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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	3	
9 Integration Integrating x^n , finding $y = f(x)$ from $f'(x)$	10	67	own PDF	

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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.



8

Chapter 8: Differentiation

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

Question 1

5 marks

Part	Scheme	Marks
(a)	Reduces a power by one on any term: $x^n \rightarrow x^{n-1}$ Two of $12x^2$, $+12x^{-3}$, $+\frac{5}{2}x^{-\frac{1}{2}}$ $12x^2 + 12x^{-3} + \frac{5}{2}x^{-\frac{1}{2}}$ <i>Writing $-\frac{6}{x^2}$ as $-6x^{-2}$ is essential. Adding $+c$ loses the final A1.</i>	M1 A1 A1 (3)
(b)	Differentiates their $\frac{dy}{dx}$ again $24x - 36x^{-4} - \frac{5}{4}x^{-\frac{3}{2}}$	M1 A1 (2)
Total for Question 1: 5 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	Splits the fraction: $\frac{3x^2}{2x^{\frac{1}{2}}} - \frac{4}{2x^{\frac{1}{2}}}$ One term correct: $\frac{3}{2}x^{\frac{3}{2}}$ or $-2x^{-\frac{1}{2}}$ $\frac{3}{2}x^{\frac{3}{2}} - 2x^{-\frac{1}{2}}$ ($A = \frac{3}{2}$, $p = \frac{3}{2}$, $B = -2$, $q = -\frac{1}{2}$)	M1 A1 A1 (3)
(b)	Differentiates their expression $\frac{9}{4}x^{\frac{1}{2}} + x^{-\frac{3}{2}}$	M1 A1 (2)
Total for Question 2: 5 marks		



Question 3

5 marks

Part	Scheme	Marks
(a)	y at Q : $(4+h)^2 - 3(4+h) = 16 + 8h + h^2 - 12 - 3h$ $= 4 + 5h + h^2$ Gradient = $\frac{4 + 5h + h^2 - 4}{(4+h) - 4} = \frac{5h + h^2}{h} = 5 + h$ *	M1 A1 A1* (3)
(b)	As $h \rightarrow 0$, Q moves towards P and the chord gradient tends to the gradient of the tangent at P 5 Check: $\frac{dy}{dx} = 2x - 3 = 5$ at $x = 4$.	B1 B1 (2)
Total for Question 3: 5 marks		

Question 4

6 marks

Part	Scheme	Marks
(a)	Reduces a power by one on either term $3t^{-\frac{1}{2}} - \frac{3}{2}t^{\frac{1}{2}}$	M1 A1 (2)
(b)	Substitutes $t = 3$: $\frac{3}{\sqrt{3}} - \frac{3}{2}\sqrt{3}$ $\frac{3}{\sqrt{3}} = \sqrt{3}$, so $\sqrt{3} - \frac{3}{2}\sqrt{3}$ $-\frac{\sqrt{3}}{2}$ A decimal answer (-0.866) with no surd working scores M1 M0 A0.	M1 M1 A1 (3)
(c)	At 3 minutes the volume of water is <i>decreasing</i> at a rate of $\frac{\sqrt{3}}{2}$ (about 0.87) litres per minute Needs "decreasing" (or equivalent) and the rate with units.	B1ft (1)
Total for Question 4: 6 marks		



Question 5

6 marks

Part	Scheme	Marks
(a)	$2^3 - 4 \times 2^2 + 7 = 8 - 16 + 7 = -1$, so P lies on C	B1 (1)
(b)	$\frac{dy}{dx} = 3x^2 - 8x$ At $x = 2$: gradient = -4 $y + 1 = -4(x - 2) \Rightarrow y = -4x + 7$	M1 A1 A1 (3)
(c)	Normal gradient $\frac{1}{4}$: $y + 1 = \frac{1}{4}(x - 2)$ $x - 4y - 6 = 0$	M1 A1 (2)
Total for Question 5: 6 marks		

Question 6

8 marks

Part	Scheme	Marks
(a)	Multiplies out two brackets, then the third $x^3 - 3x^2 - 6x + 8$	M1 A1 (2)
(b)	$f'(x) = 3x^2 - 6x - 6$ $f'(0) = -6$ and $f(0) = 8$ $y = 8 - 6x$ <i>Using $f(0)$ or $f''(0)$ as the gradient scores M0.</i>	M1 A1 A1 (3)
(c)	$x^3 - 3x^2 - 6x + 8 = 8 - 6x \Rightarrow x^3 - 3x^2 = 0$ $x^2(x - 3) = 0$, so $x = 3$ (as $x = 0$ is the point of contact) $P(3, -10)$	M1 M1 A1 (3)
Total for Question 6: 8 marks		



