Pearson Edexcel International Advanced Level

Wednesday 15 October 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WMA12/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Pure Mathematics P2
Question paper

You must have:
Answer book (sent separately).
Do not return this question paper with the answer book.

Turn over ▶

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

A sequence u_1, u_2, u_3, is defined by

$$u_1 = 1$$

$$u_{n+1} = k - \frac{8}{u_n} \qquad n \geqslant 1$$

where k is a constant.

(a) Write down expressions for u_2 and u_3 in terms of k.

(2)

Given that $u_3 = 6$

(b) find the possible values of k.

(3)

(Total for Question 1 is 5 marks)

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2. Find the first 3 terms in ascending powers of x of

$$\left(2 - \frac{x}{2}\right)^6$$

giving each term in its simplest form.

(4)

(Total for Question 2 is 4 marks)

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3.

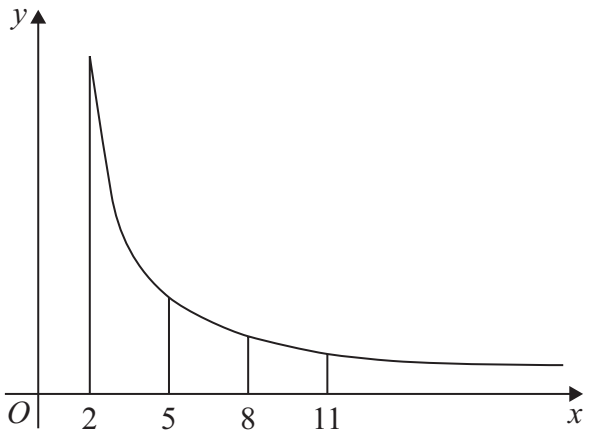


Figure 1

Figure 1 shows a sketch of part of the graph of $y = \dfrac{12}{\sqrt{x^2 - 2}} \quad x \geqslant 2$

The table below gives values of y rounded to 3 decimal places.

x	2	5	8	11
y	8.485	2.502	1.524	1.100

(a) Use the trapezium rule with all the values of y from the table to find an approximate value, to 2 decimal places, for

$$\int_2^{11} \frac{12}{\sqrt{x^2 - 2}} \, dx$$

(3)

(b) Use your answer to part (a) to estimate a value for

$$\int_2^{11} \left(1 + \frac{6}{\sqrt{x^2 - 2}} \right) dx$$

(3)

(Total for Question 3 is 6 marks)

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

$$f(x) = 13 + 3x + (x + 2)(x + k)^2 \qquad \text{where } k \text{ is a constant}$$

Given that $(x + 3)$ is a factor of $f(x)$,

(a) (i) show that a possible value of k is 5

(ii) find the other possible value of k.

(3)

Given that $k = 5$

(b) (i) write $f(x)$ as the product of two algebraic factors

(ii) show that the equation $f(x) = 0$ has only one real solution.

(6)

(Total for Question 4 is 9 marks)

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

(i) Given that

$$\log_a x + \log_a 3 = \log_a 27 - 1 \qquad \text{where } a \text{ is a positive constant}$$

find, in its simplest form, an expression for x in terms of a.

(4)

(ii) Solve the equation

$$(\log_5 y)^2 - 7(\log_5 y) + 12 = 0$$

showing each step of your working.

(4)

(Total for Question 5 is 8 marks)

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6. A circle C has equation $x^2 + y^2 - 6x - 14y + k = 0$ where k is constant.

(a) Find the coordinates of the centre of C.

(2)

(b) Find the radius of C when $k = -32$

(2)

(c) Find the range of values of k for which C lies completely within the first quadrant.

(4)

(Total for Question 6 is 8 marks)

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

(i) Solve, for $0 \leqslant \theta < 180°$, the equation

$$7\sin 2\theta = 5\cos 2\theta$$

giving your answers, in degrees, to one decimal place.

(4)

(ii) Solve, for $0 \leqslant x < 2\pi$, the equation

$$24\tan x = 5\cos x$$

giving your answers, in radians, to 3 decimal places.

(5)

(Total for Question 7 is 9 marks)

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8. A curve has equation $y = (x + 2)^2(4 - x)$

The finite region R is bounded by the curve and the x-axis.

(a) Using algebraic integration and showing each step of your working, find the exact area of R.

(5)

(b) Using the answer to part (a) and explaining your reasoning, find the area of the finite region bounded by the curve with equation $y = (3x + 6)^2\left(2 - \frac{1}{2}x\right)$ and the x-axis.

