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Pearson Edexcel IAL Pure Mathematics 1 (WMA11/01), October 2022

One real student's handwritten script, 28 pages. Name and candidate details removed.

Marked against Pearson's official mark scheme with the same instructions given to all eight examiners.

Whole paper: 47/75

By question

Question 1	3 / 6 (page 2)
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How to read it: every part has its mark, the examiner's reason, and for lost marks the concept to fix.

This is sample marking for practice and mocks, not official Pearson marking.

In normal use, the student's teacher approves every mark before it is released.

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Please check the examination details below before entering your candidate information

Candidate details removed

Pearson Edexcel International Advanced Level

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 9 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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B:1/1/1/1/

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Sample script · whole paper 47/75

Cover page. Marking starts on page 2.

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1. The curve C has equation

$$y = \frac{x^3}{4} - x^2 + \frac{17}{x} \qquad x > 0$$

(a) Find $\frac{dy}{dx}$, giving your answer in simplest form.

(3)

The point $R\left(2, \frac{13}{2}\right)$ lies on C.

(b) Find the equation of the tangent to C at the point R. Write your answer in the form $ax + by + c = 0$, where a, b and c are integers to be found.

(3)

a) $\frac{3x^2}{4} - 2x - \frac{17}{x^2}$

b) $m = \frac{2^3}{4} - 2^2 + \frac{17}{2} = \frac{13}{2}$

$y - y_1 = m(x - x_1)$

$y - \frac{13}{2} = \frac{13}{2}(x - 2)$

$y - \frac{13}{2} = \frac{13}{2}x - 13$

$y = \frac{13}{2}x - \frac{13}{2}$

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Sample script · whole paper 47/75

Question 1 3/6

1(a) 3/3

Correct derivative in simplest form: power reduced on each term (M1), two terms correct (A1), all three terms correct (A1).

1(b) 0/3

The gradient was found by substituting x=2 into y, not into dy/dx, so the M1 is lost. The line therefore uses the wrong gradient, so dM1 and A1 are also lost.

Fix: tangent gradient must come from dy/dx, not y

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Question 1 continued

(Total for Question 1 is 6 marks)

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Question 1 (continued) 3/6

1(a) 3/3

Correct derivative in simplest form: power reduced on each term (M1), two terms correct (A1), all three terms correct (A1).

1(b) 0/3

The gradient was found by substituting x=2 into y, not into dy/dx, so the M1 is lost. The line therefore uses the wrong gradient, so dM1 and A1 are also lost.

Fix: tangent gradient must come from dy/dx, not y

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2. Given that

$$(x-5)(2x+1)(x+3) \equiv ax^3 + bx^2 - 32x - 15$$

where a and b are constants,

(a) find the value of a and the value of b.

(2)

(b) Hence find

$$\int \frac{(x-5)(2x+1)(x+3)}{5\sqrt{x}}\,dx$$

writing each term in simplest form.

(5)

a) $(2x^2+x-10x-5)(x+3)$

$(2x^2-9x-5)(x+3)$

$2x^3-9x^2-5x+6x^2-27x-15$

$2x^3-3x^2-32x-15$

hence $a=2$

$b=-3$

b) $\frac{2x^3-3x^2-32x-15}{5\sqrt{x}}$

$\frac{2}{5}x^{2.5} - \frac{3}{5}x^{1.5} - 32x^{0.5} - \frac{3}{\sqrt{x}}$

$\frac{2x^{2.5+1}}{5(2.5+1)} - \frac{3x^{1.5+1}}{5(1.5+1)} - \frac{32x^{0.5+1}}{0.5+1} - 3\sqrt{x} + C$

$\frac{4}{35}x^{3.5} - \frac{6}{25}x^{2.5} - \frac{64}{3}x^{1.5} - 3\sqrt{x} + C$

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Question 2 6/7

2(a) 2/2

Expansion is correct and both constants are identified correctly.

2(b) 4/5

Division by $5\sqrt{x}$ and the first three integrated terms are correct. The last term integrates $-3x^{(-1/2)}$ to $-6\sqrt{x}$, not $-3\sqrt{x}$, so the final all-correct A1 is withheld.

