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**Edexcel**
**International GCSE**

Centre Number | Candidate Number

# Mathematics B

## Paper 2R

Tuesday 21 May 2013 – Morning
**Time: 2 hours 30 minutes**

Paper Reference
**4MB0/02R**

**You must have:** Ruler graduated in centimetres and millimetres, protractor, compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Calculators may be used.**

## Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
- Without sufficient working, correct answers may be awarded no marks.

*Turn over*

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**Answer ALL ELEVEN questions.**

**Write your answers in the spaces provided.**

**You must write down all stages in your working.**

**1** Solve the simultaneous equations

$$3x - 2y = 10$$
$$2x - 3y = 5$$

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**Question 1 continued**

**(Total for Question 1 is 4 marks)**

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**2**

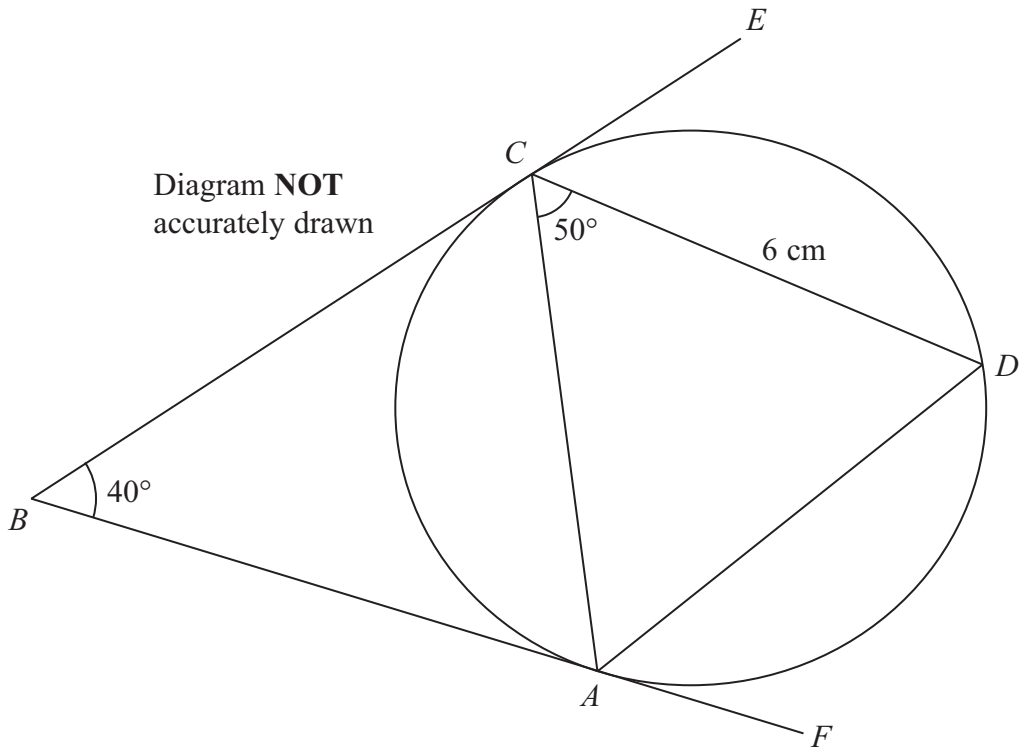


**Figure 1**

In Figure 1, $BCE$ is the tangent to the circle $ACD$ at $C$ and $BAF$ is the tangent to the circle at $A$.

Given that $\angle ABC = 40°$ and $\angle ACD = 50°$,

(a) find the size of $\angle CAD$. Give your reasons.

**(3)**

Given also that $CD = 6$ cm,

(b) calculate the length, in cm to 3 significant figures, of $AD$.

**(3)**

$$\left[\text{Sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}\right]$$

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**Question 2 continued**

**(Total for Question 2 is 6 marks)**

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**3** The curve $C$ has the equation $y = 6 - x - x^2$

(a) Show that the coordinates of the stationary point of $C$ are $\left(-\frac{1}{2}, 6\frac{1}{4}\right)$.

**(4)**

(b) (i) Find the gradient of the curve $C$ at each of the points where $x = -1$ and $x = 0$

(ii) Hence, or otherwise, explain why the stationary point of $C$ is a maximum.