(2)

(Total for Question 8 is 7 marks)

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

(i) A car has five gears. Given that

- the maximum speed of the car in first gear is $22\,\text{km}\,\text{h}^{-1}$
- the maximum speed in each successive gear forms a geometric sequence
- the maximum speed of the car in fifth gear is $130\,\text{km}\,\text{h}^{-1}$

find the maximum speed of the car in second gear, giving your answer, in $\text{km}\,\text{h}^{-1}$, to one decimal place.

(4)

(ii) The first two terms of an arithmetic sequence are 208 and 207.2

Given that S_n is the sum to n terms,

(a) find the maximum value of S_n

(4)

(b) Hence or otherwise state the smallest value of N such that $S_N < 0$

(1)

(Total for Question 9 is 9 marks)

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

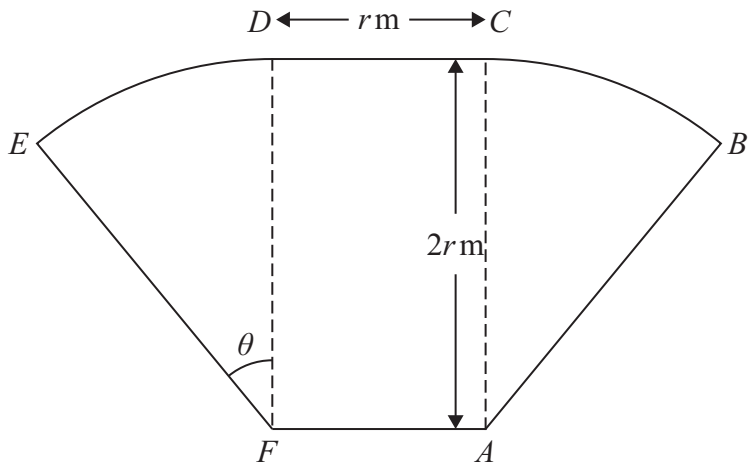


Figure 2

Figure 2 shows the plan view of the design for a stage at a trade fair.

The shape of the stage *ABCDEFA*, consists of a rectangle *ACDF* joined to two congruent sectors of circles. *ABC* is a sector of a circle centre *A* and *FDE* is a sector of a circle centre *F*.

Given that $AC = 2r$ metres, $CD = r$ metres, angle $DFE = \theta$ radians and the area of the stage is $30\,\text{m}^2$,

(a) show that the perimeter, *P* metres, of the stage, is given by

$$P = 4r + \frac{30}{r}$$

(4)

(b) Use calculus to find the minimum value for *P*, giving your answer in the form $a\sqrt{b}$, where *a* and *b* are integers to be found.

(4)

(c) Justify that the value of *P* found in part (b) is the minimum.

(2)

(Total for Question 10 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS

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Candidate surname StemUp Model Solution | Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 15 October 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WMA12/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Pure Mathematics P2
Answer Book

You must have: Question paper (sent separately), 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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Question 1

Write the answer to Question 1 on these 2 pages

(a) $u_2 = k - \frac{8}{u_1} = k - \frac{8}{1} = k - 8$

$u_3 = k - \frac{8}{u_2} = k - \frac{8}{k-8}$

(b) $k - \frac{8}{k-8} = 6$

$k(k-8) - 8 = 6(k-8)$

$k^2 - 8k - 8 = 6k - 48$

$k^2 - 14k + 40 = 0$

$(k-4)(k-10) = 0$

$k = 4$ or $k = 10$

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Question 1 continued

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(Total for Question 1 is 5 marks)

Question 2

Write the answer to Question 2 on these 2 pages

$$\left(2 - \frac{x}{2}\right)^6 = 2^6 + {}^6C_1 \times 2^5 \times \left(-\frac{x}{2}\right) + {}^6C_2 \times 2^4 \times \left(-\frac{x}{2}\right)^2 + \ldots$$

$$= 64 + 6 \times 32 \times \left(-\frac{x}{2}\right) + 15 \times 16 \times \frac{x^2}{4} + \ldots$$

$$= 64 - 96x + 60x^2 + \ldots$$

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Question 2 continued

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(Total for Question 2 is 4 marks)

Question 3

Write the answer to Question 3 on these 2 pages

(a) $h = 3$

$$\int_2^{11} \frac{12}{\sqrt{(x^2 - 2)}}\,dx \approx \frac{1}{2} \times 3 \times \left[8.485 + 1.100 + 2(2.502 + 1.524)\right]$$

$$= \frac{3}{2} \times \left[9.585 + 8.052\right] = \frac{3}{2} \times 17.637$$

$$= 26.4555 \approx 26.46$$

(b) $$\int_2^{11} \left(1 + \frac{6}{\sqrt{(x^2 - 2)}}\right)dx = \int_2^{11} 1\,dx + \frac{1}{2}\int_2^{11} \frac{12}{\sqrt{(x^2 - 2)}}\,dx$$

$$= \left[x\right]_2^{11} + \frac{1}{2} \times 26.46$$

$$= (11 - 2) + 13.23 = 9 + 13.23$$

$$\approx 22.23$$

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Question 3 continued

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(Total for Question 3 is 6 marks)