Fix: integrating $x^{(-1/2)}$ gives $2x^{(1/2)}$, so the coefficient doubles

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Question 2 continued

(Total for Question 2 is 7 marks)

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Question 2 (continued) 6/7

2(a) 2/2

Expansion is correct and both constants are identified correctly.

2(b) 4/5

Division by $5\sqrt{x}$ and the first three integrated terms are correct. The last term integrates $-3x^{(-1/2)}$ to $-6\sqrt{x}$, not $-3\sqrt{x}$, so the final all-correct A1 is withheld.

Fix: integrating $x^{(-1/2)}$ gives $2x^{(1/2)}$, so the coefficient doubles

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3. The share price of a company is monitored.

Exactly 3 years after monitoring began, the share price was £1.05

Exactly 5 years after monitoring began, the share price was £1.65

The share price, £V, of the company is modelled by the equation

$$V = pt + q$$

where t is the number of years after monitoring began and p and q are constants.

(a) Find the value of p and the value of q.

(3)

Exactly T years after monitoring began, the share price was £2.50

(b) Find the value of T, according to the model, giving your answer to one decimal place.

(2)

a) $1.05 = p + q$

$1.05 = 3p + q$

$1.65 = 5p + q$

$1.05 - 3p = 1.65 - 5p$

$2p = 0.6$

$p = 0.3$

$q = 1.05 - 3(0.3) = \frac{3}{20}$

b) $2.5 = 0.3t + 0.15$

$\frac{2.5 - 0.15}{0.3} = t = \frac{47}{6}$

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Question 3 4/5

3(a) 3/3

Two correct simultaneous equations solved to give p = 0.3 and q = 0.15 (3/20) with no errors.

3(b) 1/2

The rearrangement is correct (M1), but the answer is left as 47/6 and never given as 7.8 to one decimal place, so A1 is lost.

Fix: give the final answer in the requested decimal form

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Question 3 continued

(Total for Question 3 is 5 marks)

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Sample script · whole paper 47/75

Question 3 (continued) 4/5

3(a) 3/3

Two correct simultaneous equations solved to give p = 0.3 and q = 0.15 (3/20) with no errors.

3(b) 1/2

The rearrangement is correct (M1), but the answer is left as 47/6 and never given as 7.8 to one decimal place, so A1 is lost.

Fix: give the final answer in the requested decimal form

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4. **In this question you must show detailed reasoning.**
Solutions relying on calculator technology are not acceptable.

$$f(x) = x^2(2x + 1) - 15x$$

(a) Solve

$$f(x) = 0$$

(4)

(b) Hence solve

$$y^{\frac{4}{3}}\left(2y^{\frac{2}{3}} + 1\right) - 15y^{\frac{2}{3}} = 0 \qquad y > 0$$

giving your answer in simplified surd form.

(2)

a) $x^2(2x+1) - 15x = 0$

$x(2x+1) = 15x$

$2x^2 + 2x - 15 = 0$

$\sqrt{b^2 - 4ac} = 2\sqrt{31}$

$\frac{-2 + 2\sqrt{31}}{2(2)} = 2.28, -3.28$

b) $y^{\frac{4}{3}}(2y^{\frac{2}{3}} + 1) = 15y^{\frac{2}{3}}$

$y^{\frac{2}{3}}(2y^{\frac{2}{3}} + 1) = 15$

$2y^{\frac{4}{3}} + y^{\frac{2}{3}} - 15$

$y^{\frac{2}{3}} = x$

$y^{\frac{2}{3}} = 2.28$

$y = \sqrt[\frac{2}{3}]{2.28}$

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Sample script · whole paper 47/75

Question 4 2/6

4(a) 2/4

Cancelling x gives a quadratic (M1), and the formula is attempted (dM1). However the quadratic is wrong (should be $2x^2+x-15$), the root x=0 is lost, and no correct roots are found, so B1 and A1 are lost.

Fix: dividing by x loses the root x=0; quadratic must be $2x^2+x-15$

4(b) 0/2

Built on the incorrect decimal solution from (a), with no valid method for the fractional power. The answer is not given in exact surd form, so no marks.