**(2)**

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**Question 3 continued**

**(Total for Question 3 is 6 marks)**

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**4** 172 people went to a market.

The incomplete Venn diagram in Figure 2 shows information about the 172 people who went to the market and about the numbers of these people who bought combinations of fruit ($F$), vegetables ($V$) and meat ($M$).

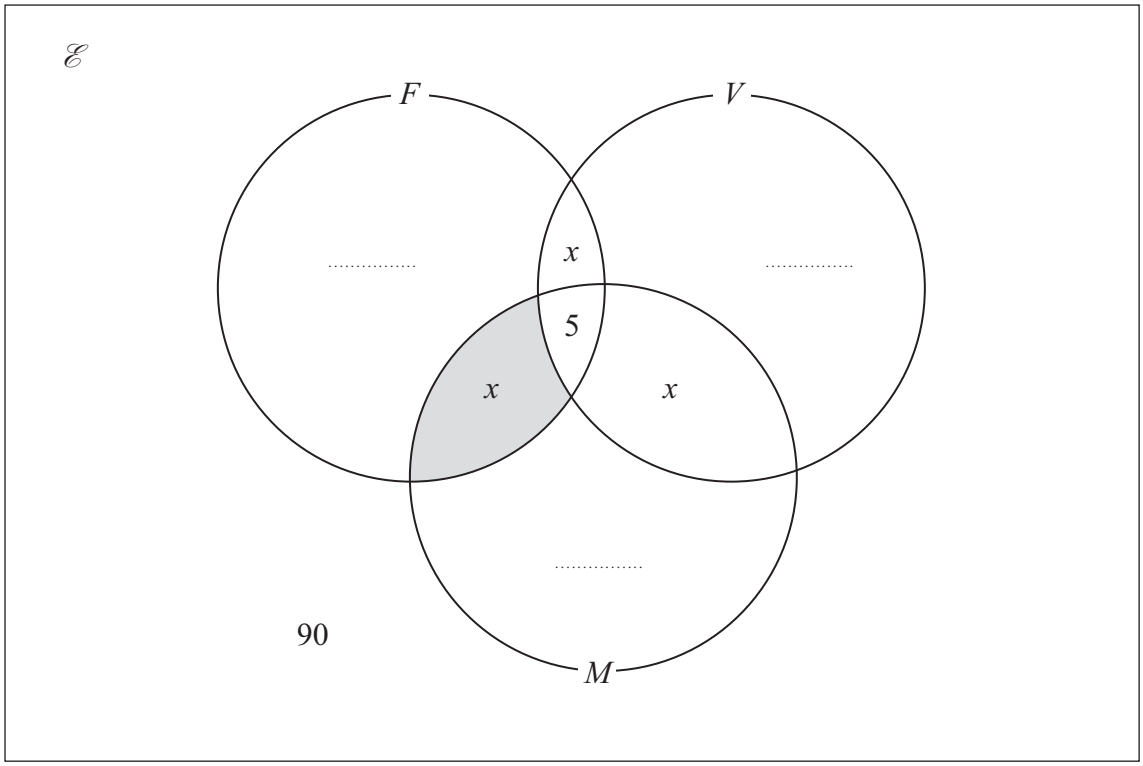


**Figure 2**

(a) Explain what the number 90 in the Venn diagram represents.

**(1)**

Given that n($F$) = 60, n($V$) = 30 and n($M$) = 20,

(b) complete the Venn diagram.

Give your answers in terms of $x$ where appropriate.

**(2)**

(c) Describe, in set notation, the shaded region of the Venn diagram.

**(1)**

(d) Calculate the value of $x$

**(3)**

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**Question 4 continued**

**(Total for Question 4 is 7 marks)**

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**5** Mariam walked $(3x + 5)$ kilometres in $(x + 3)$ hours.

Her average speed for this journey was $\frac{2x}{3}$ km/h.

(a) Show that $2x^2 - 3x - 15 = 0$

**(3)**

(b) Calculate the distance, in kilometres to 3 significant figures, that Mariam walked.

**(4)**

$$\left[\text{Solutions of } ax^2 + bx + c = 0 \text{ are } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right]$$

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**Question 5 continued**

**(Total for Question 5 is 7 marks)**

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**6** (a) Given that $\mathbf{M} + \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ 1 \\ 3 \end{pmatrix}$

write down the matrix **M**.

