Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Wednesday 13 January 2021

Afternoon (Time: 2 hours 30 minutes) | Paper Reference **4MB1/02R**

Mathematics B
Paper 2R

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of 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

Answer ALL ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 $\mathscr{E}$ is the universal set and A, B and C are three sets such that

$\mathscr{E}$ = {even numbers between 5 and 31}
A = {factors of 24}
B = {8, 16}
C = {multiples of 6}

The Venn diagram on the opposite page can be used to show these sets.

(a) Complete the Venn diagram for the sets $\mathscr{E}$, A, B and C

(3)

List the elements of the set

(b) $A \cap C$

(1)

(c) $(A \cup B \cup C)'$

(1)

Find

(d) $\mathrm{n}([A \cup B]')$

(1)

(e) $\mathrm{n}([A \cap B] \cup C)$

(1)

A number is selected at random from $\mathscr{E}$

(f) Find the probability that the number is in set B

(2)

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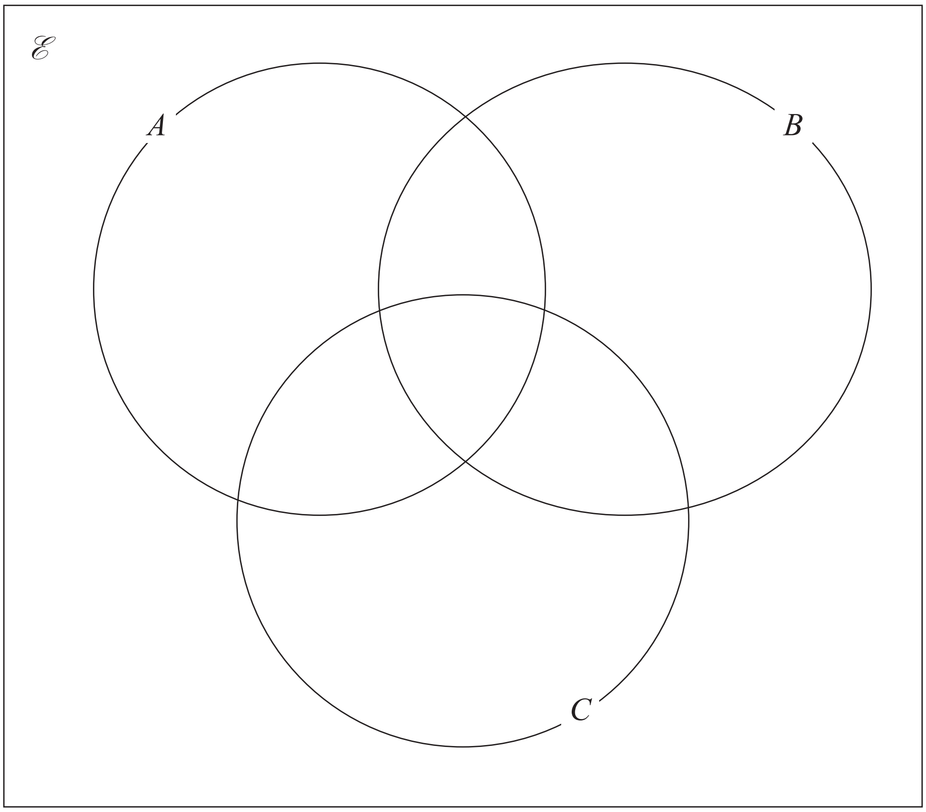
Question 1 continued



Turn over for a spare copy of the Venn diagram.