Fix: exact surd answers needed; decimals from part (a) cannot be used

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Question 4 continued

(Total for Question 4 is 6 marks)

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Question 4 (continued) 2/6

4(a) 2/4

Cancelling x gives a quadratic (M1), and the formula is attempted (dM1). However the quadratic is wrong (should be $2x^2+x-15$), the root x=0 is lost, and no correct roots are found, so B1 and A1 are lost.

Fix: dividing by x loses the root x=0; quadratic must be $2x^2+x-15$

4(b) 0/2

Built on the incorrect decimal solution from (a), with no valid method for the fractional power. The answer is not given in exact surd form, so no marks.

Fix: exact surd answers needed; decimals from part (a) cannot be used

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

The curve C has equation $y = f(x), x > 0$

Given that

- $f'(x) = \frac{12}{\sqrt{x}} + \frac{x}{3} - 4$
- the point $P(9, 8)$ lies on C

(a) find, in simplest form, $f(x)$

(5)

The line l is the normal to C at P

(b) Find the coordinates of the point at which l crosses the y-axis.

(4)

a) $12x^{-0.5} + \frac{x}{3} - 4$

$\frac{12\sqrt{x}}{0.5} + \frac{x^2}{3(2)} - 4x + C$

$24\sqrt{x} + \frac{x^2}{6} - 4x + C = 8$

$24\sqrt{9} + \frac{9^2}{6} - 4(6) + C = 6$

$C = -\frac{107}{2}$

$24\sqrt{x} + \frac{x^2}{6} - 4x - \frac{107}{2}$

b) $12x^{-0.5} + \frac{x}{3} - 4 = m$

$12(9)^{-0.5} + \frac{9}{3} - 4 = m = 3$

$y - y_1 = m(x - x_1)$ → $y = 3x - 27 + 8$

$y - 8 = 3(x - 9)$ → $y = 3x - 19$

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Question 5 5/9

5(a) 4/5

Integration is correct (M1, two terms, full expression with +C). Substitution (9,8) is attempted (dM1), but −4x was evaluated with x=6 and the RHS is wrong, so the final f(x) is not correct (A1 lost).

Fix: substitute x=9 into every term, including −4x

5(b) 1/4

f′(9)=3 is correct (M1). The line uses the tangent gradient 3 instead of the normal gradient −1/3, so the dM1 and the later M1 and A1 are lost.

Fix: normal gradient is the negative reciprocal of the tangent gradient

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Question 5 continued

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Question 5 (continued) 5/9

5(a) 4/5

Integration is correct (M1, two terms, full expression with +C). Substitution (9,8) is attempted (dM1), but −4x was evaluated with x=6 and the RHS is wrong, so the final f(x) is not correct (A1 lost).

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Fix: normal gradient is the negative reciprocal of the tangent gradient

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Question 5 continued

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Question 5 (continued) 5/9

5(a) 4/5

Integration is correct (M1, two terms, full expression with +C). Substitution (9,8) is attempted (dM1), but −4x was evaluated with x=6 and the RHS is wrong, so the final f(x) is not correct (A1 lost).

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f′(9)=3 is correct (M1). The line uses the tangent gradient 3 instead of the normal gradient −1/3, so the dM1 and the later M1 and A1 are lost.

Fix: normal gradient is the negative reciprocal of the tangent gradient

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Question 5 continued

(Total for Question 5 is 9 marks)

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Question 5 (continued) 5/9

5(a) 4/5

Integration is correct (M1, two terms, full expression with +C). Substitution (9,8) is attempted (dM1), but −4x was evaluated with x=6 and the RHS is wrong, so the final f(x) is not correct (A1 lost).

Fix: substitute x=9 into every term, including −4x

5(b) 1/4

f′(9)=3 is correct (M1). The line uses the tangent gradient 3 instead of the normal gradient −1/3, so the dM1 and the later M1 and A1 are lost.

Fix: normal gradient is the negative reciprocal of the tangent gradient

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6. (a) Given that k is a positive constant such that $0 < k < 4$ sketch, on **separate axes**, the graphs of

(i) $y = (2x - k)(x + 4)^2$

(ii) $y = \dfrac{k}{x^2}$

showing the coordinates of any points where the graphs cross or meet the coordinate axes, leaving coordinates in terms of k, where appropriate.

