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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	3	
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	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.



1

Chapter 1: Algebraic Expressions

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

Question 1

4 marks

Part	Scheme	Marks
(a)	$27^{-\frac{2}{3}} = \frac{1}{27^{\frac{2}{3}}}$ or $27^{\frac{2}{3}} = 9$ or $(\sqrt[3]{27})^{-2} = 3^{-2}$ $\frac{1}{9}$ M1: deals correctly with either the negative sign (reciprocal) or the fractional power. A1: $\frac{1}{9}$ cao.	M1 A1 (2)
(b)	$(27x^6)^{\frac{2}{3}} = 9x^4$ or $(3x)^2 = 9x^2$ x^2 M1: numerator or denominator correctly simplified. A1: x^2 cao. Leaving $9x^4 \div 9x^2$ unsimplified scores A0.	M1 A1 (2)
Total for Question 1: 4 marks		

Question 2

6 marks

Part	Scheme	Marks
(a)	Takes out the common factor x : $x(2x^2 - 7x - 15)$ Attempts to factorise their quadratic: $(2x \pm 3)(x \pm 5)$ $x(2x + 3)(x - 5)$ A1: all three factors must be seen together, in any order. $(2x^2 + 3x)(x - 5)$ is not factorised completely: A0.	B1 M1 A1 (3)
(b)	Multiplies two brackets to get a three-term quadratic, e.g. $(x + 3)(2x - 1) = 2x^2 + 5x - 3$ Multiplies their quadratic by the third bracket: $(2x^2 + 5x - 3)(4 - x) = 8x^2 + 20x - 12 - 2x^3 - 5x^2 + 3x$ $-2x^3 + 3x^2 + 23x - 12$ dM1 depends on the first M1. A1: all four terms correct, in any order.	M1 dM1 A1 (3)
Total for Question 2: 6 marks		



Question 3

5 marks

Part	Scheme	Marks
(a)	$\sqrt{50} = 5\sqrt{2}$ or $\sqrt{18} = 3\sqrt{2}$ $2\sqrt{2}$	M1 A1 (2)
(b)	$\frac{2\sqrt{2}}{3\sqrt{2}-4} \times \frac{3\sqrt{2}+4}{3\sqrt{2}+4}$ Numerator $2\sqrt{2}(3\sqrt{2}+4) = 12+8\sqrt{2}$ or denominator $18-16=2$ $6+4\sqrt{2}$ <i>First M1: multiplies top and bottom by $3\sqrt{2}+4$. Using the unsimplified numerator $\sqrt{50}-\sqrt{18}$ can score full marks. A decimal answer with no working scores 0.</i>	M1 M1 A1 (3)
Total for Question 3: 5 marks		

Question 4

5 marks

Part	Scheme	Marks
(a)	Attempts $(3-2\sqrt{x})(3-2\sqrt{x})$ giving 3 or 4 terms $9-12\sqrt{x}+4x$ <i>Accept $9-12x^{\frac{1}{2}}+4x$ with the terms in any order.</i>	M1 A1 (2)
(b)	Divides each term by $x^{\frac{1}{2}}$, with correct index work on at least one term, e.g. $\frac{4x}{x^{\frac{1}{2}}} = 4x^{\frac{1}{2}}$ Two of the three terms correct $9x^{-\frac{1}{2}} - 12 + 4x^{\frac{1}{2}}$ <i>Accept $A=9$, $p=-\frac{1}{2}$, $B=-12$, $C=4$, $q=\frac{1}{2}$ stated separately. Follow through their expansion from (a) for M1 only.</i>	M1 A1 A1 (3)
Total for Question 4: 5 marks		



Question 5

6 marks

Part	Scheme	Marks
(a)	$BC = \frac{13+7\sqrt{3}}{2+\sqrt{3}}$ $\frac{(13+7\sqrt{3})(2-\sqrt{3})}{(2+\sqrt{3})(2-\sqrt{3})} = \frac{26-13\sqrt{3}+14\sqrt{3}-21}{4-3}$ $\boxed{5+\sqrt{3}}$ Alternative: $(2+\sqrt{3})(a+b\sqrt{3}) = 13+7\sqrt{3}$ gives $2a+3b=13$ and $a+2b=7$. M1 for both equations, M1 for solving them, A1 for $a=5, b=1$.	M1 M1 A1 (3)
(b)	Uses Pythagoras: $AC^2 = (2+\sqrt{3})^2 + (5+\sqrt{3})^2$ Squares one surd length correctly: $(2+\sqrt{3})^2 = 7+4\sqrt{3}$ or $(5+\sqrt{3})^2 = 28+10\sqrt{3}$ $AC^2 = 35+14\sqrt{3} = 7(5+2\sqrt{3})$ * A1* cso: both squares correct and $35+14\sqrt{3}$ seen before the given answer. Follow through their BC for the M marks only.	M1 M1 A1* (3)
Total for Question 5: 6 marks		

Question 6

6 marks

Part	Scheme	Marks
(a)	$2^{2x+1} = 2 \times (2^x)^2 = 2p^2$ $2^{x+4} + 2^x = 16 \times 2^x + 2^x = 17p$ $2p^2 + 8 = 17p \Rightarrow 2p^2 - 17p + 8 = 0$ * A1* cso: both B marks, with no errors in the rearrangement.	B1 B1 A1* (3)
(b)	Solves the quadratic: $(2p-1)(p-8) = 0$, so $p = \frac{1}{2}$ or $p = 8$ Uses $2^x =$ one of their values of p to find x, e.g. $2^x = 8 \Rightarrow x = 3$ $\boxed{x = -1, x = 3}$ Answers with no working score 0, because the question says solutions relying on calculator technology are not acceptable. dM1: accept $x = \log 8 \div \log 2$.	M1 dM1 A1 (3)
Total for Question 6: 6 marks		