Question 1 continued

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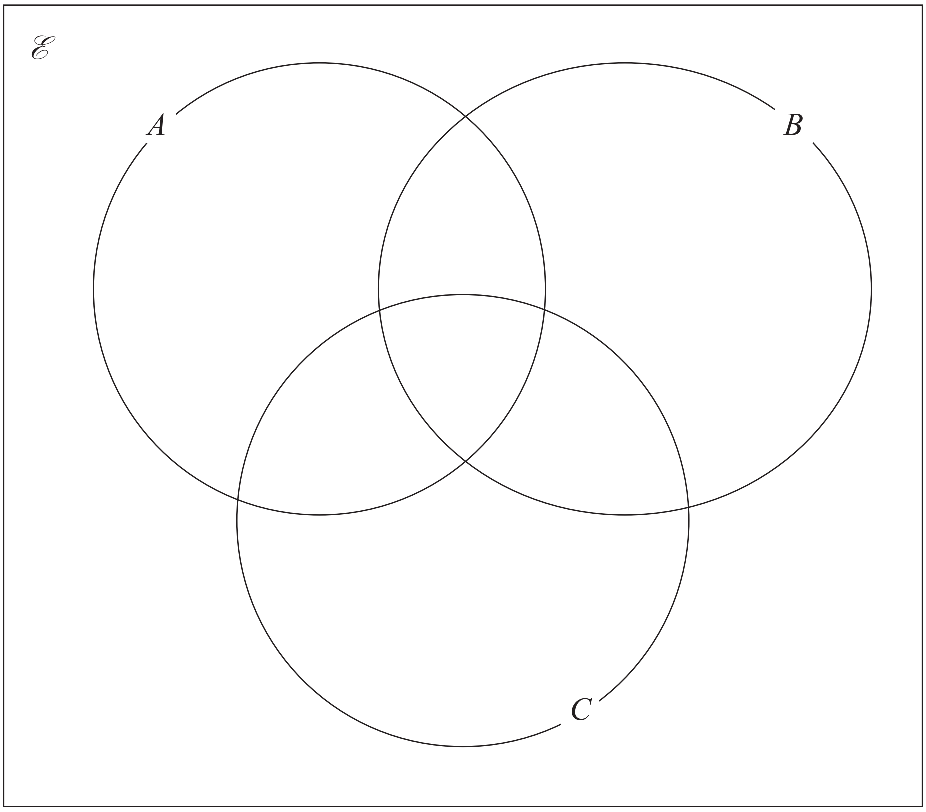
Question 1 continued

Only use this Venn diagram if you wish to replace your answer to part (a)



(Total for Question 1 is 9 marks)

2 Each year the students at a college organise a music concert.

In 2017, the total cost of organising the concert was \$675
In 2018, the total cost of organising the concert was 20% more than the total cost in 2017

(a) Calculate the total cost of organising the concert in 2018

(2)

The tickets sold each year were either adult tickets or student tickets.

In 2019, the total number of tickets sold was 385
In 2019, the number of adult tickets sold and the number of student tickets sold were in the ratio

number of adult tickets : number of student tickets = 19 : 16

(b) Calculate the number of adult tickets sold in 2019

(2)

In 2019, the price of each adult ticket sold was \$8.50 and the price of each student ticket sold was \$4.50

(c) Calculate the total amount of money, in \$, received for all the tickets sold in 2019

(2)

In 2019, the total cost of organising the concert was double the total cost in 2017

(d) Calculate the percentage profit made in 2019
Give your answer to 1 decimal place.

(2)

Question 2 continued

(Total for Question 2 is 8 marks)

3 The equation of a curve is $y = -2x^3 + 6x + \dfrac{5}{x^2}$

(a) Complete the table of values for $y = -2x^3 + 6x + \dfrac{5}{x^2}$

Give your values of y to 2 decimal places where necessary.

x	−2	−1.8	−1.7	−1.6	−1.4	−1.2	−1	−0.9	−0.8
y	5.25	2.41		0.55	−0.36		1		4.04

(2)

