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INTERNATIONAL A LEVEL MATHEMATICS • PURE 2

Pure Mathematics 2

Exam Questions by Topic

Pearson Edexcel International Advanced Level (WMA12/01) • Calculator allowed

Multi-step exam questions at the difficulty of the real WMA12 paper, with a full mark scheme

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Algebraic Methods Algebraic fractions, the factor and remainder theorems, proof	10	66	own PDF	
2 Coordinate Geometry in the (x, y) Plane Equations of circles, tangents, chords and intersections	10	68	own PDF	
3 Exponentials and Logarithms Laws of logarithms, exponential equations, modelling	10	68	own PDF	
4 The Binomial Expansion Expanding $(a + bx)^n$, coefficients and approximations	10	65	own PDF	
5 Sequences and Series Arithmetic and geometric series, sigma notation, recurrence	10	69	own PDF	
6 Trigonometric Identities and Equations $\tan \theta = \frac{\sin \theta}{\cos \theta}$, $\sin^2 \theta + \cos^2 \theta = 1$, solving equations	10	66	own PDF	
7 Differentiation Increasing and decreasing functions, stationary points, optimisation	10	67	own PDF	
8 Integration Definite integrals, areas under curves, the trapezium rule	10	67	2	

[Full mark scheme](#)

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8

CHAPTER 8 • KEY SKILLS

Integration

Specification P2: 8.1, 8.2, 8.3 • 10 questions • 67 marks • about 80 minutes

1 Definite integrals

$$\int_a^b f'(x) dx = f(b) - f(a)$$

Show the substituted brackets; no +c.

2 Rewrite first

Split fractions into powers of x :

$$\frac{x-3}{\sqrt{x}} = x^{\frac{1}{2}} - 3x^{-\frac{1}{2}}$$

3 Area under a curve

Area = $\int_a^b y dx$ when the curve is above the x -axis. Find the limits from the roots.

4 Regions below the axis

Below the x -axis the integral is negative. Integrate each part separately and add the sizes.

5 Between a curve and a line

Find where they meet, then integrate (top – bottom), or subtract the area under the curve from a trapezium.

6 Unknown limits and constants

Evaluate in terms of k and solve the resulting equation. Check which roots are allowed.

7 The trapezium rule

$$\text{Area} \approx \frac{h}{2} (y_0 + y_n + 2(y_1 + \dots + y_{n-1}))$$

where $h = \frac{b-a}{n}$ and n strips need $n+1$ values of y .

8 Over or under?

If the curve bends upwards (convex) the trapezia lie above it: an overestimate. More strips improve the estimate.

9 Related integrals

Split the integral up:

$$\int_a^b k f(x) dx = k \int_a^b f(x) dx$$

$$\text{and } \int_a^b c dx = c(b-a)$$

Skills map every skill above is tested at least once; interleaved skills come from GCSE or other chapters

Skill	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Marks	4	5	5	5	5	8	8	8	9	10
1 Definite integrals	•	•	•		•	•	•		•	•
2 Rewrite first	•	•								•
3 Area under a curve			•						•	•
4 Regions below the axis					•					
5 Between a curve and a line						•				
6 Unknown limits and constants		•					•			
7 The trapezium rule				•				•		•
8 Over or under?				•				•		•
9 Related integrals							•	•		
Interleaved: stationary points (Chapter 7)									•	•
Interleaved: factor theorem, exponentials (Chapters 1, 3)							•	•		
Interleaved: quadratics, transformations (P1)			•			•	•			

Exam difficulty. Questions 1 to 5 check each skill on its own. Questions 6 to 10 are multi-step questions built like the last questions on a real WMA12 paper, where one part leads into the next and skills from different topics are combined.

Must learn. The trapezium rule *is* in the formula booklet, but you must know that n strips need $n+1$ values. An area is always positive: never let a negative integral cancel a positive one.



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1. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Find the exact value of

$$\int_1^4 \left(3x^2 - \frac{4}{\sqrt{x}} \right) dx$$

(4)

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(Total for Question 1 is 4 marks)



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2. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Given that

$$\int_1^9 \frac{kx - 3}{\sqrt{x}} dx = 40$$

where k is a constant, find the value of k .

(5)

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Question 2 continued

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(Total for Question 2 is 5 marks)



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3. The curve C has equation $y = 6x - x^2$

(a) Find the x coordinates of the points where C meets the x -axis.

(1)

(b) Use integration to find the area of the region bounded by C and the x -axis.

(4)

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Question 3 continued

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(Total for Question 3 is 5 marks)



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x	0	0.5	1	1.5	2
y	1		1.4142		2.2361

(1)

$\int_0^2 \sqrt{x^2 + 1} \, dx$, giving your answer to 3 decimal places.

(3)

(1)

Question 4 continued

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(Total for Question 4 is 5 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.

