Please check the examination details below before entering your candidate information

Candidate surname StemUp Model Solution | Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 8 May 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WMA11/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Pure Mathematics P1

You must have:
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 10 questions in this question paper. The total mark for this paper is 75.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

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1. Given that

$$p = \frac{1}{16}x^4 \qquad q = \frac{40}{x^3}$$

express each of the following in the form kx^n where k and n are fully simplified constants.

(a) $p^{\frac{1}{2}}$

(1)

(b) $(pq)^{-1}$

(2)

(c) pq^2

(2)

(a) $p^{1/2} = \left(\frac{1}{16}x^4\right)^{1/2} = \frac{1}{4}x^2$

(b) $pq = \frac{1}{16}x^4 \times \frac{40}{x^3} = \frac{40}{16}x = \frac{5}{2}x$

$(pq)^{-1} = \left(\frac{5}{2}x\right)^{-1} = \frac{2}{5}x^{-1}$

(c) $q^2 = \frac{1600}{x^6} = 1600x^{-6}$

$pq^2 = \frac{1}{16}x^4 \times 1600x^{-6} = \frac{1600}{16}x^{-2}$

$pq^2 = 100x^{-2}$

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Question 1 continued

(Total for Question 1 is 5 marks)

2. The curve C has equation

$$y = 2x^{\frac{5}{2}} - 4x + 3$$

(a) Find $\dfrac{dy}{dx}$ writing your answer in simplest form.

(2)

The point P lies on C.

Given that

- the x coordinate of P is 2^k where k is a constant
- the gradient of C at the point P is 16

(b) find the value of k.

(3)

(a) $y = 2x^{5/2} - 4x + 3$ $\quad \frac{dy}{dx} = 2 \times \frac{5}{2} x^{3/2} - 4$

$\frac{dy}{dx} = 5x^{3/2} - 4$

(b) Gradient 16: $5x^{3/2} - 4 = 16$

$5x^{3/2} = 20 \Rightarrow x^{3/2} = 4$

$x = 4^{2/3} = (2^2)^{2/3} = 2^{4/3}$

x coordinate of P is $2^k \Rightarrow 2^k = 2^{4/3}$

$k = \frac{4}{3}$

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Question 2 continued

(Total for Question 2 is 5 marks)

3. Find

$$\int \frac{(x+3)^2}{3\sqrt{x}}\,dx$$

writing your answer in simplest form.

(5)

$\frac{(x+3)^2}{3\sqrt{x}} = \frac{x^2+6x+9}{3x^{1/2}} = \frac{1}{3}x^{3/2} + 2x^{1/2} + 3x^{-1/2}$

$\int \frac{(x+3)^2}{3\sqrt{x}}\,dx = \int \left(\frac{1}{3}x^{3/2} + 2x^{1/2} + 3x^{-1/2}\right) dx$

$= \frac{1}{3} \times \frac{x^{5/2}}{5/2} + 2 \times \frac{x^{3/2}}{3/2} + 3 \times \frac{x^{1/2}}{1/2} + c$

$= \frac{2}{15}x^{5/2} + \frac{4}{3}x^{3/2} + 6x^{1/2} + c$

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Question 3 continued

(Total for Question 3 is 5 marks)

4.

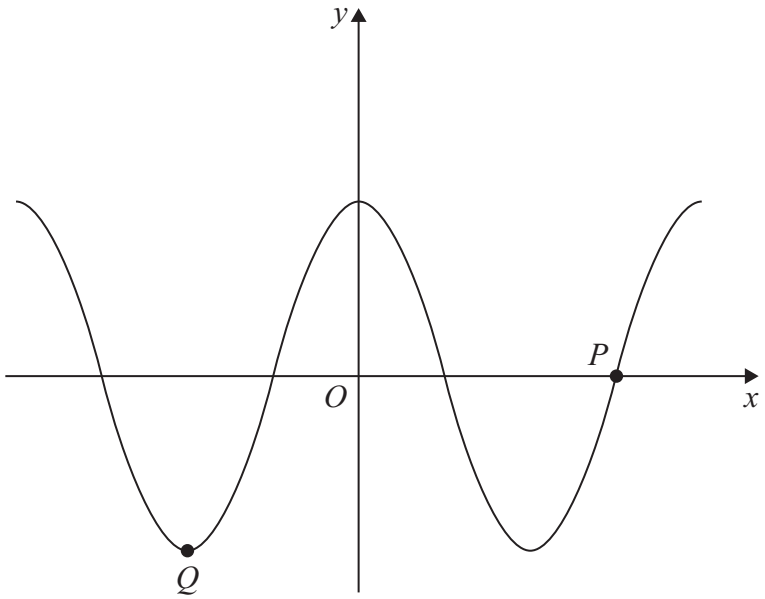


Figure 1

Figure 1 shows a sketch of part of the curve with equation

$$y = 4\cos x$$

where x is measured in degrees.