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

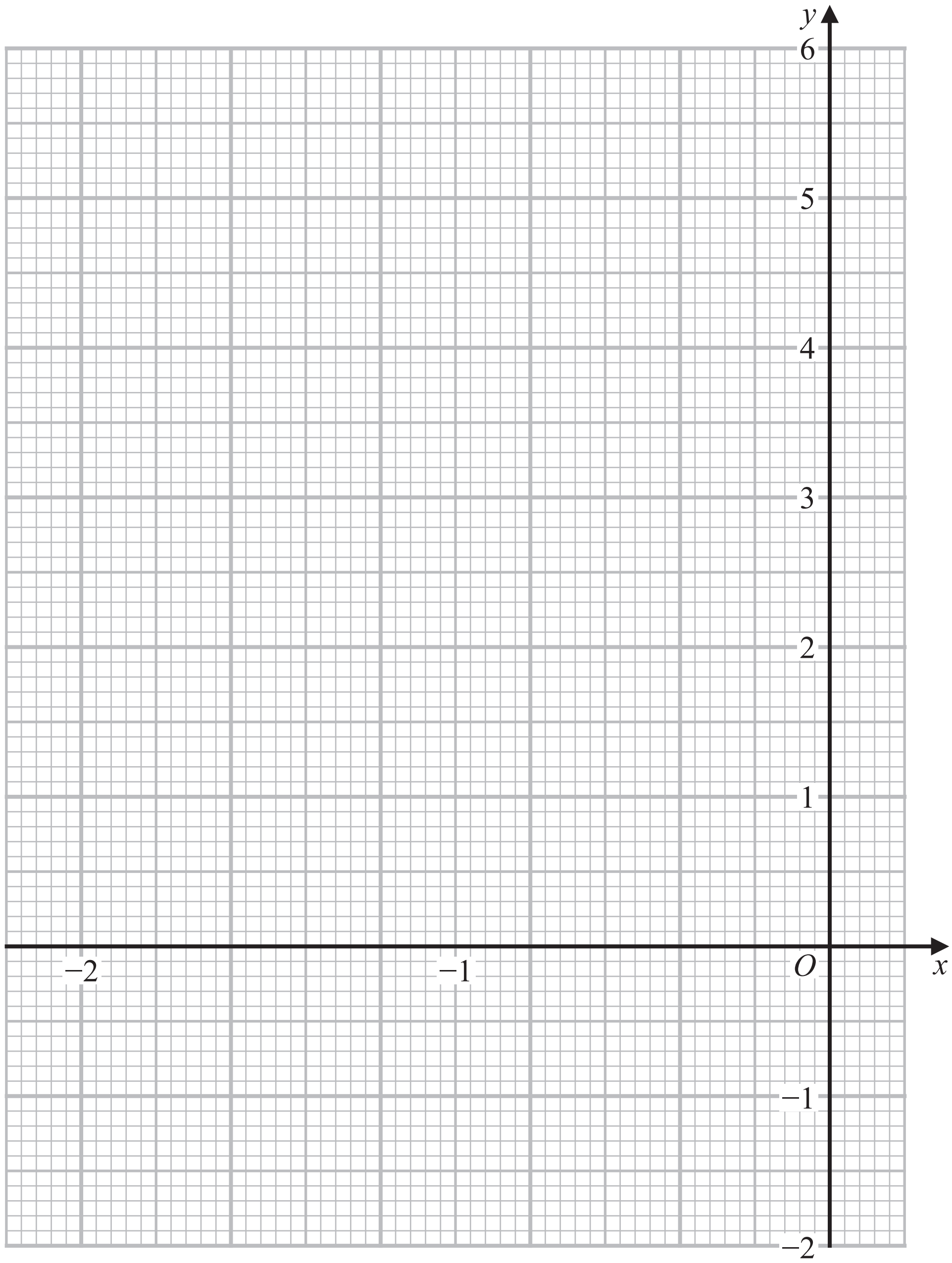
(3)

(c) Use your graph to find an estimate, to 2 decimal places, for the minimum value of

$-2x^3 + 6x + \dfrac{5}{x^2}$ for values of x in $-2 \leqslant x \leqslant -0.8$

(1)