Question 4

Write the answer to Question 4 on these 2 pages

(a)(i) $f(-3) = 13 + 3(-3) + (-3 + 2)(-3 + k)^2 = 4 - (k - 3)^2$

When $k = 5$: $f(-3) = 4 - (5 - 3)^2 = 4 - 4 = 0$

so $(x + 3)$ is a factor and $k = 5$ is a possible value

(a)(ii) $f(-3) = 0 \Rightarrow (k - 3)^2 = 4 \Rightarrow k - 3 = \pm 2$

$k = 5$ or $k = 1$, so the other value is $k = 1$

(b)(i) $f(x) = 13 + 3x + (x + 2)(x + 5)^2$

$= 13 + 3x + (x + 2)(x^2 + 10x + 25)$

$= 13 + 3x + x^3 + 10x^2 + 25x + 2x^2 + 20x + 50$

$= x^3 + 12x^2 + 48x + 63$

Divide by $(x + 3)$:

$x^2(x + 3) = x^3 + 3x^2$, leaves $9x^2 + 48x + 63$

$9x(x + 3) = 9x^2 + 27x$, leaves $21x + 63 = 21(x + 3)$

$f(x) = (x + 3)(x^2 + 9x + 21)$

(b)(ii) $f(x) = 0 \Rightarrow x + 3 = 0$ or $x^2 + 9x + 21 = 0$

For $x^2 + 9x + 21$: $b^2 - 4ac = 9^2 - 4 \times 1 \times 21 = 81 - 84 = -3$

$-3 < 0$, so $x^2 + 9x + 21 = 0$ has no real roots

So $x = -3$ is the only real solution of $f(x) = 0$

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Question 4 continued

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(Total for Question 4 is 9 marks)

Question 5

Write the answer to Question 5 on these 2 pages

(i) $\log_a x + \log_a 3 = \log_a 27 - \log_a a$

$\log_a 3x = \log_a \frac{27}{a}$

$3x = \frac{27}{a}$

$x = \frac{9}{a}$

(ii) Let $p = \log_5 y$: $p^2 - 7p + 12 = 0$

$(p - 3)(p - 4) = 0 \Rightarrow p = 3$ or $p = 4$

$\log_5 y = 3 \Rightarrow y = 5^3 = 125$

$\log_5 y = 4 \Rightarrow y = 5^4 = 625$

$y = 125$ or $y = 625$

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Question 5 continued

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(Total for Question 5 is 8 marks)

Question 6

Write the answer to Question 6 on these 2 pages

(a) $x^2 - 6x + y^2 - 14y + k = 0$

$(x - 3)^2 - 9 + (y - 7)^2 - 49 + k = 0$

Centre $(3, 7)$

(b) $(x - 3)^2 + (y - 7)^2 = 58 - k = 58 + 32 = 90$

$r = \sqrt{90} = 3\sqrt{10}$

(c) $r^2 = 9 + 49 - k = 58 - k$

Centre $(3, 7)$ is 3 from the y-axis and 7 from the x-axis,

so C lies in the first quadrant when $0 < r < 3$

$r < 3$: $58 - k < 9 \Rightarrow k > 49$

$r > 0$: $58 - k > 0 \Rightarrow k < 58$

$49 < k < 58$

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Question 6 continued

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(Total for Question 6 is 8 marks)

Question 7

Write the answer to Question 7 on these 2 pages

(i) $7 \sin 2\theta = 5 \cos 2\theta \Rightarrow \tan 2\theta = \frac{5}{7}$

$0 \leqslant 2\theta < 360°$: $2\theta = \tan^{-1}\left(\frac{5}{7}\right) = 35.537...°$, $180 + 35.537... = 215.537...°$

$\theta = 17.768...°$, $107.768...°$

$\theta = 17.8°$, $107.8°$

(ii) $24 \frac{\sin x}{\cos x} = 5 \cos x \Rightarrow 24 \sin x = 5 \cos^2 x$

$24 \sin x = 5(1 - \sin^2 x)$

$5 \sin^2 x + 24 \sin x - 5 = 0$

$(5 \sin x - 1)(\sin x + 5) = 0$

$\sin x = \frac{1}{5}$ ($\sin x = -5$ has no solutions)

