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INTERNATIONAL A LEVEL MATHEMATICS • PURE 2

Pure Mathematics 2

Exam Questions by Topic: Mark Scheme

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

Every question in the booklet, marked line by line the way an examiner marks it

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	3	

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How to use this mark scheme

The same marking rules Pearson examiners use for WMA12.

Mark every line, not just the answer. Method marks are given for a correct method even when the final answer is wrong. If you lost marks, find the *first* line where your working differs from the scheme. That is the thing to fix.

Code	Meaning
M1	Method mark: for knowing a correct method and attempting to apply it. Small slips in the working do not lose this mark.
dM1	Dependent method mark: can only be given if the method mark before it has been given.
A1	Accuracy mark: for a correct answer or line of working. It can only be given if the method mark it depends on has been given.
B1	Independent mark: for a correct result or statement, whatever method was used.
*	The answer is given in the question. Every step must be shown, and the answer must follow from correct working (cso).
cao	Correct answer only.
cso	Correct solution only: no errors anywhere in the working.
ft	Follow through: the mark can be given for correct work using your own earlier (wrong) answer.
oe	Or equivalent: any correct equivalent form is accepted.

“Solutions relying on calculator technology are not acceptable.” When a question says this, a correct final answer with no algebraic working scores **no marks**. The notes under each scheme line say when this applies.



8

Chapter 8: Integration

Mark scheme. Marks are shown on the right of each line.

Question 1

4 marks

Part	Scheme	Marks
	Integrates: x^3 or $-8x^{\frac{1}{2}}$	M1
	$\left[x^3 - 8x^{\frac{1}{2}}\right]_1^4$	A1
	Substitutes the limits: $(64 - 16) - (1 - 8)$	M1
	55	A1
		(4)
Total for Question 1: 4 marks		

Question 2

5 marks

Part	Scheme	Marks
	Writes the integrand as $kx^{\frac{1}{2}} - 3x^{-\frac{1}{2}}$	M1
	Integrates: $\frac{2k}{3}x^{\frac{3}{2}} - 6x^{\frac{1}{2}}$	M1
	Both terms correct	A1
	Substitutes the limits and sets equal to 40: $(18k - 18) - \left(\frac{2k}{3} - 6\right) = 40$	M1
	$\frac{52k}{3} = 52$, so $k = 3$	A1
		(5)
Total for Question 2: 5 marks		

Question 3

5 marks

Part	Scheme	Marks
(a)	$x(6 - x) = 0$: $x = 0$ and $x = 6$	B1
		(1)
(b)	Integrates: $3x^2 - \frac{x^3}{3}$	M1
	Correct integral	A1
	Uses the limits 0 and 6: $108 - 72$	M1
	36	A1
		(4)
Total for Question 3: 5 marks		



Question 4

5 marks

Part	Scheme	Marks
(a)	1.1180 and 1.8028	B1 (1)
(b)	$h = 0.5$ $\frac{0.5}{2} (1 + 2.2361 + 2(1.1180 + 1.4142 + 1.8028))$ 2.977	B1 M1 A1 (3)
(c)	Overestimate: the curve is convex (bends upwards), so the tops of the trapezia lie above the curve	B1 (1)
Total for Question 4: 5 marks		

Question 5

5 marks

Part	Scheme	Marks
(a)	$\left[\frac{x^4}{4} - 2x^3 + 4x^2 \right]_0^4$ $= 64 - 128 + 64 - 0 = 0$ *	M1 A1* (2)
(b)	The region for $2 < x < 4$ is below the x-axis, so its integral is negative and cancels the positive part $\int_0^2 \dots = 4$ and $\int_2^4 \dots = -4$ Area = $4 + 4 = 8$	B1 M1 A1 (3)
Total for Question 5: 5 marks		



