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INTERNATIONAL A LEVEL MATHEMATICS • PURE 1

Pure Mathematics 1

Exam Questions by Topic: Mark Scheme

Pearson Edexcel International Advanced Level (WMA11/01) • 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 Expressions Indices, surds, expanding and factorising	10	57	own PDF	
2 Quadratics Completing the square, the discriminant, quadratic graphs	10	65	own PDF	
3 Equations and Inequalities Simultaneous equations, inequalities, regions	10	69	own PDF	
4 Graphs and Transformations Cubic and reciprocal graphs, intersections, transformations	10	68	own PDF	
5 Straight-line Graphs Gradients, equations of lines, parallel and perpendicular	10	68	own PDF	
6 Trigonometric Ratios Sine and cosine rules, area of a triangle, trig graphs	10	66	own PDF	
7 Radians Radian measure, arc length, sector and segment areas	10	71	own PDF	
8 Differentiation Gradients, second derivatives, tangents and normals	10	71	own PDF	
9 Integration Integrating x^n , finding $y = f(x)$ from $f'(x)$	10	67	3	

Question booklet

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How to use this mark scheme

The same marking rules Pearson examiners use for WMA11.

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.



9

Chapter 9: Integration

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

Question 1

4 marks

Part	Scheme	Marks
	Raises a power by one on any term: $x^n \rightarrow x^{n+1}$	M1
	Two of x^6 , $-2x^{-2}$, $-6x^{\frac{1}{2}}$	A1
	All three terms correct and simplified	A1
	$x^6 - 2x^{-2} - 6x^{\frac{1}{2}} + c$	A1
	<i>The last A1 needs +c. Common errors: $+2x^{-2}$ (from $\frac{4x^{-2}}{-2}$) and $-2x^{\frac{1}{2}}$ (from dividing by 2 instead of $\frac{1}{2}$).</i>	
		(4)
Total for Question 1: 4 marks		

Question 2

5 marks

Part	Scheme	Marks
	Splits into separate powers: $\frac{3x^4}{x^{\frac{5}{2}}} - \frac{2}{x^{\frac{5}{2}}}$	M1
	$3x^{\frac{3}{2}} - 2x^{-\frac{5}{2}}$	A1
	Raises a power by one on either term	M1
	One term correct: $\frac{6}{5}x^{\frac{5}{2}}$ or $+\frac{4}{3}x^{-\frac{3}{2}}$	A1
	$\frac{6}{5}x^{\frac{5}{2}} + \frac{4}{3}x^{-\frac{3}{2}} + c$	A1
	<i>Integrating the numerator and denominator separately scores 0.</i>	
		(5)
Total for Question 2: 5 marks		



Question 3

5 marks

Part	Scheme	Marks
(a)	Expands: $\frac{4x - 12\sqrt{x} + 9}{\sqrt{x}}$	M1
	$4x^{\frac{1}{2}} - 12 + 9x^{-\frac{1}{2}}$, so $A = -12$, $B = 9$	A1
		(2)
(b)	Raises a power by one on any term	M1
	Two terms correct	A1
	$\frac{8}{3}x^{\frac{3}{2}} - 12x + 18x^{\frac{1}{2}} + c$	A1
		(3)
Total for Question 3: 5 marks		

Question 4

5 marks

Part	Scheme	Marks
	Integrates: $x^{\frac{1}{2}} \rightarrow x^{\frac{3}{2}}$ or $x^{-2} \rightarrow x^{-1}$	M1
	$2x^{\frac{3}{2}}$	A1
	$+4x^{-1} + c$	A1
	Substitutes (4, 10): $2 \times 8 + \frac{4}{4} + c = 10$	M1
	$f(x) = 2x^{\frac{3}{2}} + \frac{4}{x} - 7$	A1
	The final answer must be written out as $f(x) = \dots$, not just $c = -7$.	(5)
Total for Question 4: 5 marks		



Question 5

5 marks

Part	Scheme	Marks
(a)	Reduces a power by one on either term $6x^2 + 3x^{-\frac{3}{2}}$ <i>No +c after differentiating.</i>	M1 A1 (2)
(b)	Raises a power by one on either term One term correct: $\frac{1}{2}x^4$ or $-12x^{\frac{1}{2}}$ $\frac{1}{2}x^4 - 12x^{\frac{1}{2}} + c$	M1 A1 A1 (3)
Total for Question 5: 5 marks		