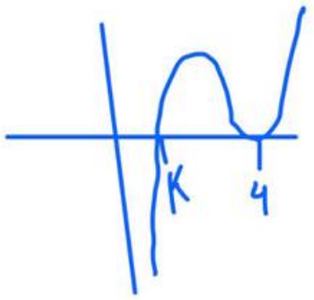
(5)

(b) State, with a reason, the number of roots of the equation

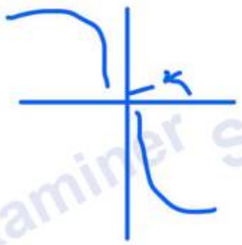
$$(2x - k)(x + 4)^2 = \frac{k}{x^2}$$

(1)

i)



ii)



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Question 6 — 2/6

6(a)(i) 1/3

A cubic-type curve with a max and min is drawn (B1). The end behaviour is inconsistent with a positive cubic, the crossing point and touching point are mislabelled, and the y-intercept −16k is not shown.

Fix: sketch a cubic with correct end behaviour and intercepts

6(a)(i) 1/2

The curve is in the correct shape in the second quadrant (B1), but the extra branch in quadrant 4 means the second B1 is withheld.

Fix: $y = k/x^2$ lies only in quadrants 1 and 2

6(b) 0/1

The graphs intersect once, so there is one root. The stated reason is wrong.

Fix: count intersections of the two graphs correctly

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Question 6 continued

b)

No real roots as graphs do not intersect

(Total for Question 6 is 6 marks)

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Question 6 (continued) 2/6

6(a)(i) 1/3

A cubic-type curve with a max and min is drawn (B1). The end behaviour is inconsistent with a positive cubic, the crossing point and touching point are mislabelled, and the y-intercept −16k is not shown.

Fix: sketch a cubic with correct end behaviour and intercepts

6(a)(i) 1/2

The curve is in the correct shape in the second quadrant (B1), but the extra branch in quadrant 4 means the second B1 is withheld.

Fix: $y = k/x^2$ lies only in quadrants 1 and 2

6(b) 0/1

The graphs intersect once, so there is one root. The stated reason is wrong.

Fix: count intersections of the two graphs correctly

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7.

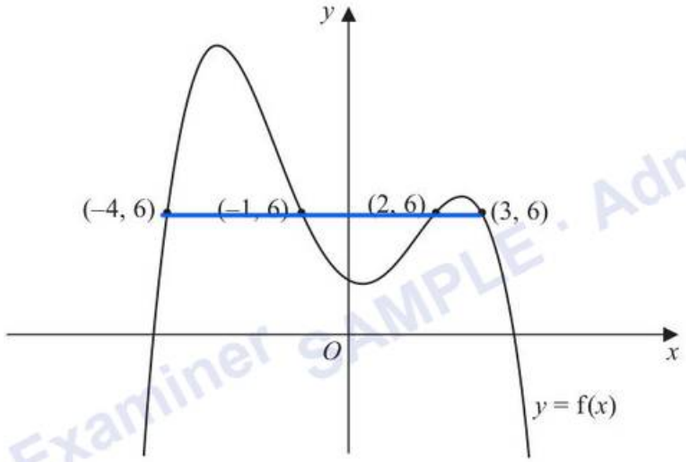


Figure 1

Figure 1 shows the curve with equation $y = f(x)$.

The points $P(-4, 6)$, $Q(-1, 6)$, $R(2, 6)$ and $S(3, 6)$ lie on the curve.

(a) Using Figure 1, find the range of values of x for which

$$f(x) < 6$$

(3)

(b) State the largest solution of the equation

$$f(2x) = 6$$

(1)

(c) (i) Sketch the curve with equation $y = f(-x)$.

On your sketch, state the coordinates of the points to which P, Q, R and S are transformed.

(ii) Hence find the set of values of x for which

$$f(-x) \geqslant 6 \text{ and } x < 0$$

(4)

a) below −4, between −1 and 2, above 3

b) 1.5 = x

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Question 7 5/8

7(a) 1/3

The correct intervals are identified (M1), but they are written in words and not as inequalities in x, so A1 and the final B1 are withheld.