Question 3 continued

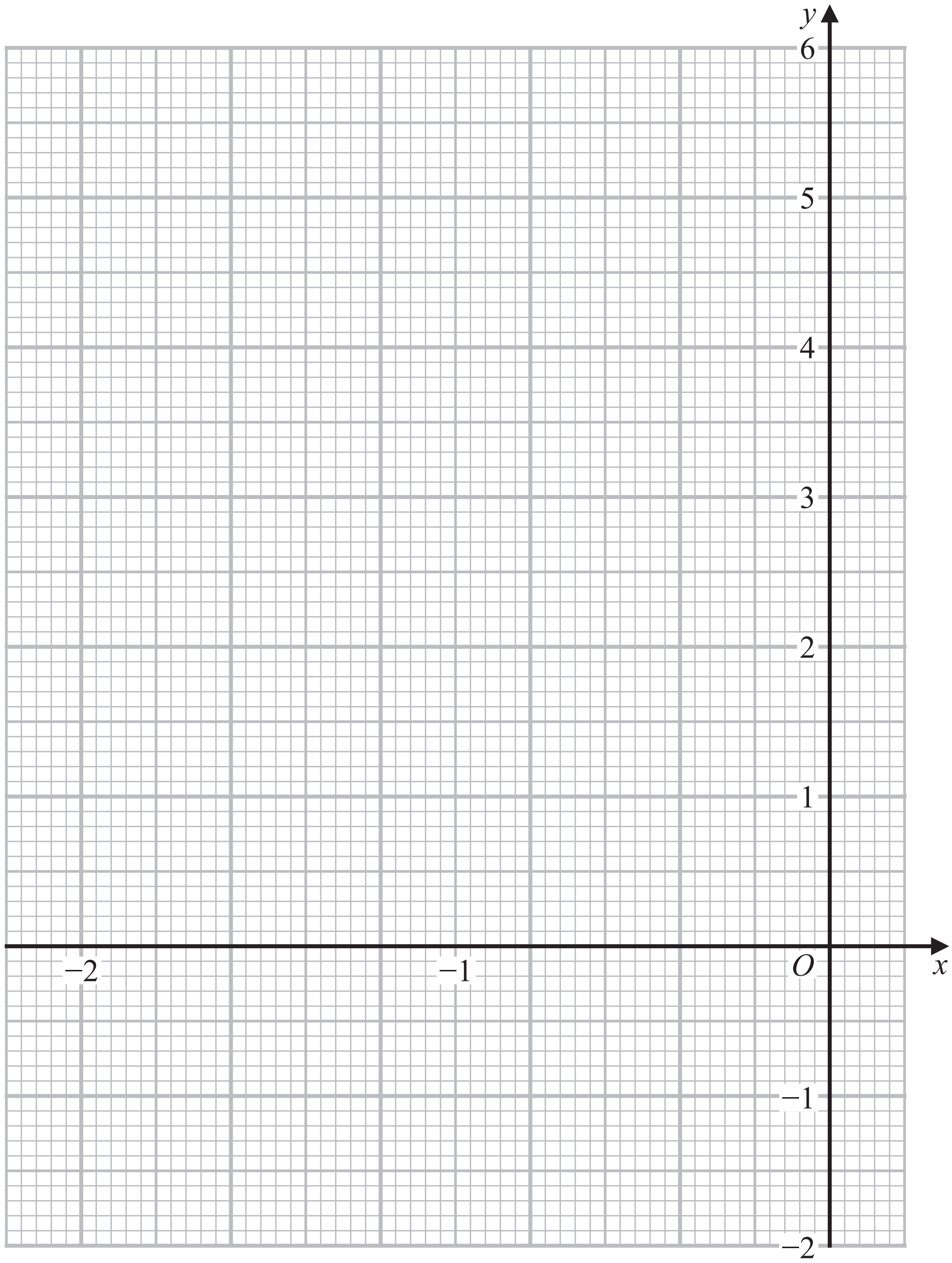


Turn over for a spare grid if you need to redraw your curve.

Question 3 continued

Question 3 continued

Only use this grid if you need to redraw your curve.



(Total for Question 3 is 6 marks)

4 Ramesh, Maya, Kalil, Chen and Andreia each have a bag containing an identical set of six cards.

There is a number on each of the six cards.
Here are the cards in each of the bags.

2	**4**	**4**	**7**	**9**	**10**

Ramesh takes at random **one** of the six cards in his bag.

(a) Write down the probability that the number on the card Ramesh takes is a prime number.

(1)

Maya takes at random from her bag **two** of the six cards in her bag.

(b) Find the probability that neither of the two cards has a number **4** on it.

(2)

Kalil takes at random from his bag **two** of the six cards in his bag.

(c) Find the probability that the total of the two numbers on the cards is 11

(2)

Chen takes at random **one** card at a time, without replacement, from her bag until she gets a card with a number **4** on it. She then stops taking cards from her bag.