Question 6

9 marks

Part	Scheme	Marks
(a)	Integrates: $x^3 - 4x^2 + 5x + c$ All three terms correct Uses (3, 4): $27 - 36 + 15 + c = 4$ $f(x) = x^3 - 4x^2 + 5x - 2$	M1 A1 M1 A1 (4)
(b)	Expands: $(x - 1)^2(x - 2) = (x^2 - 2x + 1)(x - 2)$ $= x^3 - 4x^2 + 5x - 2$, which is $f(x)$ *	M1 A1* (2)
(c)	Positive cubic shape Touches the x -axis at (1, 0) and crosses at (2, 0) Crosses the y -axis at (0, -2)	B1 B1 B1 (3)
Total for Question 6: 9 marks		



Question 7

8 marks

Part	Scheme	Marks
(a)	Normal gradient $-\frac{1}{10}$, so the tangent gradient is 10 $f'(4) = 4k - 3 \times 2 = 10$ $4k = 16$, so $k = 4$ *	B1 M1 A1* (3)
(b)	Integrates $4x - 3x^{\frac{1}{2}}$ $2x^2$ $-2x^{\frac{3}{2}} + c$ Uses (4, 20): $32 - 16 + c = 20$ $f(x) = 2x^2 - 2x^{\frac{3}{2}} + 4$	M1 A1 A1 M1 A1 (5)
Total for Question 7: 8 marks		

Question 8

8 marks

Part	Scheme	Marks
(a)	From the tangent: $f'(1) = 5$, so $a + b = 5$ * Normal gradient $-\frac{1}{16}$, so $f'(4) = 16$: $4a + 2b = 16$ $2a + b = 8$ *	B1* M1 A1* (3)
(b)	Solves simultaneously: $a = 3$, $b = 2$ Integrates $3x + 2x^{\frac{1}{2}}$: $\frac{3}{2}x^2 + \frac{4}{3}x^{\frac{3}{2}} + c$ Both terms correct The tangent gives $f(1) = 5 \times 1 - 2 = 3$: $\frac{3}{2} + \frac{4}{3} + c = 3$ $f(x) = \frac{3}{2}x^2 + \frac{4}{3}x^{\frac{3}{2}} + \frac{1}{6}$ <i>The point (1, 3) comes from the tangent equation. Using (1, 5) is the common error.</i>	B1 M1 A1 M1 A1 (5)
Total for Question 8: 8 marks		



Question 9

8 marks

Part	Scheme	Marks
(a)	P is $(1, 5)$ and the normal gradient is $-\frac{1}{2}$: $y - 5 = -\frac{1}{2}(x - 1)$ $x + 2y - 11 = 0$	M1 A1 (2)
(b)	Integrates $f''(x)$: $f'(x) = 6x^2 + 2x^{-2} + c_1$ Correct $f'(x)$, including $+c_1$ Uses $f'(1) = 2$: $6 + 2 + c_1 = 2$, so $c_1 = -6$ Integrates again: $f(x) = 2x^3 - 2x^{-1} - 6x + c_2$ Uses $f(1) = 5$: $2 - 2 - 6 + c_2 = 5$ $f(x) = 2x^3 - \frac{2}{x} - 6x + 11$ <i>Integrating twice and adding a constant only at the end, or using $(1, 5)$ to find c_1, are the most common errors.</i>	M1 A1 M1 A1ft M1 A1 (6)
Total for Question 9: 8 marks		

Question 10

10 marks

Part	Scheme	Marks
(a)	Splits: $f'(x) = 1 - 9x^{-2}$ Integrates: $x + 9x^{-1} + c$ Uses $(3, 2)$: $3 + 3 + c = 2$ $f(x) = x + \frac{9}{x} - 4$	M1 A1 M1 A1 (4)
(b)	$f(1) = 6$ and $f'(1) = 1 - 9 = -8$ $y - 6 = -8(x - 1)$ $y = -8x + 14$	M1 M1 A1 (3)
(c)	$x + \frac{9}{x} - 4 = -8x + 14$ and multiplies by x: $9x^2 - 18x + 9 = 0$ $9(x - 1)^2 = 0$, a repeated root (or $b^2 - 4ac = 324 - 324 = 0$) So $x = 1$ is the only solution: the tangent touches C at $x = 1$ and meets it nowhere else *	M1 M1 A1* (3)
Total for Question 10: 10 marks		

