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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	3	
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	own PDF	

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.



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Chapter 4: Graphs and Transformations

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

Question 1

5 marks

Part	Scheme	Marks
(a)	Takes out x : $x(x^2 - 6x + 9)$ $x(x - 3)^2$	M1 A1 (2)
(b)	Positive cubic shape (bottom left to top right) Passes through (0, 0) Touches the x -axis at (3, 0), a minimum point <i>Third B1: follow through a repeated root from their factorisation. A curve crossing at (3, 0) scores B0.</i>	B1 B1 B1ft (3)
Total for Question 1: 5 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	Two branches, both above the x -axis, symmetrical about the y -axis Both branches asymptotic to both coordinate axes	B1 B1 (2)
(b)	Same shape translated down, with both branches crossing the x -axis $y = -1$ stated as the horizontal asymptote $(-\sqrt{3}, 0)$ and $(\sqrt{3}, 0)$ <i>Third B1: from $\frac{3}{x^2} = 1$. Decimals ± 1.73 score B0 because the question asks for exact coordinates.</i>	B1 B1 B1 (3)
Total for Question 2: 5 marks		



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Question 3

6 marks

Part	Scheme	Marks
(a)	Maximum $(-3, 4)$	B1
	Minimum $(0, -3)$	B1
		(2)
(b)	Maximum $(-1, 12)$	B1
	Minimum $(2, -9)$	B1
		(2)
(c)	Maximum $(-\frac{1}{2}, 4)$	B1
	Minimum $(1, -3)$	B1
	<i>(a) moves the graph 2 left; (b) multiplies y coordinates by 3; (c) divides x coordinates by 2.</i>	(2)
Total for Question 3: 6 marks		

Question 4

5 marks

Part	Scheme	Marks
(a)	Positive cubic touching the x -axis at O (a maximum) and crossing at $(3, 0)$	B1
	Coordinates $(0, 0)$ and $(3, 0)$ shown	B1
	Reciprocal curve with branches in the first and third quadrants, asymptotic to both axes	B1
		(3)
(b)	Divides by x ($x \neq 0$): $x^4 - 3x^3 = 4 \Leftrightarrow x^2(x - 3) = \frac{4}{x}$	M1
	2 solutions, because the two graphs meet at two points	A1
	<i>The curves cross once in the third quadrant (at $x = -1$) and once for $x > 3$. A1 needs the reason, linked to their sketch.</i>	(2)
Total for Question 4: 5 marks		



Question 5

5 marks

Part	Scheme	Marks
(a)	(i) $y = \frac{4}{x+3}$	B1
	(ii) $x = -3$	B1 (2)
(b)	A translation 2 units in the negative y direction, i.e. by the vector $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$	M1 A1 (2)
(c)	$\frac{4}{x} - 2 = 0 \Rightarrow x = 2$: $(2, 0)$	B1 (1)
Total for Question 5: 5 marks		



Question 6

9 marks

Part	Scheme	Marks
(a)	Positive cubic shape Touches the x -axis at $(-\frac{1}{2}, 0)$ and crosses at $(3, 0)$ Crosses the y -axis at $(0, -3)$	B1 B1 B1 (3)
(b)	$x > 3$ $f(-\frac{1}{2}) = 0$, so this point is not included; $f(x) < 0$ elsewhere for $x < 3$.	B1ft (1)
(c)	Expands $(4x^2 + 4x + 1)(x - 3)$ $4x^3 - 8x^2 - 11x - 3$	M1 A1 (2)
(d)	$4x^3 - 8x^2 - 11x - 3 = -3 \Rightarrow x(4x^2 - 8x - 11) = 0$ $x = \frac{8 \pm \sqrt{64 + 176}}{8} = \frac{8 \pm 4\sqrt{15}}{8}$ $x = 1 \pm \frac{\sqrt{15}}{2}$ Accept $\frac{2 \pm \sqrt{15}}{2}$. The root $x = 0$ is the y intercept itself, so it is not one of the "other" points. Decimals only score M1 M0 A0.	M1 M1 A1 (3)
Total for Question 6: 9 marks		



Question 7

8 marks

Part	Scheme	Marks
(a)	$f(x) = kx(x - 6)$ and uses $(3, -9)$: $-9k = -9$ $f(x) = x(x - 6) = x^2 - 6x$	M1 A1 (2)
(b)	$g(x) = kx(x - 6)^2$ Uses $(2, 16)$: $k \times 2 \times 16 = 16$ $g(x) = \frac{1}{2}x(x - 6)^2$ <i>Omitting the constant k scores B0 M0 A0.</i>	B1 M1 A1 (3)
(c)	$x(x - 6) = \frac{1}{2}x(x - 6)^2 \Rightarrow x(x - 6) \left[1 - \frac{1}{2}(x - 6) \right] = 0$ $x = 8$ (as $x = 0$ and $x = 6$ are O and $(6, 0)$) $P(8, 16)$ <i>Expanding to a cubic and solving is acceptable. The y coordinate may come from either curve.</i>	M1 A1 A1 (3)
Total for Question 7: 8 marks		



Question 8

8 marks

Part	Scheme	Marks
(a)	Reciprocal shape with branches top right and bottom left of the asymptotes Asymptotes $x = 0$ and $y = -2$ Crosses the x -axis at $(\frac{3}{2}, 0)$	B1 B1 B1 (3)
(b)	At $x = -3$ on C : $y = \frac{3}{-3} - 2 = -3$, so $P(-3, -3)$ and $-3 = -3k + 1$ $k = \frac{4}{3}$	M1 A1 (2)
(c)	$\frac{4}{3}x + 1 = \frac{3}{x} - 2$ and multiplies by $3x$: $4x^2 + 9x - 9 = 0$ $(4x - 3)(x + 3) = 0$, so $x = \frac{3}{4}$ (as $x = -3$ is P) $Q(\frac{3}{4}, 2)$ <i>Knowing that $x = -3$ is one root is a check on the factorisation. The y coordinate may come from l or from C.</i>	M1 M1 A1 (3)
Total for Question 8: 8 marks		

Question 9

8 marks

Part	Scheme	Marks
(a)	Same shape as $y = f(x)$, translated down 2 Asymptotes $x = 1$ and $y = 0$ Crosses the y -axis at $(0, -3)$ and does not meet the x -axis	B1 B1 B1 (3)
(b)	Same shape, stretched horizontally by scale factor 2 Asymptotes $x = 2$ and $y = 2$ $(-1, 0)$ and $(0, -1)$	B1 B1 B1 (3)
(c)	$a = 2$ (from the horizontal asymptote) $b = 3$ (from $f(0) = 2 - b = -1$)	B1 B1 (2)
Total for Question 9: 8 marks		



Question 10

9 marks

Part	Scheme	Marks
(a)	Positive cubic shape Crosses the x -axis at $(-1, 0)$ and touches at $(2, 0)$ Maximum at $(0, 4)$ on the y -axis	B1 B1 B1 (3)
(b)	The line $y = k$ must lie between the minimum $y = 0$ and the maximum $y = 4$ $0 < k < 4$	M1 A1 (2)
(c)	$y = f(x + 3)$ is a horizontal translation, so it has the same number of solutions as $f(x) = 2$ 3 , because $0 < 2 < 4$	M1 A1 (2)
(d)	$c = 0$ (the minimum is already on the x -axis) $c = -4$ (the maximum moves down onto the x -axis)	B1 B1 (2)
Total for Question 10: 9 marks		