(d) Find the probability that Chen stops taking cards from her bag before she takes the fourth card.

(2)

Andreia puts another card with a number on it into her bag so that she has seven cards in her bag.

The mean of the numbers on the seven cards in Andreia's bag is 8

(e) Find the value of the number on the card that Andreia put into her bag.

(2)

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Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 9 marks)

5

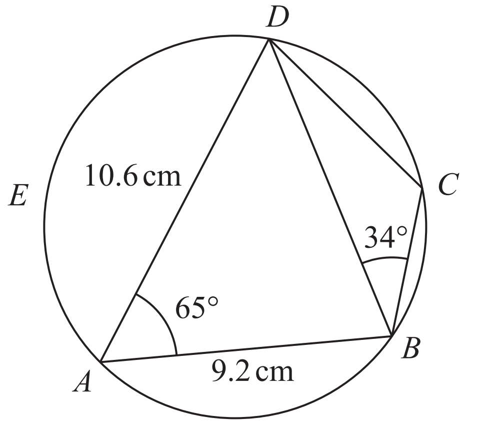

Diagram **NOT** accurately drawn

Figure 1

In Figure 1, *ABCDE* is a circle.

$AB = 9.2\,\text{cm}$ $\quad AD = 10.6\,\text{cm}$ $\quad \angle BAD = 65°$ $\quad \angle CBD = 34°$

(a) Calculate the length, in cm to 3 significant figures, of *BD*.

(2)

(b) Explain why $\angle BCD = 115°$

(1)

(c) Calculate the length, in cm to 3 significant figures, of *BC*.

(2)

The point *E* is such that ΔBDE is isosceles, with $DE = BE$.

(d) Calculate the area, in cm^2 to 3 significant figures, of the quadrilateral *BCDE*.

(4)

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Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Area of triangle $= \dfrac{1}{2}ab\sin C$

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 9 marks)

6 The two functions, f and g, are defined for all values of x as

$$\mathrm{f} : x \mapsto 3x + 1$$

$$\mathrm{g} : x \mapsto x^2 - 2$$

(a) Find (i) $\mathrm{g}(-3)$ (ii) $\mathrm{fg}(1)$

(2)

(b) Write down the range of g

(1)

(c) Express the composite function gf in the form $\mathrm{gf} : x \mapsto \ldots$

(1)

The function h is defined as

$$\mathrm{h} : x \mapsto \frac{2x - 1}{x + 3} \qquad \text{where } x \neq -3$$

(d) Solve the equation $\mathrm{h}(x) = 1$

(2)

(e) (i) Express the inverse function h^{-1} in the form $\mathrm{h}^{-1} : x \mapsto \ldots$

(ii) Write down the value of x that must be excluded from the domain of h^{-1}

(4)

(f) Find the exact values of p for which

$$4\mathrm{gf}(p) = \mathrm{fh}^{-1}(1)$$

Show your working clearly.

Give your values in the form $\dfrac{a \pm \sqrt{b}}{c}$ where a, b and c are integers.

(3)

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

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 13 marks)

7 The points with coordinates $(2, 2)$, $(5, 2)$ and $(4, -1)$ are the vertices of triangle A.

(a) On the grid, draw and label triangle A.

(1)

Triangle A is transformed to triangle B under the transformation with matrix **M** where

$$\mathbf{M} = \begin{pmatrix} 3 & \frac{1}{2} \\ -1 & -\frac{1}{2} \end{pmatrix}$$

(b) On the grid, draw and label triangle B.

(2)

Triangle B is transformed to triangle C under the transformation with matrix **N** where

$$\mathbf{N} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$$

(c) On the grid, draw and label triangle C.