Fix: give answer as inequalities in x, e.g. x < −4

7(b) 1/1

Correct: 2x = 3 gives the largest solution x = 1.5.

7(c)(i) 3/3

Sketch is correctly reflected in the y-axis, with the taller peak on the right, and all four coordinates are correct.

7(c)(i) 0/1

The interval is correct but is not written as an inequality in x (−3 ≤ x ≤ −2), so the mark is withheld.

Fix: answer with inequalities in x, inclusive where needed

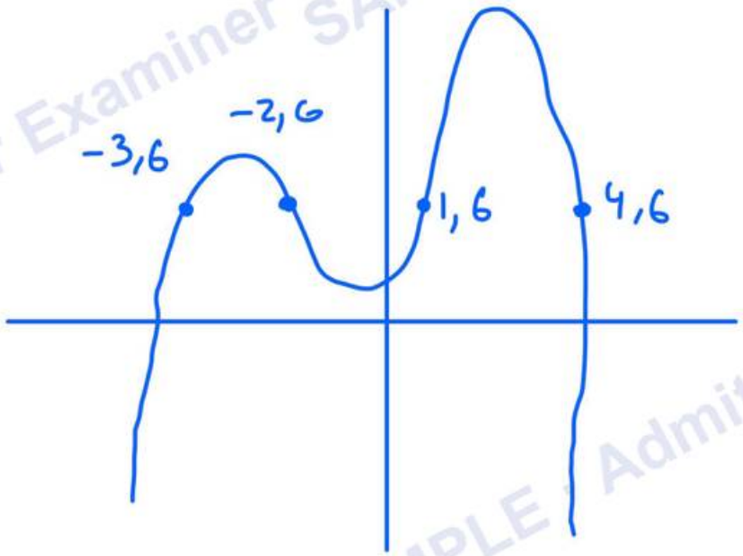
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Question 7 continued

ii) between −3 and −2

( )

i)



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Question 7 (continued) 5/8

7(a) 1/3

The correct intervals are identified (M1), but they are written in words and not as inequalities in x, so A1 and the final B1 are withheld.

Fix: give answer as inequalities in x, e.g. $x < -4$

7(b) 1/1

Correct: $2x = 3$ gives the largest solution $x = 1.5$.

7(c)(i) 3/3

Sketch is correctly reflected in the y-axis, with the taller peak on the right, and all four coordinates are correct.

7(c)(i) 0/1

The interval is correct but is not written as an inequality in x ($-3 \le x \le -2$), so the mark is withheld.

Fix: answer with inequalities in x, inclusive where needed

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Question 7 continued

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Question 7 (continued) 5/8

7(a) 1/3

The correct intervals are identified (M1), but they are written in words and not as inequalities in x, so A1 and the final B1 are withheld.

Fix: give answer as inequalities in x, e.g. $x < -4$

7(b) 1/1

Correct: $2x = 3$ gives the largest solution $x = 1.5$.

7(c)(i) 3/3

Sketch is correctly reflected in the y-axis, with the taller peak on the right, and all four coordinates are correct.

7(c)(i) 0/1

The interval is correct but is not written as an inequality in x ($-3 \le x \le -2$), so the mark is withheld.

Fix: answer with inequalities in x, inclusive where needed

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Question 7 continued

(Total for Question 7 is 8 marks)

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Question 7 (continued) 5/8

7(a) 1/3

The correct intervals are identified (M1), but they are written in words and not as inequalities in x, so A1 and the final B1 are withheld.

Fix: give answer as inequalities in x, e.g. $x < -4$

7(b) 1/1

Correct: $2x = 3$ gives the largest solution $x = 1.5$.

7(c)(i) 3/3

Sketch is correctly reflected in the y-axis, with the taller peak on the right, and all four coordinates are correct.

7(c)(i) 0/1

The interval is correct but is not written as an inequality in x ($-3 \le x \le -2$), so the mark is withheld.

Fix: answer with inequalities in x, inclusive where needed

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8.

