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**Edexcel International GCSE**

Centre Number | Candidate Number

# Mathematics B

## Paper 2

Tuesday 15 January 2013 – Morning

**Time: 2 hours 30 minutes**

Paper Reference **4MB0/02**

**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** $A = \{a, b, c\}$

List all the subsets of $A$.

**(Total for Question 1 is 3 marks)**

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**2** A mixture of sugar and salt is in the ratio 3 : 2

The weight of the mixture is 150 grams.

(a) Calculate the weight of sugar and the weight of salt in the mixture.

**(3)**

30 grams of sugar and 10 grams of salt are added to the mixture.

(b) Calculate the ratio of sugar to salt in the new mixture.

**(2)**

**(Total for Question 2 is 5 marks)**

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**3**

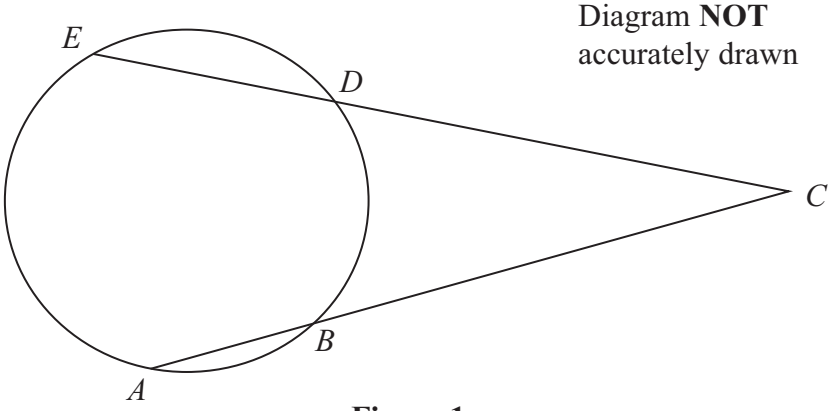


Diagram **NOT** accurately drawn

**Figure 1**

Figure 1 shows the circle $ABDE$ with chord $ED = 3$ cm.

The chords $ED$ and $AB$ are extended to meet at $C$ with $DC = 6$ cm and $AC = 8$ cm.

(a) Calculate the length, in cm, of $AB$.

**(3)**

Given also that $BD = 2$ cm,

(b) calculate the length, in cm, of $EA$.

**(2)**

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**Question 3 continued**

**(Total for Question 3 is 5 marks)**

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**4** An accurate model of a bus is made to a scale of 1 : 20
The length of the bus is 10 m.

(a) Calculate the length, in m, of the model.

**(2)**

The capacity of the fuel tank of the model is 30 ml.

(b) Calculate the capacity, in litres, of the fuel tank of the bus.

**(2)**

The bus has 64 passenger seats.

(c) Write down the number of passenger seats in the model.

**(1)**

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**Question 4 continued**

**(Total for Question 4 is 5 marks)**

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**5** (a) Expand and simplify $(x + 4)(x^2 + 4x - 2)$