$x = \sin^{-1}(0.2) = 0.20135...$, $x = \pi - 0.20135... = 2.94023...$

$x = 0.201$, 2.940

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Question 7 continued

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(Total for Question 7 is 9 marks)

Question 8

Write the answer to Question 8 on these 2 pages

(a) $y = (x^2 + 4x + 4)(4 - x) = 4x^2 + 16x + 16 - x^3 - 4x^2 - 4x$

$y = 16 + 12x - x^3$

Curve meets the x-axis at $x = -2$ and $x = 4$

$$\text{Area} = \int_{-2}^{4} \left(16 + 12x - x^3\right) dx = \left[16x + 6x^2 - \frac{1}{4}x^4\right]_{-2}^{4}$$

$= (64 + 96 - 64) - (-32 + 24 - 4)$

$= 96 - (-12)$

Area of $R = 108$

(b) $y = (3x + 6)^2\left(2 - \frac{1}{2}x\right) = 3^2(x + 2)^2 \times \frac{1}{2}(4 - x)$

$= \frac{9}{2}(x + 2)^2(4 - x)$

This is the original curve stretched by scale factor $\frac{9}{2}$ parallel to the y-axis, with the same roots $x = -2$ and $x = 4$, so the area is 4.5 times bigger

Area $= 4.5 \times 108 = 486$

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Question 8 continued

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(Total for Question 8 is 7 marks)

Question 9

Write the answer to Question 9 on these 4 pages

(i) $a = 22, \quad ar^4 = 130$

$r^4 = \frac{130}{22} = \frac{65}{11}$

$r = \left(\frac{65}{11}\right)^{1/4} = 1.5591\ldots$

Second gear: $ar = 22 \times 1.5591\ldots = 34.300\ldots$

Maximum speed in second gear = 34.3 km h^{-1}

(ii)(a) $a = 208, \quad d = 207.2 - 208 = -0.8$

S_n is a maximum when the terms stop being positive:

$u_n = 208 + (n-1)(-0.8) = 0 \quad \Rightarrow \quad n - 1 = 260 \quad \Rightarrow \quad n = 261$

($u_{261} = 0$, so $S_{260} = S_{261}$ is the maximum)

$S_{261} = \frac{261}{2}\left[2(208) + 260(-0.8)\right] = \frac{261}{2} \times 208$

Maximum $S_n = 27144$

(ii)(b) $S_N = \frac{N}{2}\left[416 - 0.8(N-1)\right] = \frac{N}{2}(416.8 - 0.8N)$

$S_N = 0$ when $N = \frac{416.8}{0.8} = 521$, so $S_N < 0$ for $N > 521$

$N = 522$

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Question 9 continued

Question 9 continued

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Question 9 continued

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(Total for Question 9 is 9 marks)

Question 10

Write the answer to Question 10 on these 3 pages

(a) Area = rectangle + 2 sectors $= 2r \times r + 2 \times \frac{1}{2}(2r)^2\theta$

$30 = 2r^2 + 2r^2\theta + 2r^2\theta = 2r^2 + 4r^2\theta$

$4r^2\theta = 30 - 2r^2 \Rightarrow 4r\theta = \frac{30 - 2r^2}{r}$

$P = AB + \text{arc } BC + CD + \text{arc } DE + EF + FA$

$P = 2r + 2r\theta + r + 2r\theta + 2r + r = 6r + 4r\theta$

$P = 6r + \frac{30 - 2r^2}{r} = 6r + \frac{30}{r} - 2r$

$P = 4r + \frac{30}{r}$ as required

(b) $P = 4r + 30r^{-1} \Rightarrow \frac{dP}{dr} = 4 - 30r^{-2} = 4 - \frac{30}{r^2}$

$\frac{dP}{dr} = 0 \Rightarrow r^2 = \frac{30}{4} = \frac{15}{2} \Rightarrow r = \sqrt{\frac{15}{2}}$

$P = 4\sqrt{\frac{15}{2}} + 30 \times \frac{\sqrt{2}}{\sqrt{15}} = \frac{4\sqrt{15}}{\sqrt{2}} + \frac{30\sqrt{2}}{\sqrt{15}}$

$= 2\sqrt{30} + 2\sqrt{30}$

Minimum $P = 4\sqrt{30}$

(c) $\frac{d^2P}{dr^2} = 60r^{-3} = \frac{60}{r^3}$

At $r = \sqrt{\frac{15}{2}} = 2.738\ldots$: $\frac{d^2P}{dr^2} = \frac{60}{(2.738\ldots)^3} = 2.92\ldots > 0$

so the value of P found in (b) is a minimum

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Question 10 continued

Question 10 continued

(Total for Question 10 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS

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