Diagram **NOT** to scale

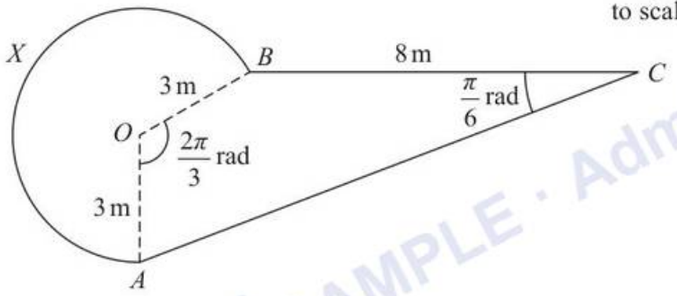


Figure 2

Figure 2 shows the plan view of a design for a pond.

The design consists of a sector $AOBX$ of a circle centre O joined to a quadrilateral $AOBC$.

- $BC = 8\,\text{m}$
- $OA = OB = 3\,\text{m}$
- angle AOB is $\frac{2\pi}{3}$ radians
- angle BCA is $\frac{\pi}{6}$ radians

(a) Calculate (i) the exact area of the sector $AOBX$,

(ii) the exact perimeter of the sector $AOBX$.

(5)

(b) Calculate the exact area of the triangle AOB.

(2)

(c) Show that the length AB is $3\sqrt{3}$ m.

(2)

(d) Find the total surface area of the pond. Give your answer in m^2 correct to 2 significant figures.

(5)

a) i) $2\pi - \frac{2\pi}{3} = \frac{4}{3}\pi$

$a = \frac{r^2\theta}{2} = \frac{3^2 \times \frac{4}{3}\pi}{2} = 6\pi\,\text{m}^2$

ii) $s = r\theta = 3 \times \frac{4}{3}\pi = 4\pi\,\text{m}$

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Sample script · whole paper 47/75

Question 8 — 8/14

8(a)(i) 3/3

Reflex angle found, sector area formula used with correct values, and exact answer 6π given.

8(a)(i) 1/2

The arc length is correct (M1), but the two radii were not added to give the perimeter 4π + 6, so A1 is lost.

Fix: perimeter of a sector includes both radii

8(b) 2/2

Written working uses a different triangle, but the value $9\sqrt{3}/4$ (awrt 3.90) is correct for triangle AOB, so the method mark and the exact answer are both credited.

8(c) 2/2

Correct cosine rule with the correct angle, simplified to AB = $3\sqrt{3}$ with no errors.

8(d) 0/5

Triangle ABC is omitted completely, so the total area is wrong. No sine rule or triangle area attempt is shown.

Fix: include triangle ABC in the total surface area

Question 8 continued

b+c) $\frac{2\pi}{3} + 2x = \pi$

$x = \pi - \frac{2\pi}{3} \quad \times\frac{1}{2} = \frac{\pi}{6}$

$c^2 = 3^2 + 3^2 - 2(3)(3)\cos\frac{2\pi}{3}$

$c = 3\sqrt{3}$

$\frac{1}{2}ab\sin C$

$\frac{1}{2} 3\sqrt{3} \times 3 \sin\frac{\pi}{6} = \frac{9\sqrt{3}}{4} m^2$

d) $6\pi + \frac{9\sqrt{3}}{4} = 22.75 m^2$
$= 23 m^2$

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Question 8 (continued) 8/14

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8(d) 0/5

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Fix: include triangle ABC in the total surface area

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Question 8 continued

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Question 8 (continued) 8/14

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Question 8 continued

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(Total for Question 8 is 14 marks)

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Sample script · whole paper 47/75

Question 8 (continued) 8/14

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9.