**(2)**

Given that $y = (x + 4)(x^2 + 4x - 2)$

(b) find $\frac{dy}{dx}$

**(2)**

(c) find the values of $x$ for which $\frac{dy}{dx} = 2 - 4x$

**(4)**

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**Question 5 continued**

**(Total for Question 5 is 8 marks)**

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**6** Frequency density

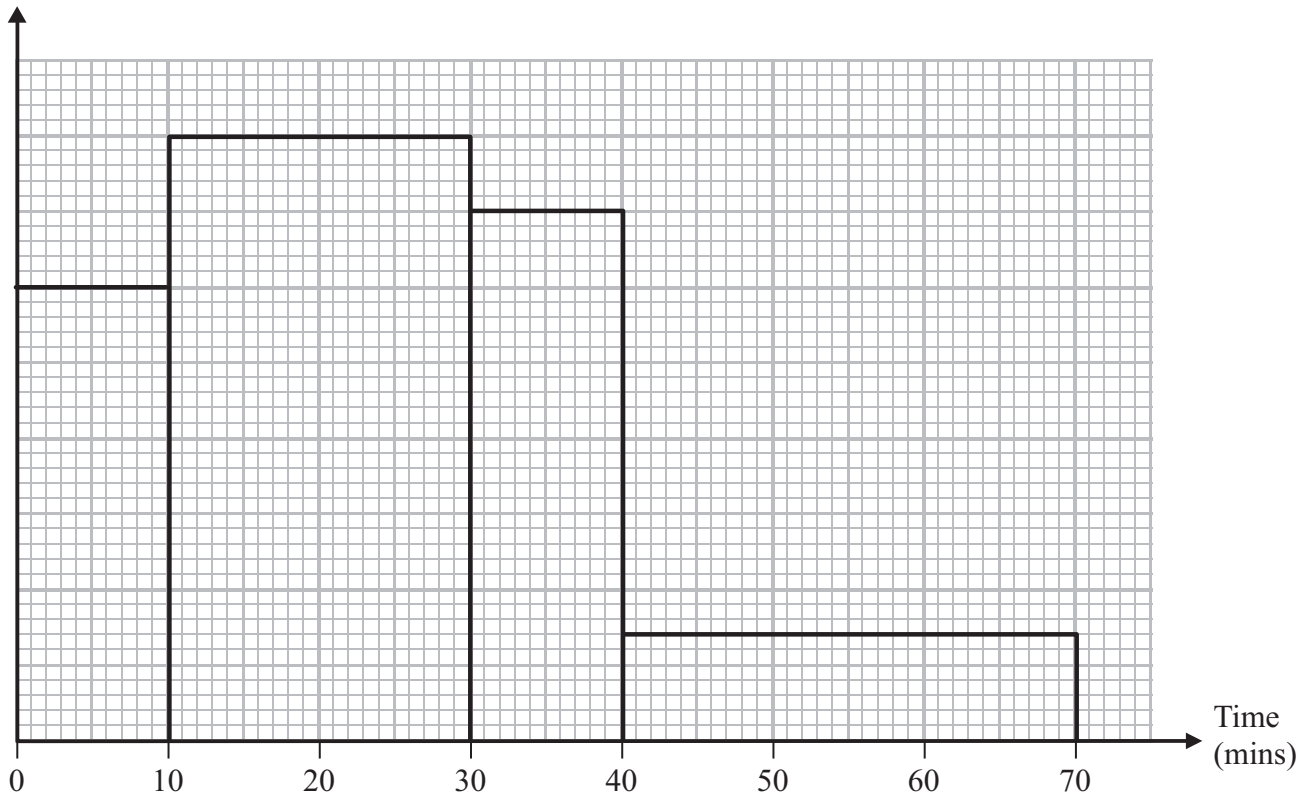


**Figure 2**

A survey was carried out into the time it took students to travel to school on Monday.
Information about the results of this survey is shown in the histogram in Figure 2.
No student took more than 70 minutes to travel to school.
35 students took between 30 minutes and 40 minutes to travel to school.

(a) Calculate how many students took part in the survey.

**(4)**

One of these students is to be chosen at random.

(b) Calculate the probability that this student took more than 30 minutes to travel to school.

**(2)**

A similar survey was carried out on Tuesday and the results were compared with those of Monday's survey.

On Tuesday, 8 fewer students took less than 10 minutes to travel to school.
The number of students that took between 10 minutes and 30 minutes to travel to school was the same on both Monday and Tuesday.
3 more students took between 30 minutes and 40 minutes to travel to school,
5 fewer students took more than 40 minutes to travel to school.
No student took more than 70 minutes to travel to school.

One of the students from Tuesday's survey is to be chosen at random.

(c) Calculate the probability that this student took more than 30 minutes to travel to school.

**(3)**

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**Question 6 continued**

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**Question 6 continued**

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**Question 6 continued**

**(Total for Question 6 is 9 marks)**

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**7** A tank is filled with 300 litres of water.

At time $t = 0$, a tap at the bottom of the tank is opened and water flows out of the tank through the tap.

The volume, $V$, in litres, of water in the tank at time $t$ minutes is given by the formula
$V = 300 - t^2 - 2t,\ t \geqslant 0$

Calculate,

(a) the volume, in litres, of water flowing out of the tank in the first 12 minutes,

**(2)**

(b) the volume, in litres, of water which flows out of the tank during the 15th minute,

**(2)**

(c) the rate of change of the volume of water when $t = 5$

**(4)**

(d) Calculate, in minutes to 3 significant figures, how long it takes for all of the water to flow out of the tank.