(2)

Triangle B is the image of triangle C under the transformation with matrix **P**

(d) Find the matrix **P**

(2)

Triangle A is transformed to triangle C under the transformation with matrix **Q**

(e) Find the matrix **Q**

(2)

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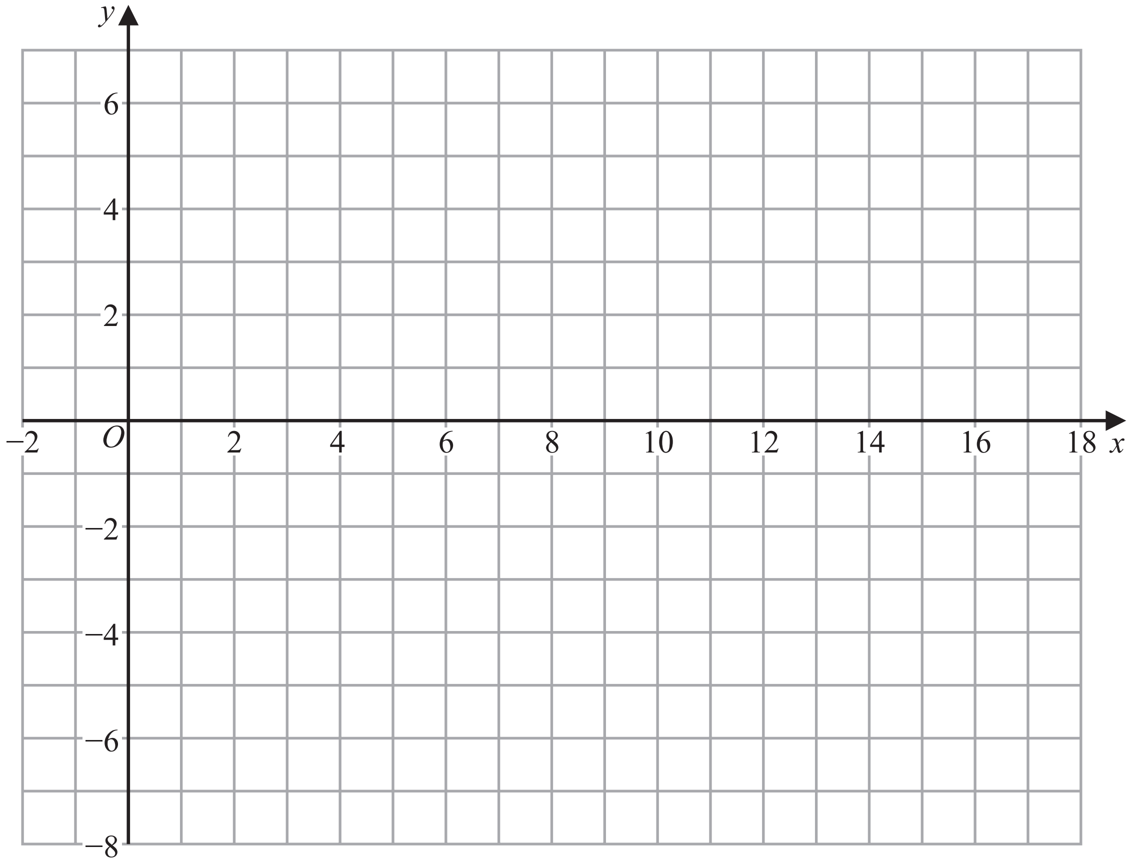
$$\left[\textbf{The inverse of matrix } \begin{pmatrix} a & b \\ c & d \end{pmatrix} \text{ is } \frac{1}{ad - bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}\right]$$

