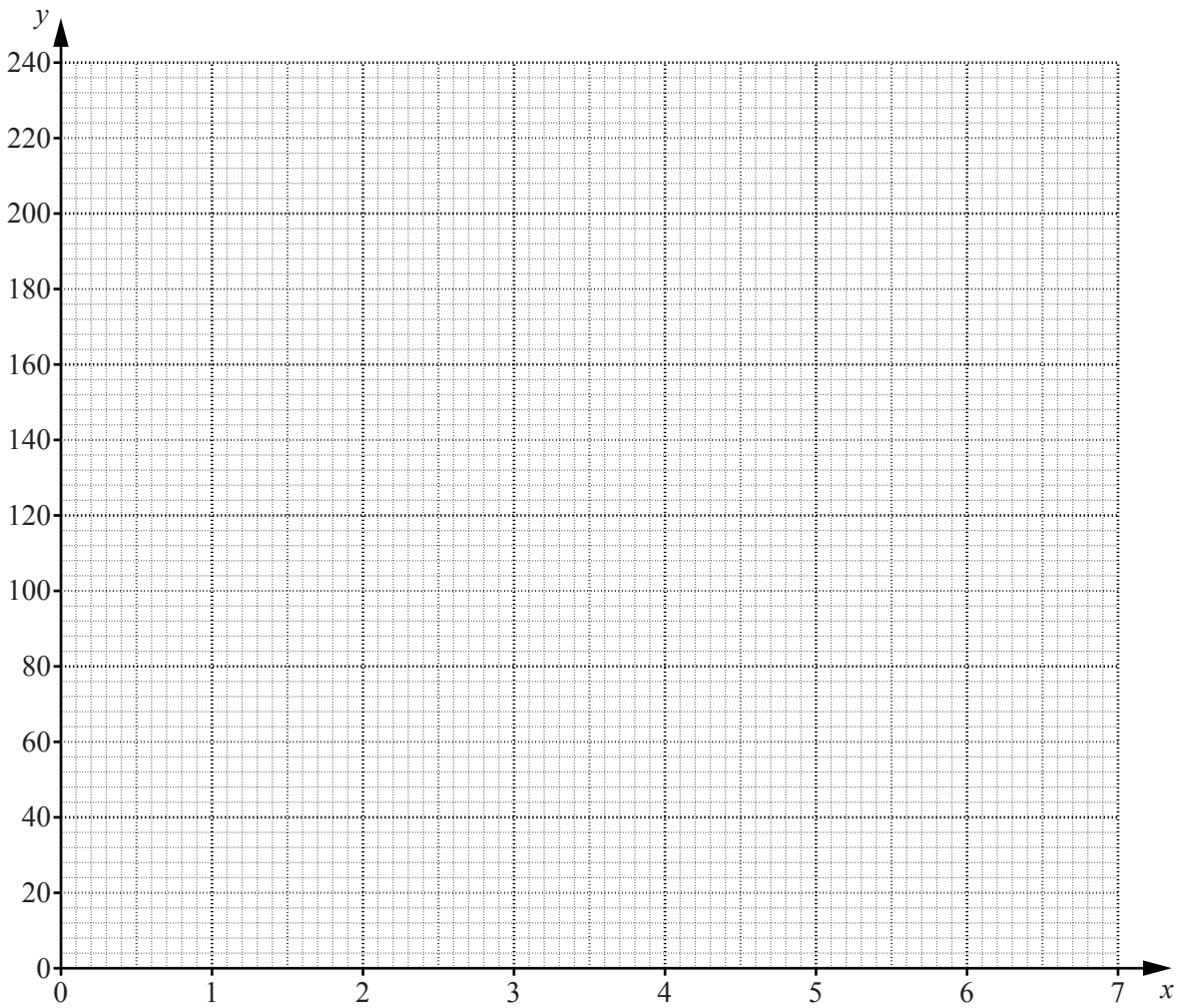
- (i) Complete the table. [1]

- (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 cm<sup>3</sup>.

Answer ..... cm [2]

Do not  
write in this  
margin



- (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  $\pi$  as 3.

Answer ..... [3]

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.