The points P and Q lie on the curve and are shown in Figure 1.

(a) State the coordinates of P.

(1)

(b) State the coordinates of Q.

(2)

(c) State the **number** of solutions of the equation

(i) $4\cos x = 3$ in the interval $0 < x \leqslant 18\,000°$

(ii) $5 + 4\cos x = 1$ in the interval $-720° < x \leqslant 720°$

(iii) $4\cos x - 3 = 1$ in the interval $-1080° \leqslant x \leqslant 1080°$

(3)

(a) P(270°, 0)

(b) Q(−180°, −4)

(c) (i) 100

(ii) 4

(iii) 7

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Question 4 continued

(Total for Question 4 is 6 marks)

5. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

The line l_1 has equation

$$x - 2y + 25 = 0$$

The line l_2 passes through the origin and is perpendicular to l_1

(a) Find an equation for l_2

(2)

The lines l_1 and l_2 intersect at the point P.

(b) Use algebra to find the coordinates of P.

(3)

(c) Hence find the shortest distance from l_1 to the origin.

Write your answer as a fully simplified surd.

(2)

(a) l_1: $2y = x + 25 \Rightarrow y = \frac{1}{2}x + \frac{25}{2}$, gradient $\frac{1}{2}$

l_2 perpendicular $\Rightarrow$ gradient of $l_2 = -1 \div \frac{1}{2} = -2$

l_2 passes through (0, 0): $y = -2x$

(b) Substitute $y = -2x$ into $x - 2y + 25 = 0$:

$x - 2(-2x) + 25 = 0 \Rightarrow 5x + 25 = 0$

$x = -5$, $y = -2 \times (-5) = 10$

$P(-5, 10)$

(c) Shortest distance = OP (OP is perpendicular to l_1)

$OP = \sqrt{((-5)^2 + 10^2)} = \sqrt{(25 + 100)} = \sqrt{125}$

$= 5\sqrt{5}$

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Question 5 continued

Question 5 continued

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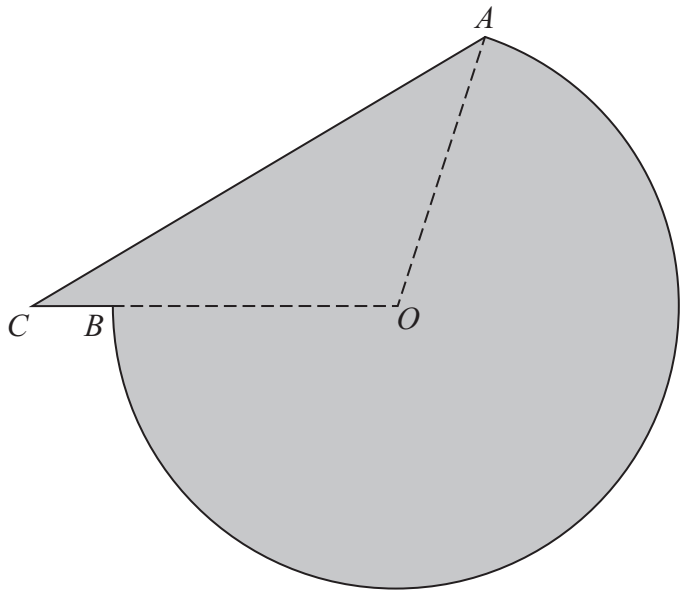
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Question 5 continued

(Total for Question 5 is 7 marks)

6.



Not to scale

Figure 2

The shaded area in Figure 2 shows the plan view of a helicopter landing pad.

The area consists of the major sector AOB of a circle centre O joined to a triangle AOC.