The curve C has equation $y = x^3 - 6x^2 + 8x = x(x - 2)(x - 4)$

- (a) Show that $\int_0^4 (x^3 - 6x^2 + 8x) \, dx = 0$ (2)
- (b) Explain why this integral does not give the area enclosed between C and the x -axis, and find this area. (3)

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Question 5 continued

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(Total for Question 5 is 5 marks)



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

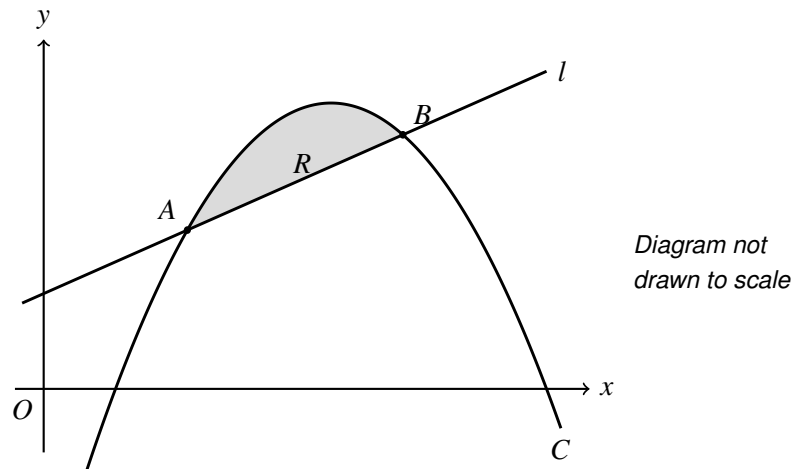
**Figure 1**

Figure 1 shows part of the curve C with equation $y = -x^2 + 8x - 7$ and the line l with equation $y = x + 3$

The line meets C at the points A and B . The region R , shown shaded, is bounded by C and l .

- (a) Find the coordinates of A and B .

(3)

- (b) Use calculus to find the exact area of R .

(5)



Question 6 continued

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(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 on calculator technology are not acceptable.

Given that

$$\int_1^k (3x^2 - 2x) \, dx = 48$$

where k is a real constant,

- (a)** show that $k^3 - k^2 - 48 = 0$

(3)

- (b)** show that $k = 4$ is the only real solution of this equation.

(3)

- (c)** Hence, giving a reason, write down the value of $\int_{-4}^{-1} (3x^2 + 2x) \, dx$

(2)

Question 7 continued

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(Total for Question 7 is 8 marks)



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8. The curve C has equation $y = 2^x$

- (a) Use the trapezium rule with 4 strips of equal width to find an estimate for $\int_0^2 2^x dx$, giving your answer to 3 decimal places.

(4)

- (b) Explain why your answer to part (a) is an overestimate.

(1)

- (c) Using your answer to part (a), find an estimate for $\int_0^2 (2^{x+1} + 3) dx$

(3)

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Question 8 continued

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(Total for Question 8 is 8 marks)



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9. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

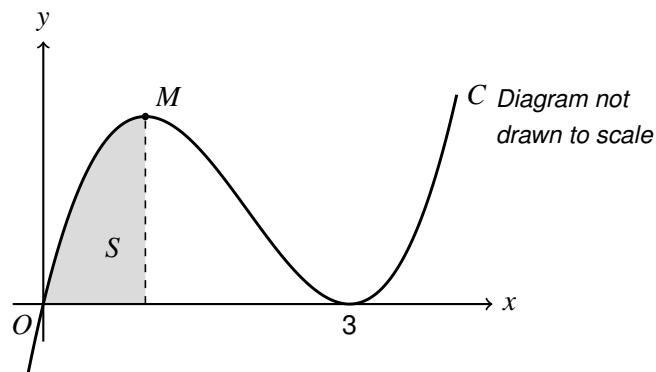


Figure 2

Figure 2 shows part of the curve C with equation $y = x^3 - 6x^2 + 9x$

The point M is the maximum point of C . The region S , shown shaded, is bounded by C , the x -axis and the line through M parallel to the y -axis.

- (a) Use calculus to find the coordinates of M .
(3)
- (b) Find the exact area of S .
(3)
- (c) Find the exact area of the region bounded by C and the x -axis for $0 \leq x \leq 3$
(2)
- (d) Hence write down the area of the region bounded by C , the x -axis and the line through M parallel to the y -axis, for $1 \leq x \leq 3$
(1)

Question 9 continued

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Question 9 continued

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(Total for Question 9 is 9 marks)



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10.

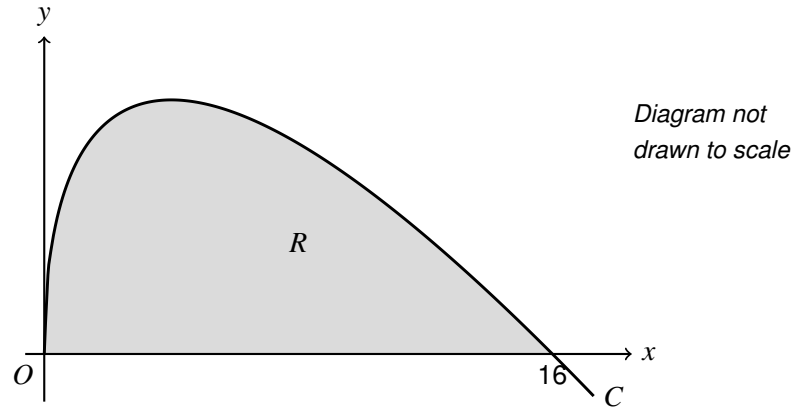


Figure 3

Figure 3 shows part of the curve C with equation $y = 8\sqrt{x} - 2x$, $x \geq 0$

The curve meets the x -axis at the origin and at the point where $x = 16$. The region R , shown shaded, is bounded by C and the x -axis.

- (a) Use calculus to find the coordinates of the maximum point of C . (3)
- (b) Find the exact area of R . (4)
- (c) Use the trapezium rule with 4 strips of equal width to find an estimate for the area of R , giving your answer to 2 decimal places. (2)
- (d) Find the percentage error in your estimate, to 2 significant figures. (1)



Question 10 continued

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Question 10 continued

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(Total for Question 10 is 10 marks)

TOTAL FOR CHAPTER 8 IS 67 MARKS

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