**(2)**

(b) Given that

$$2\begin{pmatrix} 3 & a-1 \\ c-1 & 2 \end{pmatrix} + \begin{pmatrix} 4 & 2-4b \\ 2-5d & 2 \end{pmatrix} = \begin{pmatrix} a & 12 \\ 2-c & 3d \end{pmatrix}$$

find the values of $a$, $b$, $c$ and $d$.

**(8)**

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**Question 6 continued**

**(Total for Question 6 is 10 marks)**

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**7** Umar has two unbiased six-sided dice, one coloured yellow and one coloured blue.
The dice are numbered as shown below.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow die** | 1 | 2 | 2 | 2 | 3 | 6 |
| **Blue die** | 1 | 2 | 3 | 4 | 5 | 6 |

Umar throws both dice once and adds together the scores on the dice. He calls this the Total Score.

The table below shows some of the possible Total Scores.

| | | **Yellow die** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **2** | **2** | **3** | **6** |
| **Blue die** | **1** | 2 | 3 | 3 | 3 | 4 | 7 |
| | **2** | 3 | 4 | 4 | 4 | 5 | 8 |
| | **3** | 4 | 5 | 5 | 5 | 6 | 9 |
| | **4** | 5 | 6 | 6 | | | |
| | **5** | 6 | 7 | 7 | | | |
| | **6** | | | | | | |

(a) Complete the table.

**(2)**

Umar throws both dice once.

(b) Use your table to write down the probability that

(i) the Total Score is 2
(ii) the Total Score is less than 5

**(2)**

Umar throws both dice once and he then throws both dice again.
He adds together both Total Scores to get a Grand Total.

(c) Use your table to calculate the probability that the Grand Total is

(i) 4

(ii) 9

**(6)**

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**Question 7 continued**

**(Total for Question 7 is 10 marks)**

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**8** The points $A(2, 2)$, $B(4, 2)$ and $C(6, 4)$ are the vertices of a triangle.

(a) On the graph paper opposite, draw and label $\Delta ABC$.

**(1)**

$\Delta DEF$ is the image of $\Delta ABC$ under the enlargement with scale factor $\frac{1}{2}$ and centre of enlargement (0, 0).

(b) On the graph paper, draw and label $\Delta DEF$.

**(2)**

The matrix $\mathbf{S} = \begin{pmatrix} 0 & 4 \\ -4 & 0 \end{pmatrix}$

$\Delta DEF$ is transformed to $\Delta PQR$, where $P$, $Q$ and $R$ are respectively the images of $D$, $E$ and $F$ under the transformation with matrix $\mathbf{S}$.

(c) On the graph paper, draw and label $\Delta PQR$.

**(3)**

$\Delta ABC$ is mapped onto $\Delta PQR$ by a rotation followed by an enlargement.

(d) Describe fully the rotation and the enlargement.