Given that

- $AO = OB = 15\,\text{m}$
- $BC = 2\,\text{m}$
- CBO is a straight line
- angle $ACO = 0.6$ radians

(a) show that angle COA is 1.847 radians to 3 decimal places.

(3)

(b) Find the total area of the helicopter landing pad.
Give your answer in m^2 to 3 significant figures.

(3)

(c) Find the perimeter of the helicopter landing pad.
Give your answer in metres to 3 significant figures.

(3)

(a) Triangle AOC: OA = 15, OC = 15 + 2 = 17, angle ACO = 0.6

$\frac{\sin CAO}{17} = \frac{\sin 0.6}{15} \Rightarrow \sin CAO = \frac{17 \sin 0.6}{15} = 0.639928...$

CAO = 0.694404... (acute, since angle COA is obtuse)

COA = π − 0.6 − 0.694404... = 1.847187...

COA = 1.847 radians (3 d.p.) as required

(b) Reflex angle AOB = 2π − 1.847 = 4.436185...

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Question 6 continued

Major sector $AOB = \frac{1}{2} r^2\theta = \frac{1}{2} \times 15^2 \times 4.436185... = 499.0708...$

Triangle $AOC = \frac{1}{2} ab \sin C = \frac{1}{2} \times 15 \times 17 \times \sin 1.847 = 122.6674...$

Total area $= 499.0708... + 122.6674... = 621.738...$

Area $= 622\ m^2$ (3 s.f.)

(c) Major arc $AB = r\theta = 15 \times 4.436185... = 66.5427...$

$AC^2 = 15^2 + 17^2 - 2 \times 15 \times 17 \times \cos 1.847$

$AC^2 = 653.0796... \Rightarrow AC = 25.5554...$

Perimeter = arc $AB + BC + CA$

$= 66.5427... + 2 + 25.5554... = 94.0982...$

Perimeter $= 94.1\ m$ (3 s.f.)

Question 6 continued

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Question 6 continued

(Total for Question 6 is 9 marks)

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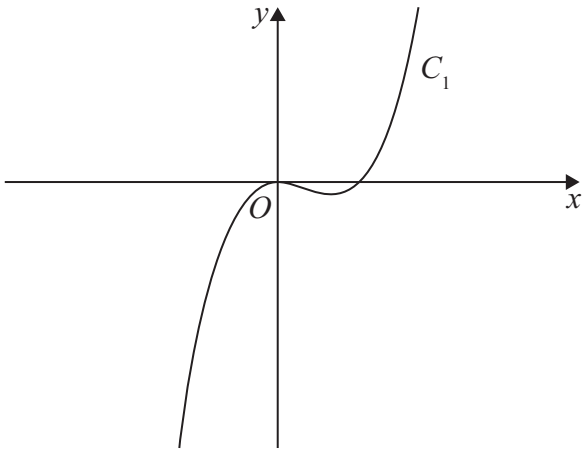


Figure 3

Figure 3 shows a sketch of part of the curve C_1

Given that C_1

- has equation $y = f(x)$ where $f(x)$ is a cubic function
- touches the x-axis at the origin and cuts the x-axis at $x = 4$
- passes through the point $(10, 120)$

(a) find $f(x)$

(3)

The curve C_2 has equation $y = 1.2x(8 - x)$

On the following page there is a copy of Figure 3 called Diagram 1.

(b) On Diagram 1 sketch a graph of the curve C_2

(2)

(c) Use algebra to find the coordinates of the points where C_1 and C_2 intersect. Show each stage of your working.

(5)

(a) Touches at O and cuts at $x = 4 \Rightarrow f(x) = \lambda x^2(x - 4)$

$(10, 120)$: $120 = \lambda \times 10^2 \times (10 - 4) = 600\lambda$

$\lambda = \frac{120}{600} = 0.2$

$f(x) = 0.2x^2(x - 4)$ $\quad (= 0.2x^3 - 0.8x^2)$

(b) Sketch of C_2 drawn on Diagram 1 below.