Question 7 continued



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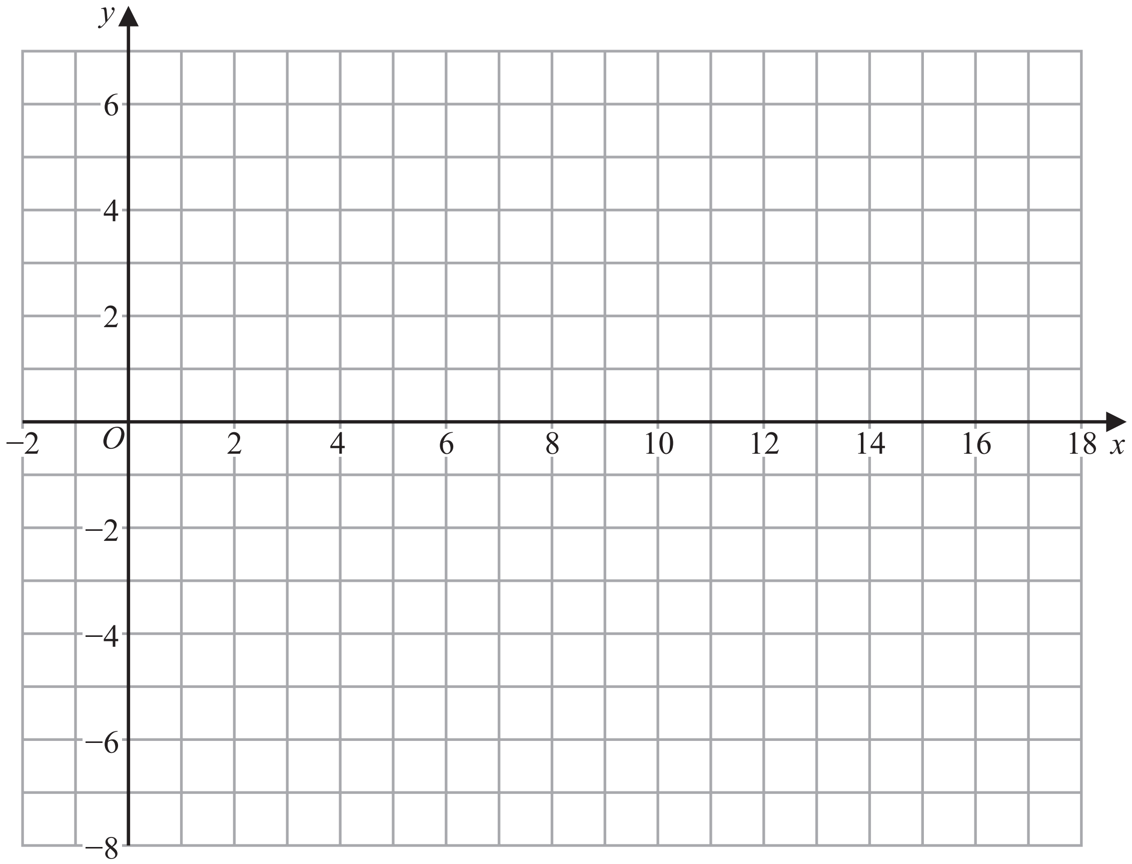
Question 7 continued

Question 7 continued

Only use this grid if you need to redraw your triangles.



(Total for Question 7 is 9 marks)

8

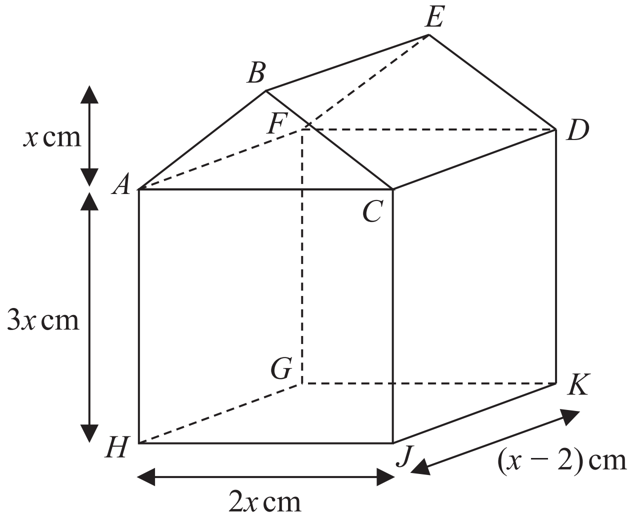


Figure 2

Figure 2 shows a solid right pentagonal prism *ABCDEFGHJK* which is made by fixing a solid right triangular prism *ABCDEF* onto a solid cuboid *ACDFGHJK*.

The triangle *ABC* is isosceles with $BA = BC$ and the height of the triangle is x cm.

$AH = FG = CJ = DK = 3x$ cm
$AC = HJ = FD = GK = 2x$ cm
$HG = JK = AF = CD = (x - 2)$ cm

The volume of the pentagonal prism is 1008 cm^3

(a) Show that $x^3 - 2x^2 - 144 = 0$

(4)

Given that $f(x) = x^3 - 2x^2 - 144$

(b) use the factor theorem to show that $(x - 6)$ is a factor of $f(x)$

(2)

(c) (i) Find the value of p, the value of q and the value of r so that

$$f(x) = (x - 6)(px^2 + qx + r)$$

(ii) Hence explain why the equation $f(x) = 0$ has only one solution.