**(3)**

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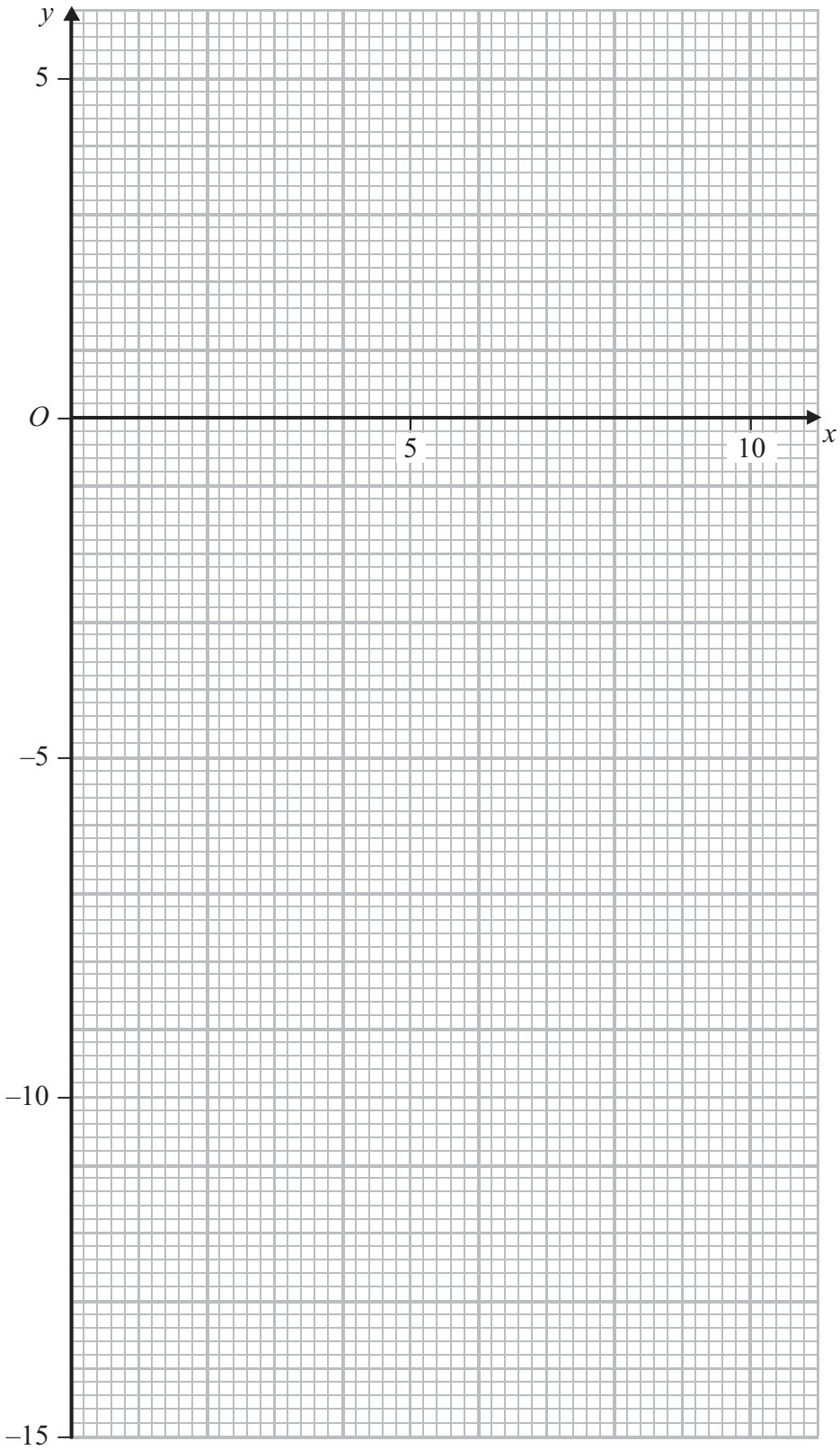
**Question 8 continued**



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**Question 8 continued**

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**Question 8 continued**

**(Total for Question 8 is 9 marks)**

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**9**

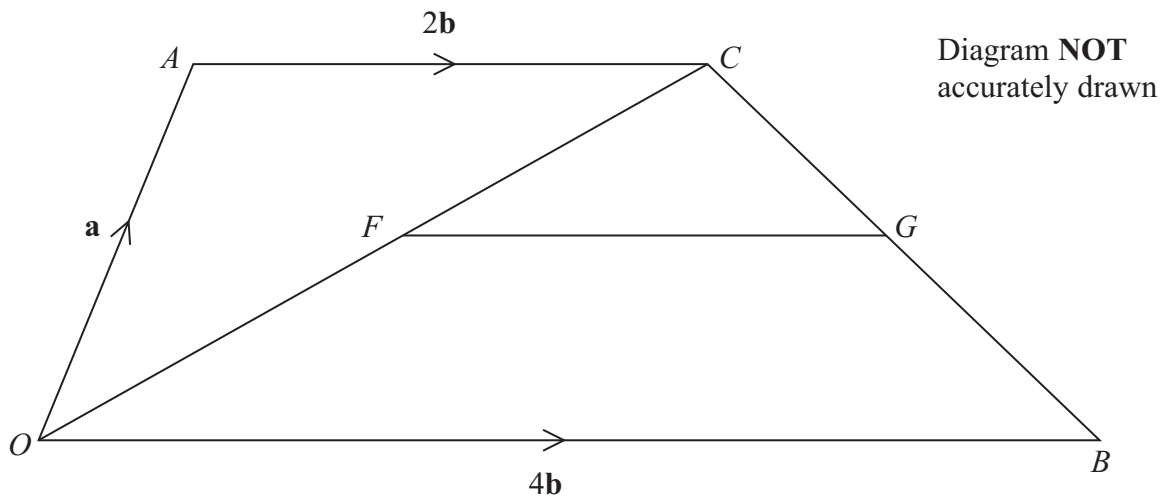


**Figure 3**

Figure 3 shows a quadrilateral $OACB$ where $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = 4\mathbf{b}$ and $\overrightarrow{AC} = 2\mathbf{b}$