(c) $1.2x(8 - x) = 0.2x^2(x - 4)$

$\times 5$: $6x(8 - x) = x^2(x - 4)$

$48x - 6x^2 = x^3 - 4x^2$

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Question 7 continued

$x^3 + 2x^2 - 48x = 0$

$x(x^2 + 2x - 48) = 0$

$x(x + 8)(x - 6) = 0 \quad \Rightarrow \quad x = 0, \; x = -8, \; x = 6$

$x = 0$: $\quad y = 1.2 \times 0 \times 8 = 0$

$x = -8$: $\quad y = 1.2 \times (-8) \times 16 = -153.6$

$x = 6$: $\quad y = 1.2 \times 6 \times 2 = 14.4$

Points of intersection: $(0, 0)$, $(-8, -153.6)$, $(6, 14.4)$

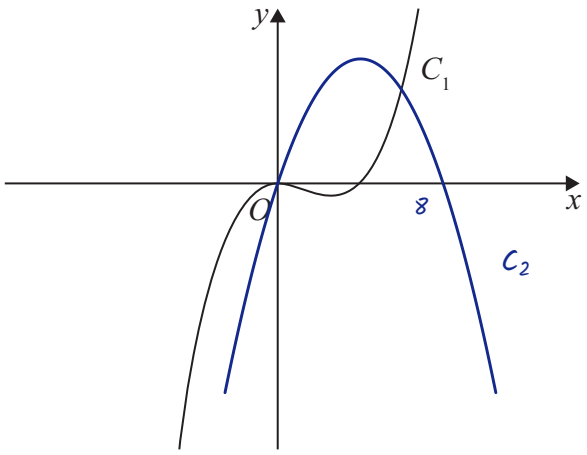


Diagram 1

Question 7 continued

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Question 7 continued

(Total for Question 7 is 10 marks)

8. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

A curve has equation $y = f(x),\ x > 0$

The point $P(4, 12)$ lies on the curve.

Given that

- $f'(x) = 3\sqrt{x} + kx^2$ where k is a constant
- the equation of the tangent to the curve at P has equation $y = 10x + c$ where c is a constant

(a) (i) show that $k = \frac{1}{4}$

(ii) find the value of c

(4)

(b) Hence find the value of $f''(x)$ at P.

(3)

(c) Find $f(x)$.

(4)

(a)(i) Tangent at P has gradient 10 $\Rightarrow$ $f'(4) = 10$

$3\sqrt{4} + k \times 4^2 = 10$

$3 \times 2 + 16k = 10 \Rightarrow 16k = 4$

$k = \frac{4}{16} = \frac{1}{4}$ as required

(ii) $P(4, 12)$ on $y = 10x + c$: $12 = 10 \times 4 + c$

$c = -28$

(b) $f'(x) = 3x^{1/2} + \frac{1}{4}x^2$

$f''(x) = \frac{3}{2}x^{-1/2} + \frac{1}{2}x$

$f''(4) = \frac{3}{2} \times \frac{1}{\sqrt{4}} + \frac{1}{2} \times 4 = \frac{3}{4} + 2$

$f''(4) = \frac{11}{4}$

(c) $f(x) = \int \left(3x^{1/2} + \frac{1}{4}x^2 \right) dx = 3 \times \frac{x^{3/2}}{3/2} + \frac{1}{4} \times \frac{x^3}{3} + d$

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Question 8 continued

$f(x) = 2x^{3/2} + \frac{1}{12}x^3 + d$

$P(4, 12)$: $12 = 2 \times 4^{3/2} + \frac{1}{12} \times 4^3 + d = 16 + \frac{16}{3} + d$

$d = 12 - 16 - \frac{16}{3} = -\frac{28}{3}$

$f(x) = 2x^{3/2} + \frac{1}{12}x^3 - \frac{28}{3}$

Question 8 continued

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Question 8 continued

(Total for Question 8 is 11 marks)