Question 6

8 marks

Part	Scheme	Marks
(a)	$-x^2 + 8x - 7 = x + 3 \Rightarrow x^2 - 7x + 10 = 0$ $(x - 2)(x - 5) = 0$ $A(2, 5) \text{ and } B(5, 8)$	M1 A1 A1 (3)
(b)	$\text{Area} = \int_2^5 ((-x^2 + 8x - 7) - (x + 3)) \, dx = \int_2^5 (-x^2 + 7x - 10) \, dx$ Integrates: $-\frac{x^3}{3} + \frac{7x^2}{2} - 10x$ Correct integral Substitutes the limits: $\left(-\frac{125}{3} + \frac{175}{2} - 50\right) - \left(-\frac{8}{3} + 14 - 20\right)$ $\frac{9}{2}$ Alternative: area under the line (a trapezium, $\frac{1}{2}(5+8) \times 3 = \frac{39}{2}$) subtracted from the area under C (24).	M1 M1 A1 M1 A1 (5)
Total for Question 6: 8 marks		

Question 7

8 marks

Part	Scheme	Marks
(a)	Integrates: $[x^3 - x^2]_1^k$ $= k^3 - k^2 - (1 - 1)$ $k^3 - k^2 = 48$, so $k^3 - k^2 - 48 = 0$ *	M1 M1 A1* (3)
(b)	$64 - 16 - 48 = 0$, so $(k - 4)$ is a factor $(k - 4)(k^2 + 3k + 12) = 0$ $k^2 + 3k + 12$ has discriminant $9 - 48 < 0$, so no other real roots: $k = 4$ only	B1 M1 A1 (3)
(c)	$y = 3x^2 + 2x$ is the reflection of $y = 3x^2 - 2x$ in the y-axis, so the integral from -4 to -1 equals the integral from 1 to 4 48	M1 A1 (2)
Total for Question 7: 8 marks		



Question 8

8 marks

Part	Scheme	Marks
(a)	$h = 0.5$ and y values 1, 1.4142, 2, 2.8284, 4 $\frac{0.5}{2}(1 + 4 + 2(1.4142 + 2 + 2.8284))$ Correct structure with their values 4.371	B1 M1 A1ft A1 (4)
(b)	The curve $y = 2^x$ is convex (bends upwards), so each trapezium lies above the curve	B1 (1)
(c)	$2^{x+1} = 2 \times 2^x$, so the integral is $2 \int_0^2 2^x dx + \int_0^2 3 dx$ $2 \times 4.371 + 6$ 14.74	M1 M1 A1 (3)
Total for Question 8: 8 marks		



Question 9

9 marks

Part	Scheme	Marks
(a)	$\frac{dy}{dx} = 3x^2 - 12x + 9 = 3(x-1)(x-3) = 0$ $x = 1$ gives the maximum ($\frac{d^2y}{dx^2} = -6 < 0$) $M(1, 4)$	M1 A1 A1 (3)
(b)	$\int_0^1 (x^3 - 6x^2 + 9x) dx = \left[\frac{x^4}{4} - 2x^3 + \frac{9}{2}x^2 \right]_0^1$ Correct integral with the limits 0 and 1 $\frac{11}{4}$	M1 A1 A1 (3)
(c)	Same integral with the limits 0 and 3: $\frac{81}{4} - 54 + \frac{81}{2}$ $\frac{27}{4}$	M1 A1 (2)
(d)	$\frac{27}{4} - \frac{11}{4} = 4$	B1ft (1)
Total for Question 9: 9 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	$\frac{dy}{dx} = 4x^{-\frac{1}{2}} - 2$ $= 0$ gives $x = 4$ $(4, 8)$	M1 A1 A1 (3)
(b)	Integrates: $\frac{16}{3}x^{\frac{3}{2}} - x^2$ Correct integral Uses the limits 0 and 16: $\frac{16}{3} \times 64 - 256$ $\frac{256}{3}$	M1 A1 M1 A1 (4)
(c)	$h = 4$, y values 0, 8, 6.6274, 3.7128, 0: $\frac{4}{2}(0 + 0 + 2(8 + 6.6274 + 3.7128))$ 73.36	M1 A1 (2)
(d)	$\frac{85.33... - 73.36...}{85.33...} \times 100 = 14\%$	B1 (1)
Total for Question 10: 10 marks		