Question 7

9 marks

Part	Scheme	Marks
(a)	Reduces a power by one on any term $3x^2 - 12x + 5$	M1 A1 (2)
(b)	$R(-1, -10)$ Gradient $3 + 12 + 5 = 20$	B1 B1 (2)
(c)	Parallel tangents have equal gradients: $3x^2 - 12x + 5 = 20$ $x^2 - 4x - 5 = 0 \Rightarrow (x - 5)(x + 1) = 0$, so $x = 5$ $P(5, 2)$ <i>The common error is to find the equation of the tangent at R and intersect it with C. That finds a different point and scores M0.</i>	M1 M1 A1 (3)
(d)	Midpoint of RP is $(2, -4)$ $2^3 - 6 \times 2^2 + 5 \times 2 + 2 = 8 - 24 + 10 + 2 = -4$, so the midpoint lies on C *	M1 A1* (2)
Total for Question 7: 9 marks		



Question 8

9 marks

Part	Scheme	Marks
(a)	$f'(x) = 6x^2 + 2kx - 12$ and $f''(x) = 12x + 2k$ $f'(2) = f''(2)$: $24 + 4k - 12 = 24 + 2k$ $2k = 12$, so $k = 6$ *	M1 M1 A1* (3)
(b)	$6x^2 + 12x - 12 = 12x + 12 \Rightarrow 6x^2 = 24$ $x = -2$ $f(-2) = -16 + 24 + 24 + 1 = 33$ <i>The y coordinate comes from $f(x)$, not from f' or f''.</i>	M1 A1 A1 (3)
(c)	$f(1) = -3$ and $f'(1) = 6 + 12 - 12 = 6$ Normal gradient $-\frac{1}{6}$: $y + 3 = -\frac{1}{6}(x - 1)$ $x + 6y + 17 = 0$	M1 M1 A1 (3)
Total for Question 8: 9 marks		

Question 9

8 marks

Part	Scheme	Marks
(a)	Writes $\frac{2}{x}$ as $2x^{-1}$ and differentiates $3x^2 - 2x^{-2}$	M1 A1 (2)
(b)	Gradient of the tangent is 5: $3x^2 - \frac{2}{x^2} = 5$ Multiplies by x^2 : $3x^4 - 5x^2 - 2 = 0$ *	M1 A1* (2)
(c)	$(3x^2 + 1)(x^2 - 2) = 0$, so $x^2 = 2$ (as $x^2 = -\frac{1}{3}$ is impossible) $x = \sqrt{2}$ (as $x > 0$) $y = 2\sqrt{2} + \frac{2}{\sqrt{2}} = 3\sqrt{2}$, and substitutes into $y = 5x + c$ $c = -2\sqrt{2}$	M1 A1 M1 A1 (4)
Total for Question 9: 8 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	Expands: $y = x^{\frac{3}{2}} - 4x^{\frac{1}{2}}$ Differentiates: $\frac{3}{2}x^{\frac{1}{2}} \dots$ $\frac{3}{2}x^{\frac{1}{2}} - 2x^{-\frac{1}{2}}$	M1 M1 A1 (3)
(b)	At $x = 4$: $y = 0$ and gradient $= \frac{3}{2} \times 2 - 2 \times \frac{1}{2} = 2$ $y - 0 = 2(x - 4)$, so $y = 2x - 8$ * $4^{\frac{1}{2}} = 2$ and $4^{-\frac{1}{2}} = \frac{1}{2}$ must be seen.	M1 A1* (2)
(c)	Normal gradient $-\frac{1}{2}$ through $(4, 0)$ $y = -\frac{1}{2}x + 2$	M1 A1 (2)
(d)	$A(0, -8)$ and $B(0, 2)$ Area $= \frac{1}{2} \times AB \times (x \text{ coordinate of } P) = \frac{1}{2} \times 10 \times 4$ 20	B1 M1 A1 (3)
Total for Question 10: 10 marks		