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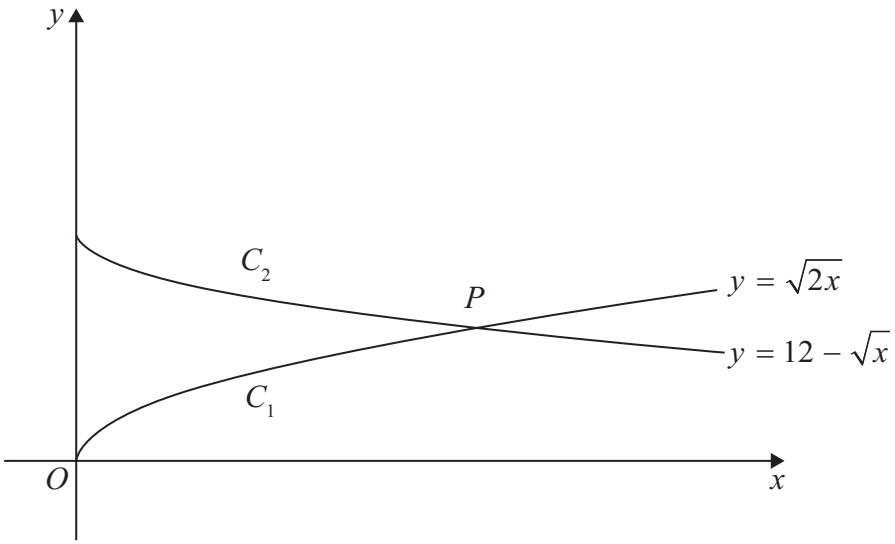


Figure 4

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

Figure 4 shows a sketch of

- the graph C_1 with equation $y = \sqrt{2x}$
- the graph C_2 with equation $y = 12 - \sqrt{x}$

(a) Describe fully the single transformation that would transform

(i) the graph with equation $y = \sqrt{x}$ onto C_1

(ii) the graph with equation $y = -\sqrt{x}$ onto C_2

(4)

The graphs C_1 and C_2 meet at the point P, as shown in Figure 4.

(b) (i) Show that the x coordinate of P is a solution of

$$\sqrt{x} = 12\left(\sqrt{2} - 1\right)$$

(ii) Hence find, in simplest form, the exact coordinates of P.

(6)

(a)(i) Stretch parallel to the x-axis, scale factor $\frac{1}{2}$

(equivalently: stretch parallel to the y-axis, scale factor $\sqrt{2}$)

(ii) Translation by the vector $\begin{pmatrix} 0 \\ 12 \end{pmatrix}$ (12 units up, parallel to the y-axis)

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Question 9 continued

(b)(i) At P: $\sqrt{(2x)} = 12 - \sqrt{x}$

$\sqrt{2}\sqrt{x} + \sqrt{x} = 12$

$(\sqrt{2} + 1)\sqrt{x} = 12$

$\sqrt{x} = \frac{12}{\sqrt{2}+1} \times \frac{\sqrt{2}-1}{\sqrt{2}-1} = \frac{12(\sqrt{2}-1)}{2-1}$

$\sqrt{x} = 12(\sqrt{2} - 1)$ as required

(ii) $x = 12^2(\sqrt{2} - 1)^2 = 144(2 - 2\sqrt{2} + 1)$

$x = 144(3 - 2\sqrt{2}) = 432 - 288\sqrt{2}$

$y = 12 - \sqrt{x} = 12 - 12(\sqrt{2} - 1) = 24 - 12\sqrt{2}$

$P(432 - 288\sqrt{2},\ 24 - 12\sqrt{2})$

Question 9 continued

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Question 9 continued

(Total for Question 9 is 10 marks)

10. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

$(k-1)x^6 + 4x^3 + (k-4) = 0$ where k is a constant

(a) Find the exact solutions to the given equation for $k = 4.5$

(3)

(b) Find the set of possible values of k for which the given equation has no real roots.

(4)

(a) $k = 4.5$: $3.5x^6 + 4x^3 + 0.5 = 0$

$\times 2$: $7x^6 + 8x^3 + 1 = 0$

$(7x^3 + 1)(x^3 + 1) = 0$

$x^3 = -\frac{1}{7}$ or $x^3 = -1$

$x = -\frac{1}{\sqrt[3]{7}}$ or $x = -1$

(b) Quadratic in x^3: $a = k - 1$, $b = 4$, $c = k - 4$

No real roots $\Rightarrow b^2 - 4ac < 0$

$b^2 - 4ac = 16 - 4(k-1)(k-4)$

$= 16 - 4(k^2 - 5k + 4) = 20k - 4k^2$

$20k - 4k^2 < 0 \Rightarrow 4k(5-k) < 0$

critical values $k = 0$, $k = 5$; negative k^2 coefficient, so outside region

$k < 0$ or $k > 5$

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Question 10 continued

Question 10 continued

(Total for Question 10 is 7 marks)

TOTAL FOR PAPER IS 75 MARKS

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