The point $F$ on $OC$ is such that $OF : OC = 2 : 5$

The point $G$ on $CB$ is such that $CG : CB = 3 : 5$

(a) Find, in terms of **a** and **b**

(i) $\overrightarrow{OC}$

(ii) $\overrightarrow{CG}$

**(4)**

(b) (i) Show that $\overrightarrow{FG} = \lambda\mathbf{b}$, where $\lambda$ is a constant. Write down the value of $\lambda$.

(ii) Write down the geometrical name of quadrilateral $OFGB$.

**(4)**

Given that $\Delta OCB$ is similar to $\Delta FCG$,

(c) find the ratio (area of $\Delta OCB$) : (area of $\Delta FCG$) in the form $m : n$ where $m$ and $n$ are integers.

**(3)**

Given that the area of $\Delta FCG$ is 18 cm$^2$,

(d) calculate the area, in cm$^2$, of $\Delta OCB$.

**(2)**

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**Question 9 continued**

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**Question 9 continued**

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**Question 9 continued**

**(Total for Question 9 is 13 marks)**

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**10**

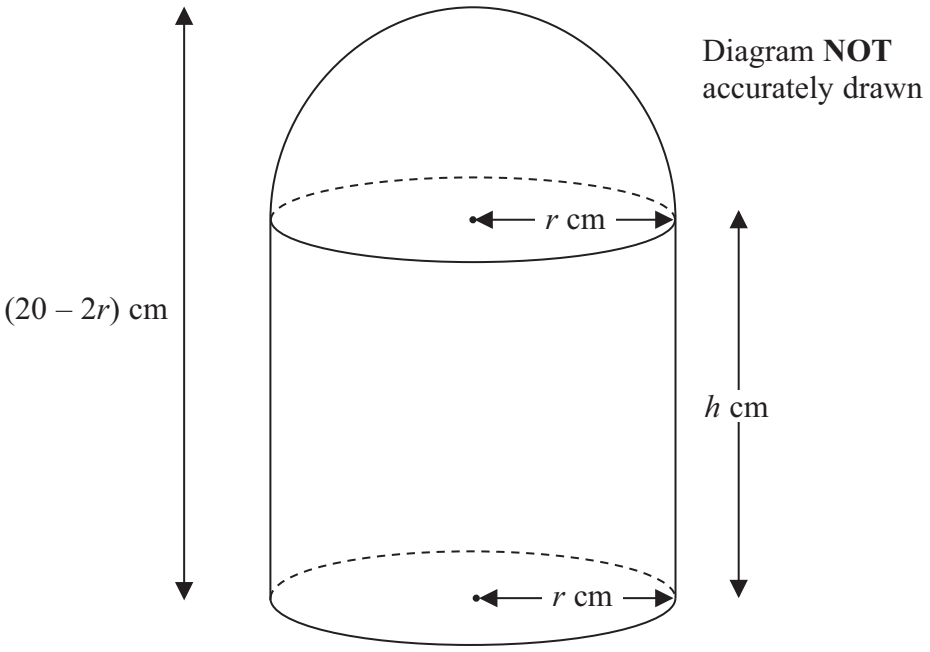


**Figure 4**

Figure 4 shows a solid which is made of a hemisphere of radius $r$ cm on top of a cylinder of radius $r$ cm. The centre of the hemisphere coincides with the centre of the upper circular face of the cylinder.