**(3)**

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

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

**(Total for Question 7 is 11 marks)**

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**8**

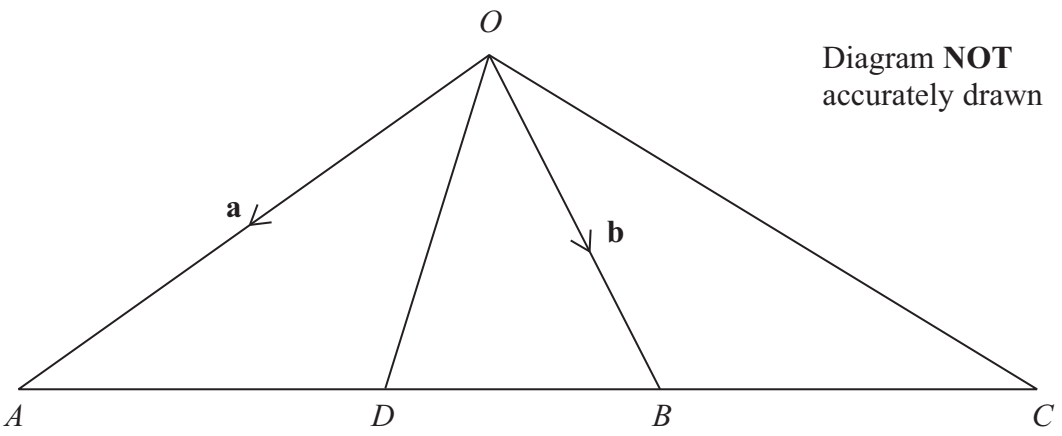


Diagram **NOT** accurately drawn

**Figure 3**

In Figure 3, $OAC$ is a triangle and $ADBC$ is a straight line with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$

The point $D$ on $AB$ is such that $AD : DB = 3 : 1$

(a) Express, in terms of **a** and **b**, simplifying each answer where possible,

(i) $\overrightarrow{AB}$

(ii) $\overrightarrow{OD}$

**(4)**

$C$ is the point on $AB$ produced such that $\overrightarrow{OC} = \frac{9}{4}\mathbf{b} - \frac{5}{4}\mathbf{a}$

(b) Express $\overrightarrow{AC}$ in terms of **a** and **b**, simplifying your answer.

**(2)**

(c) Find the ratio $AB : BC$ in the form $m : n$ where $m$ and $n$ are integers.

**(2)**

The point $E$ on $OC$ is such that $OE : EC = 1 : 2$

(d) Show that $\overrightarrow{ED}$ is parallel to $\overrightarrow{OA}$.

**(4)**

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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 12 marks)**

