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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	3	
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	own PDF	

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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.



2

Chapter 2: Coordinate Geometry in the (x, y) Plane

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

Question 1

4 marks

Part	Scheme	Marks
	Centre is the midpoint of AB : $(2, 0)$	M1
	$(2, 0)$	A1
	Radius: $r^2 = (5 - 2)^2 + (-4 - 0)^2 = 25$ (or $AB = 10$, so $r = 5$)	M1
	$(x - 2)^2 + y^2 = 25$	A1
		(4)
Total for Question 1: 4 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	Completes the square: $(x - 3)^2 + (y + 5)^2 = 9 + 25 - 9$	M1
	Centre $(3, -5)$	A1
	Radius 5	A1
		(3)
(b)	The centre is 5 units below the x -axis and $r = 5$ (or $y = 0$ gives $(x - 3)^2 = 0$, a repeated root)	M1
	So C touches the x -axis at $(3, 0)$	A1
		(2)
Total for Question 2: 5 marks		



Question 3

6 marks

Part	Scheme	Marks
(a)	(i) $r = \sqrt{(3+1)^2 + (0-3)^2} = 5$	B1 (1)
	(ii) $(x \pm 1)^2 + (y \pm 3)^2 = \dots$ $(x+1)^2 + (y-3)^2 = 25$	M1 A1 (2)
(b)	Gradient of the radius $= \frac{0-3}{3+1} = -\frac{3}{4}$, so the tangent gradient is $\frac{4}{3}$ $y-0 = \frac{4}{3}(x-3)$ $4x-3y-12=0$	M1 M1 A1 (3)
Total for Question 3: 6 marks		

Question 4

5 marks

Part	Scheme	Marks
(a)	Substitutes: $x^2 + (x+1)^2 = 25$ $2x^2 + 2x - 24 = 0 \Rightarrow x^2 + x - 12 = 0$ $(x+4)(x-3) = 0$ and finds y $(3, 4)$ and $(-4, -3)$	M1 A1 M1 A1 (4)
(b)	$\sqrt{7^2 + 7^2} = 7\sqrt{2}$	B1 (1)
Total for Question 4: 5 marks		



Question 5

5 marks

Part	Scheme	Marks
(a)	Midpoint (1, 3) and gradient of $AB = \frac{4}{6} = \frac{2}{3}$	M1
	Perpendicular gradient $-\frac{3}{2}$	M1
	$y - 3 = -\frac{3}{2}(x - 1)$, i.e. $3x + 2y - 9 = 0$	A1
		(3)
(b)	$y = 0$: centre (3, 0); $r^2 = (4 - 3)^2 + 5^2 = 26$	M1
	$(x - 3)^2 + y^2 = 26$	A1
	<i>The centre is on the perpendicular bisector of every chord, so it is where the bisector meets the x-axis.</i>	(2)
Total for Question 5: 5 marks		

Question 6

8 marks

Part	Scheme	Marks
(a)	$(x - 2)^2 + (y + 3)^2 = 12 + 4 + 9$	M1
	Centre (2, -3)	A1
	Radius 5	A1
		(3)
(b)	$(x - 10)^2 + (y - 9)^2 = -145 + 100 + 81 = 36$	M1
	Centre (10, 9), radius 6	A1
		(2)
(c)	Distance between the centres $= \sqrt{8^2 + 12^2} = \sqrt{208} = 14.4 \dots$	M1
	Compares with the sum of the radii, $5 + 6 = 11$	M1
	$\sqrt{208} > 11$, so the circles do not meet (and neither lies inside the other)	A1
	<i>The final mark needs both values and a conclusion. "The centres are in different quadrants" is not a proof.</i>	(3)
Total for Question 6: 8 marks		



Question 7

8 marks

Part	Scheme	Marks
(a)	Substitutes $y = 2x + k$: $(x - 3)^2 + (2x + k - 1)^2 = 20$ Expands: $x^2 - 6x + 9 + 4x^2 + 4(k - 1)x + (k - 1)^2 = 20$ $5x^2 + (4k - 10)x + k^2 - 2k - 10 = 0$ *	M1 M1 A1* (3)
(b)	Tangent: $b^2 - 4ac = 0$: $(4k - 10)^2 - 20(k^2 - 2k - 10) = 0$ $-4k^2 - 40k + 300 = 0 \Rightarrow k^2 + 10k - 75 = 0$ $k = 5$ or $k = -15$	M1 A1 A1 (3)
(c)	$k = 5$: $5x^2 + 10x + 5 = 0$, so $x = -1$ $(-1, 3)$ <i>Alternative for (b) and (c): the radius to the point of contact has gradient $-\frac{1}{2}$, and the distance from the centre to the line equals $\sqrt{20}$.</i>	M1 A1 (2)
Total for Question 7: 8 marks		

Question 8

8 marks

Part	Scheme	Marks
(a)	Gradient of $CA = \frac{2-0}{-1-5} = -\frac{1}{3}$ and gradient of $CB = \frac{6-0}{7-5} = 3$ Both correct $-\frac{1}{3} \times 3 = -1$, so CA is perpendicular to CB and angle $ACB = 90^\circ$ *	M1 A1 A1* (3)
(b)	Angle in a semicircle: AB is a diameter, so the centre is the midpoint $(3, 4)$ $r^2 = (7-3)^2 + (6-4)^2 = 20$ $(x-3)^2 + (y-4)^2 = 20$	M1 M1 A1 (3)
(c)	The centre is the midpoint of CD : $D = (2 \times 3 - 5, 2 \times 4 - 0)$ $D(1, 8)$	M1 A1 (2)
Total for Question 8: 8 marks		



Question 9

9 marks

Part	Scheme	Marks
(a)	$(x-4)^2 + (y-1)^2 = 8 + 16 + 1$ $P(4, 1)$, radius 5	M1 A1 (2)
(b)	Substitutes $y = x + 2$: $(x-4)^2 + (x+1)^2 = 25$ $2x^2 - 6x - 8 = 0 \Rightarrow (x-4)(x+1) = 0$ $A(-1, 1)$ and $B(4, 6)$ (in either order)	M1 A1 A1 (3)
(c)	PA is horizontal and PB is vertical (or $AB^2 = 50 = 5^2 + 5^2$, or $\cos APB = 0$ by the cosine rule) So angle $APB = \frac{\pi}{2}$ *	M1 A1* (2)
(d)	Sector – triangle: $\frac{1}{2} \times 5^2 \times \frac{\pi}{2} - \frac{1}{2} \times 5 \times 5$ $\frac{25\pi}{4} - \frac{25}{2}$	M1 A1 (2)
Total for Question 9: 9 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	$CT^2 = (14 - 2)^2 + (6 - 1)^2 = 169$ Angle $CPT = 90^\circ$, so $TP^2 = CT^2 - r^2$ $TP^2 = 169 - 25 = 144$, so $TP = 12$ *	M1 M1 A1* (3)
(b)	Two right-angled triangles: $2 \times \frac{1}{2} \times 5 \times 12$ 60	M1 A1 (2)
(c)	$\tan(\angle PCT) = \frac{12}{5}$, so $\angle PCT = 1.176\dots$ $\angle PCQ = 2.35$	M1 A1 (2)
(d)	Sector $PCQ = \frac{1}{2} \times 5^2 \times 2.352\dots = 29.40\dots$ Area of $R = 60 - 29.40\dots$ 30.6 <i>Using degrees in the sector formula scores M0. Premature rounding of the angle to 2.35 gives 30.6 still.</i>	M1 M1 A1 (3)
Total for Question 10: 10 marks		