Given that the total height of the solid is $(20 - 2r)$ cm and that the height of the cylinder is $h$ cm,

(a) explain why $h = 20 - 3r$

**(1)**

Given that the total volume of the solid is $V$ cm$^3$ and $\frac{V}{\pi} = y$

(b) show that

$$y = r^2\left(20 - \frac{7}{3}r\right)$$

**(4)**

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$$\left[\begin{array}{l} \text{Volume of a sphere} = \frac{4}{3}\pi r^3 \\ \text{Area of a circle} = \pi r^2 \end{array}\right]$$

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**Question 10 continued**

**Question 10 continues on page 26**

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**Question 10 continued**

(c) Complete the following table for $y = r^2\left(20 - \frac{7}{3}r\right)$, giving the values of $y$ to the nearest integer.

| $r$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 6.5 |
|---|---|---|---|---|---|---|---|---|
| $y$ | 0 | 18 | | 117 | | 208 | | 204 |

**(3)**

(d) On the graph paper opposite, plot the points from your completed table and join them to form a smooth curve.

**(3)**

(e) Using your curve, find in terms of $\pi$, the maximum volume $V$ cm$^3$ of the solid.

**(1)**

(f) From your curve, find the range of values of $r$ for which $y \geqslant 210$

**(2)**

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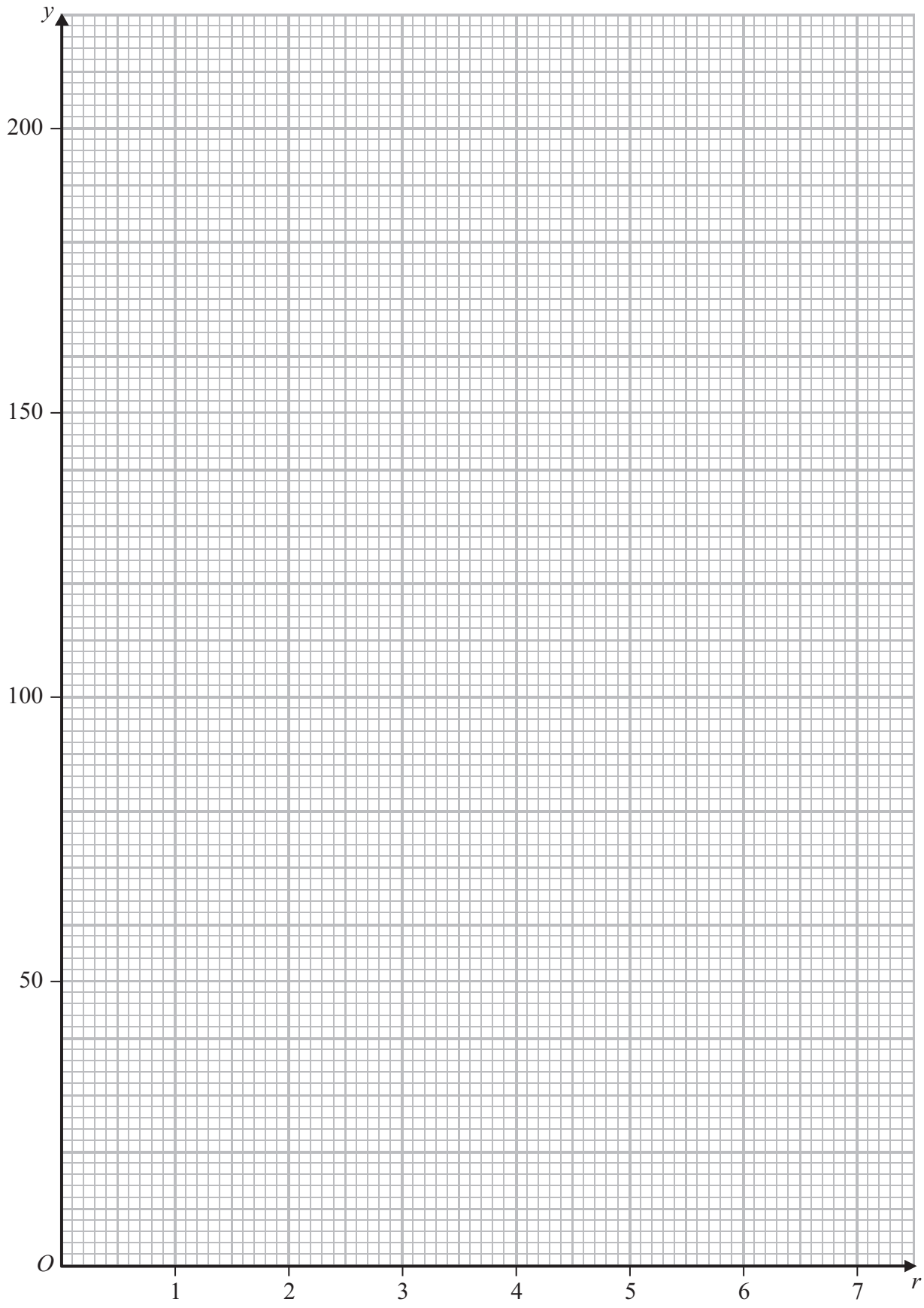
**Question 10 continued**