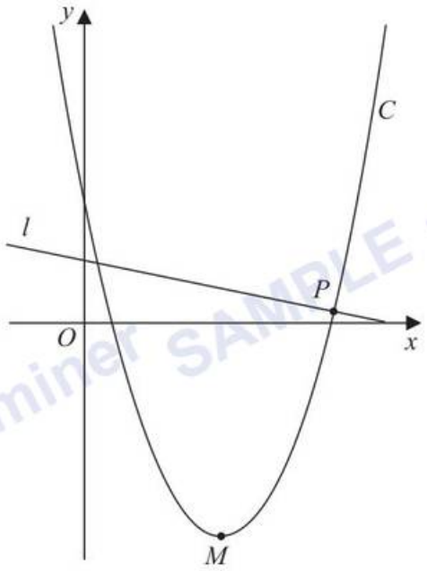


Figure 3

Figure 3 shows a sketch of the curve C with equation

$$y = \frac{1}{2}x^2 - 10x + 22$$

(a) Write $\frac{1}{2}x^2 - 10x + 22$ in the form

$$a(x + b)^2 + c$$

where a, b and c are constants to be found.

(3)

The point M is the minimum turning point of C, as shown in Figure 3.

(b) Deduce the coordinates of M

(2)

The line l is the normal to C at the point P, as shown in Figure 3.

Given that l has equation $y = k - \frac{1}{8}x$, where k is a constant,

(c) (i) find the coordinates of P

(ii) find the value of k

(6)

Question 9 continues on the next page

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Question 9 — 12/14

9(a) 3/3

Correct completion of the square with a = ½, b = −10, c = −28, checked by expansion.

9(b) 1/2

The y-coordinate −28 is correct, but the x-coordinate should be +10 (from x = −b), so only one follow-through mark is earned.

Fix: turning point of a(x+b)²+c is at (−b, c)

9(c)(i) 4/4

Gradient 8 used correctly, derivative set equal to 8, x=18 and y=4 correct.

9(c)(i) 2/2

Substitutes P into the normal equation correctly and finds k = 25/4.

9(d) 2/3

Both curve and normal inequalities are correct (two B1ft). The x-range bounds 10 ≤ x ≤ 18 are missing, so the third mark is lost.

Fix: region also needs the vertical bounds x ≥ 10 and x ≤ 18

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Question 9 continued

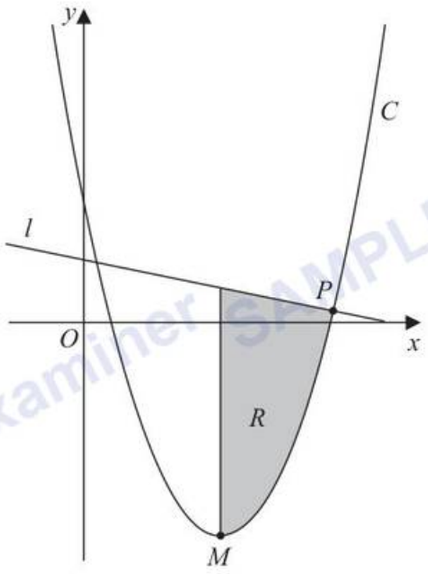


Figure 4

Figure 4 is a copy of Figure 3. The finite region R, shown shaded in Figure 4, is bounded by l, C and the line through M parallel to the y-axis.

(d) Identify the inequalities that define R.

(3)

a) $\frac{1}{2}(x-10)^2-28$

$\frac{1}{2}x^2-10x+22$

$\frac{1}{2}(x^2-20x+100)-28$

$\frac{1}{2}x^2-10x+50-28$

$\frac{1}{2}x^2-10x+22$

b) $-10, -28$

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Question 9 (continued) 12/14

9(a) 3/3

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Fix: region also needs the vertical bounds $x \ge 10$ and $x \le 18$

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Question 9 continued

c)

i) $\frac{dy}{dx} = x - 10$

$x - 10 = 8$

$x = 18$

$y = \frac{1}{2}(18)^2 - 10(18) + 22 = 4$

P is 18, 4

ii) $4 = k - \frac{1}{8}(18)$

$k = \frac{25}{4}$

d) $y \geq \frac{1}{2}x^2 - 10x + 22$

$y \leq k - \frac{1}{8}x$

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P 7 2 1 3 7 A 0 2 6 2 8

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Question 9 (continued) 12/14

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Question 9 continued

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Question 9 (continued) 12/14

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Question 9 continued

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(Total for Question 9 is 14 marks)

TOTAL FOR PAPER IS 75 MARKS

P 7 2 1 3 7 A 0 2 8 2 8

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Question 9 (continued) 12/14

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