Question 7

6 marks

Part	Scheme	Marks
	Writes the left-hand side of the first equation as a power of 2: $2^x \times 2^{2(y+1)} = 2^{x+2y+2}$	M1
	$32\sqrt{2} = 2^5 \times 2^{\frac{1}{2}} = 2^{\frac{11}{2}}$	B1
	Writes the left-hand side of the second equation as a power of 3: $\frac{3^{3x}}{3^{2y}} = 3^{3x-2y}$	M1
	$729\sqrt{3} = 3^6 \times 3^{\frac{1}{2}} = 3^{\frac{13}{2}}$	B1
	Equates indices and solves $x+2y = \frac{7}{2}$ and $3x-2y = \frac{13}{2}$	M1
	$x = \frac{5}{2}, y = \frac{1}{2}$	A1
	Final M1 needs two linear equations from equating indices, and an attempt to eliminate a variable. Answers with no working score 0. Accept $x = 2.5, y = 0.5$.	
		(6)
Total for Question 7: 6 marks		

Question 8

7 marks

Part	Scheme	Marks
(a)	Gradient of $AB = \frac{7-1}{2+2\sqrt{3}-\sqrt{3}} = \frac{6}{2+\sqrt{3}}$	M1
	$\frac{6}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = \frac{12-6\sqrt{3}}{4-3}$	M1
	$12-6\sqrt{3}$	A1
	Second M1: the rationalising step must be seen. A calculator answer with no rationalising scores M1 M0 A0.	
		(3)
(b)	Gradient of $l = \frac{-1}{12-6\sqrt{3}}$ (or $-\frac{2+\sqrt{3}}{6}$ after rationalising)	M1
	Equation of l : $y-1 = \frac{-1}{12-6\sqrt{3}}(x-\sqrt{3})$	M1
	Sets $y=0$ and solves: $x-\sqrt{3} = 12-6\sqrt{3}$	dM1
	$12-5\sqrt{3}$	A1
	First M1: uses the negative reciprocal of their gradient from (a). dM1 depends on the second M1. Seeing that $x-\sqrt{3}$ equals the gradient of AB avoids a second rationalisation, but either route scores full marks.	
		(4)
Total for Question 8: 7 marks		



Question 9

6 marks

Part	Scheme	Marks
(a)	Sets the equations equal and writes $\sqrt{2x} = \sqrt{2}\sqrt{x}$: $\sqrt{2}\sqrt{x} = \sqrt{x} + 3$ Collects the $\sqrt{x}$ terms: $\sqrt{x}(\sqrt{2} - 1) = 3 \Rightarrow \sqrt{x} = \frac{3}{\sqrt{2} - 1}$ $\sqrt{x} = \frac{3}{\sqrt{2} - 1} \times \frac{\sqrt{2} + 1}{\sqrt{2} + 1} = \frac{3(\sqrt{2} + 1)}{2 - 1} = 3(\sqrt{2} + 1)$ * <i>A1* cso: the rationalising step must be shown. Squaring both sides at the start leads to a harder route; it scores if it reaches the given answer correctly.</i>	M1 M1 A1* (3)
(b)	Squares: $x = 9(\sqrt{2} + 1)^2 = 9(3 + 2\sqrt{2})$ $x = 27 + 18\sqrt{2}$ $y = 6 + 3\sqrt{2}$ <i>y from $y = \sqrt{x} + 3 = 3\sqrt{2} + 3 + 3$, or from $y = \sqrt{2}\sqrt{x} = \sqrt{2} \times 3(\sqrt{2} + 1)$. Decimal coordinates score M1 A0 A0.</i>	M1 A1 A1 (3)
Total for Question 9: 6 marks		



Question 10

6 marks

Part	Scheme	Marks
(a)	$\left(\sqrt{k+2}\right)^2 - \left(\sqrt{k}\right)^2 = (k+2) - k = 2 \quad *$ <i>Must show the difference of two squares, or all four terms of the expansion with the middle terms cancelling.</i>	B1* (1)
(b)	$\frac{1}{\sqrt{k} + \sqrt{k+2}} \times \frac{\sqrt{k+2} - \sqrt{k}}{\sqrt{k+2} - \sqrt{k}}$ $= \frac{\sqrt{k+2} - \sqrt{k}}{2}, \text{ using the result of part (a) } *$	M1 A1* (2)
(c)	Uses part (b) on at least two terms: $\frac{\sqrt{3} - \sqrt{1}}{2} + \frac{\sqrt{5} - \sqrt{3}}{2} + \dots$ The terms cancel in pairs, leaving $\frac{\sqrt{49} - \sqrt{1}}{2}$ $= \frac{7 - 1}{2} = 3 \quad *$ <i>A1* cso: the last term $\frac{1}{2}(\sqrt{49} - \sqrt{47})$ must be shown or clearly implied. A calculator sum of the terms scores 0.</i>	M1 M1 A1* (3)
Total for Question 10: 6 marks		