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**9**

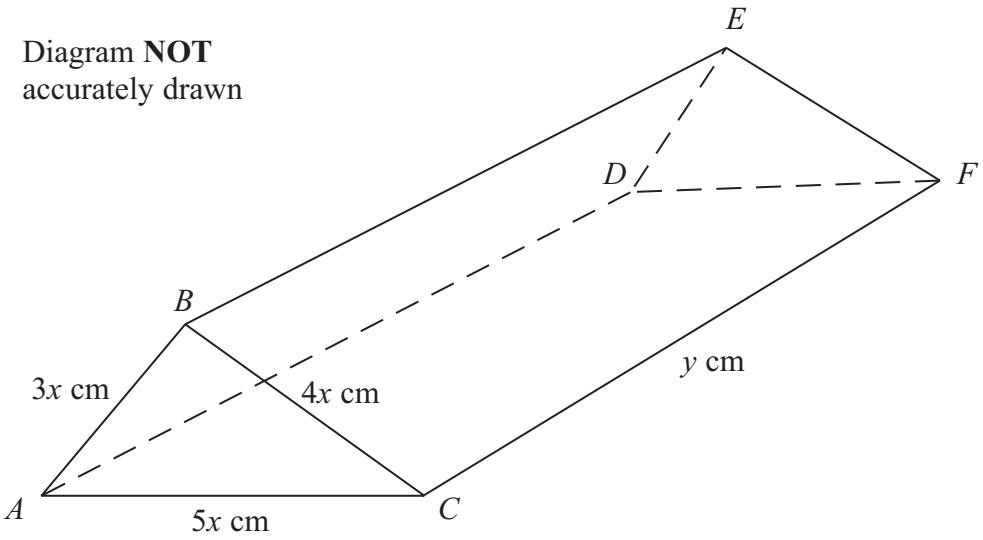


**Figure 4**

In Figure 4, *ABCFED* is a prism with triangular cross section in which $CF = AD = BE = y$ cm, $AB = DE = 3x$ cm, $BC = EF = 4x$ cm and $AC = DF = 5x$ cm.

Given that the total surface area of the prism is $S$ cm$^2$,

(a) (i) write down the size, in degrees, of $\angle ABC$,

(ii) show that the area of $\Delta ABC$ is $6x^2$ cm$^2$,

(iii) find an expression for $S$ in terms of $x$ and $y$.

**(4)**

Given also that $S = 144$

(b) show that $y = \dfrac{12 - x^2}{x}$

**(2)**

The volume of the prism is $V$ cm$^3$.

(c) Show that $V = 6x(12 - x^2)$

**(2)**

**(Parts (d), (e) and (f) follow on page 24)**

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**Question 9 continued**

**Question 9 is continued on page 24**

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**Question 9 continued**

(d) Complete the following table for $V = 6x(12 - x^2)$, giving the values of $V$ to one decimal place where necessary.

| $x$ | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 3.4 |
|---|---|---|---|---|---|---|---|---|
| $V$ | 0 | | 66 | | | | 54 | 9.0 |

**(3)**

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

**(3)**

(f) Using your graph, write down the maximum value of $V$.

**(1)**

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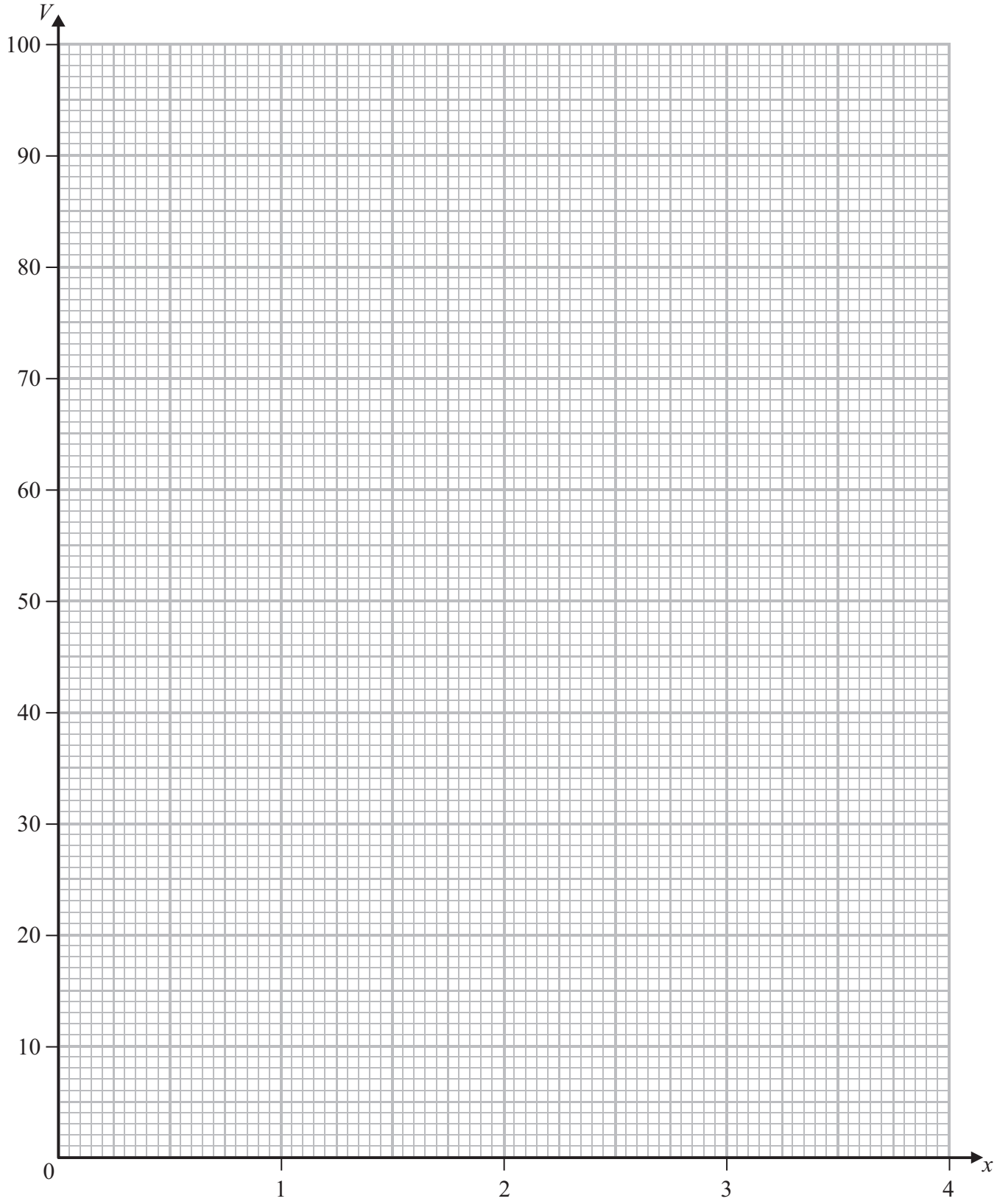
**Question 9 continued**