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**11**

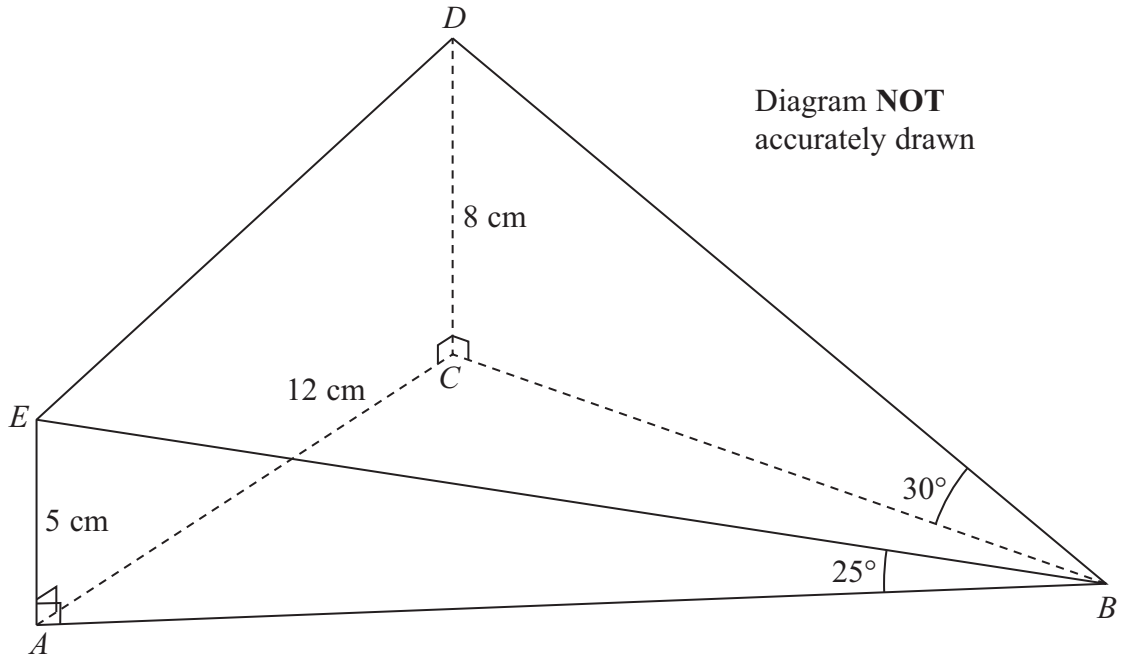


**Figure 5**

Figure 5 shows a solid *ABCDE*. The base of the solid is a triangle, *ABC*, that lies on a horizontal plane and the edges of the solid, *AE* and *CD*, are vertical.

In *ABCDE*, $AE = 5$ cm, $CD = 8$ cm and $AC = 12$ cm with $\angle ABE = 25°$ and $\angle CBD = 30°$

Calculate the length, in cm to 3 significant figures, of

(a) *BE*,

**(2)**

(b) *ED*.

**(3)**

(c) Calculate the size, in degrees to 3 significant figures, of $\angle EBD$.

**(4)**

The faces *BED* and *ACDE* are to be painted.

(d) Calculate the total surface area, in $cm^2$ to 3 significant figures, to be painted.

**(5)**

$$\left[\begin{array}{c} \text{Area of trapezium} = \frac{1}{2}(a+b)h \\ \text{Area of triangle} = \frac{1}{2}bc\sin A \\ \text{Cosine rule: } a^2 = b^2 + c^2 - 2bc\cos A \end{array}\right]$$

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**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

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**TOTAL FOR PAPER IS 100 MARKS**

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