(4)

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

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 10 marks)

9 The equation of a curve C is $y = x(2x - 3)(x + 2)$

The point P lies on C
The x coordinate of P is a

Find the range of values of a for which the gradient of C at P is at least -2
Show clear algebraic working.

(7)

Question 9 continued

(Total for Question 9 is 7 marks)

10

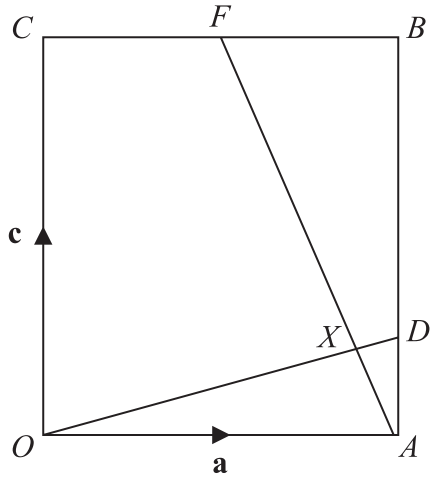


Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows a rectangle $OABC$ in which $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$

F is the midpoint of CB and D is the point on AB such that $AD:DB = 2:3$

(a) Find

(i) $\overrightarrow{CF}$ in terms of $\mathbf{a}$ (ii) $\overrightarrow{AD}$ in terms of $\mathbf{c}$

(2)

The lines OD and AF intersect at the point X

Given that $\overrightarrow{OX} = \lambda\overrightarrow{OD}$ and $\overrightarrow{AX} = \mu\overrightarrow{AF}$, where λ and μ are scalars,

(b) find the value of λ and the value of μ

(7)

Given that $OX:XD = n:1$

(c) find the value of n

(1)

Given also that $|\mathbf{a}| = 12\,\text{cm}$ and $|\mathbf{c}| = 12.5\,\text{cm}$,

(d) find the area, in cm^2, of quadrilateral $XDBF$

(4)

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P 6 6 3 1 1 A 0 3 4 4 0

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 14 marks)

11

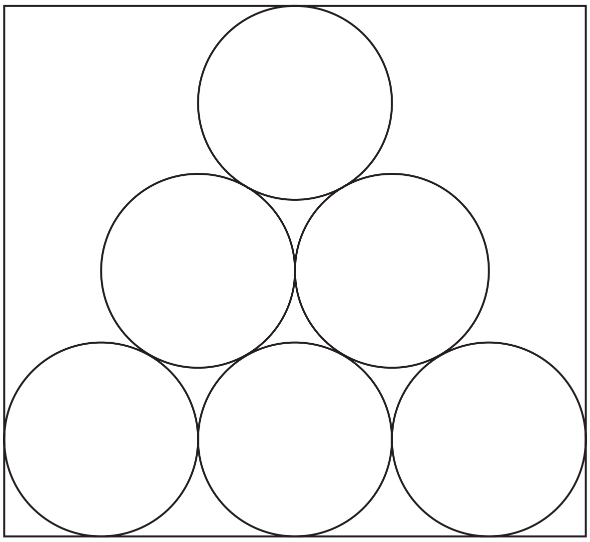

Diagram **NOT** accurately drawn

Figure 4

Figure 4 shows six identical circles inside a rectangle.
The radius of each circle is 12 cm.

The radius of the circles is the greatest possible radius so that the circles fit inside the rectangle.

The six circles form the pattern shown in Figure 4 so that

- each circle touches at least two other circles
- the circle in the top row of the pattern and the circles in the bottom row of the pattern touch at least one side of the rectangle
- the centres of the circles all lie on the perimeter of a single triangle

Show that the total area of the six circles is almost 57.5% of the area of the rectangle.

(6)

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Question 11 continued

Question 11 continued

(Total for Question 11 is 6 marks)

TOTAL FOR PAPER IS 100 MARKS