**(Total for Question 9 is 15 marks)**

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**10**

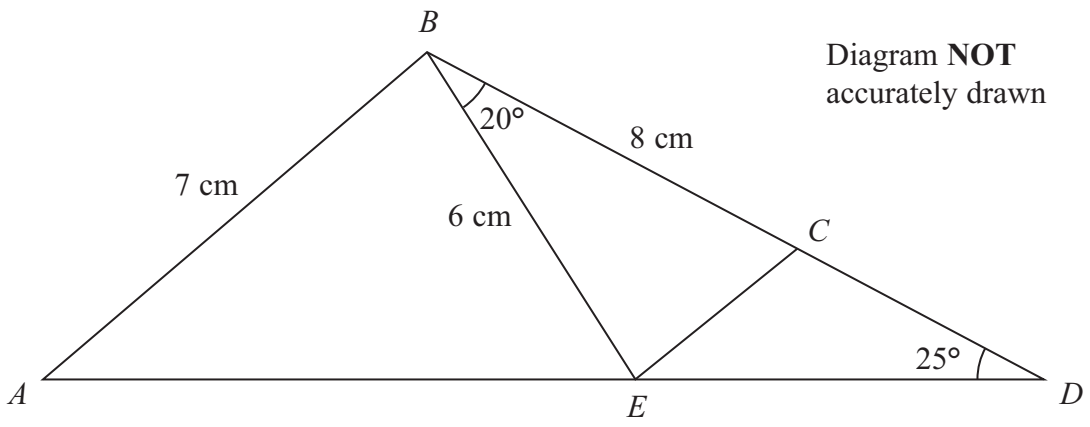


**Figure 5**

In Figure 5, $ABD$ is a triangle in which $AB = 7$ cm and $\angle BDA = 25°$

The point $E$ on $AD$ and the point $C$ on $BD$ are such that $BE = 6$ cm, $BC = 8$ cm and $\angle CBE = 20°$

Calculate to 3 significant figures,

(a) the length, in cm, of $CE$,

**(3)**

(b) the size, in degrees, of $\angle BCE$,

**(3)**

(c) the length, in cm, of $ED$,

**(3)**

(d) the size, in degrees, of $\angle ABE$,

**(4)**

(e) the area, in cm$^2$, of $\Delta ABD$.

**(3)**

$$\left[\begin{array}{c} \text{Sine rule: } \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} \\ \text{Cosine rule: } a^2 = b^2 + c^2 - 2bc\cos A \\ \text{Area of a triangle} = \dfrac{1}{2}bc\sin A \end{array}\right]$$

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**Question 10 continued**

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**Question 10 continued**

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**Question 10 continued**

**(Total for Question 10 is 16 marks)**

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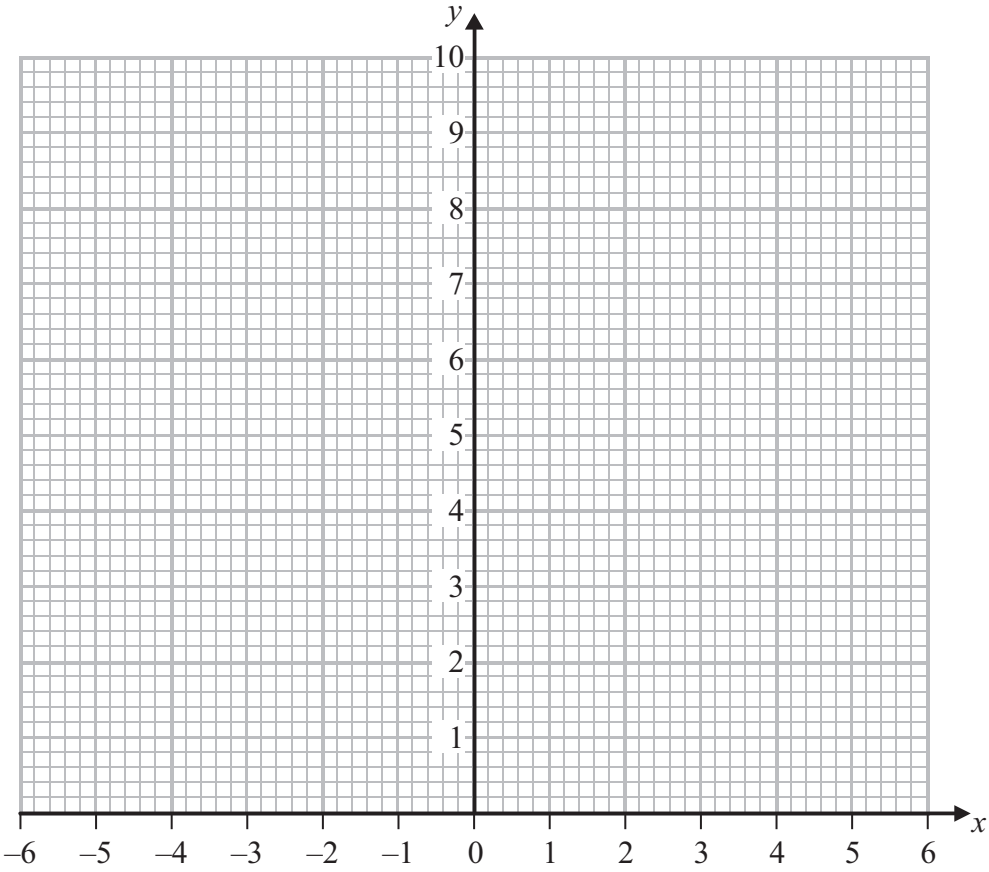
**11** The points $A(-1, 1)$, $B(-5, 1)$ and $C(-3, 3)$ are the vertices of a triangle.

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

**(1)**




$$\mathbf{P} = \begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$$

(b) Calculate the matrix product

$$\mathbf{P}\begin{pmatrix} -1 & -5 & -3 \\ 1 & 1 & 3 \end{pmatrix}$$

**(2)**

(c) Draw and label $\Delta A'B'C'$ where $A'$, $B'$ and $C'$ are respectively the images of the points $A$, $B$ and $C$ under the transformation represented by the matrix **P**.

**(1)**

$$\mathbf{Q} = \begin{pmatrix} 0 & \frac{1}{3} \\ -1 & 0 \end{pmatrix}$$

(d) Draw and label $\Delta A''B''C''$ where $A''$, $B''$ and $C''$ are respectively the images of the points $A'$, $B'$ and $C'$ under the transformation represented by the matrix **Q**.

**(3)**

(e) Describe fully the single transformation which maps $\Delta ABC$ onto $\Delta A''B''C''$.

**(2)**

(f) Find the matrix which represents this transformation.

**(2)**

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**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

**(Total for Question 11 is 11 marks)**

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