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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	3	
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	

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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 6: Trigonometric Ratios

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

Question 1

4 marks

Part	Scheme	Marks
(a)	$BC^2 = 8^2 + 11^2 - 2 \times 8 \times 11 \cos 50^\circ$ $BC = 8.48 \text{ cm}$	M1 A1 (2)
(b)	$\frac{1}{2} \times 8 \times 11 \times \sin 50^\circ$ 33.7 cm^2	M1 A1 (2)
Total for Question 1: 4 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	$\frac{\sin R}{9} = \frac{\sin 42^\circ}{7} \Rightarrow \sin R = 0.8603 \dots$ $R = 59.4^\circ$ $59.4^\circ \text{ and } 120.6^\circ$ <i>Second value from $180^\circ - 59.4^\circ$; it fits because $120.6^\circ + 42^\circ < 180^\circ$.</i>	M1 A1 A1 (3)
(b)	Angle $PQR = 180^\circ - 42^\circ - 120.6^\circ = 17.4^\circ$ and $PR = \frac{7 \sin 17.35 \dots^\circ}{\sin 42^\circ}$ 3.12 cm	M1 A1 (2)
Total for Question 2: 5 marks		



Question 3

5 marks

Part	Scheme	Marks
(a)	The largest angle is opposite the 9 cm side: $\cos \theta = \frac{5^2 + 7^2 - 9^2}{2 \times 5 \times 7}$ $= \frac{-7}{70} = -\frac{1}{10}$ *	M1 A1* (2)
(b)	Uses $\sin^2 \theta + \cos^2 \theta = 1$: $\sin \theta = \sqrt{1 - \frac{1}{100}}$ $\sin \theta = \sqrt{\frac{99}{100}} = \frac{3\sqrt{11}}{10}$ Area = $\frac{1}{2} \times 5 \times 7 \times \frac{3\sqrt{11}}{10} = \frac{21\sqrt{11}}{4}$ Uses $\sin^2 \theta + \cos^2 \theta = 1$ or a right-angled triangle with sides 1, $\sqrt{99}$, 10. Decimals only (17.4) score M1 A0 A0.	M1 A1 A1 (3)
Total for Question 3: 5 marks		

Question 4

5 marks

Part	Scheme	Marks
(a)	Tangent shape: two complete branches and parts of the branches at each end Asymptotes $x = 135^\circ$ and $x = 315^\circ$ $(0, -1)$, $(45^\circ, 0)$ and $(225^\circ, 0)$ The graph of $y = \tan x$ translated 45° to the right. y intercept: $\tan(-45^\circ) = -1$.	B1 B1 B1 (3)
(b)	2 One in each branch that covers all values: $x = 108.4^\circ$ and $x = 288.4^\circ$. The end sections take only values from -1 upwards (left) and -1 downwards (right).	B1 (1)
(c)	3 $\tan(x - 45^\circ) = -1$ at $x = 0^\circ, 180^\circ$ and 360°: both end points are included in the interval.	B1 (1)
Total for Question 4: 5 marks		



Question 5

5 marks

Part	Scheme	Marks
(a)	$a = 3$	B1
	$b = 2$ (two complete cycles in 360°)	B1
		(2)
(b)	$(90^\circ, -3)$	B1
	$(270^\circ, -3)$	B1
		(2)
(c)	4	B1
		(1)
Total for Question 5: 5 marks		

Question 6

8 marks

Part	Scheme	Marks
(a)	$AC^2 = 6^2 + 9^2 - 2 \times 6 \times 9 \cos 110^\circ$	M1
	$AC = 12.4 \text{ m}$	A1
		(2)
(b)	$\frac{\sin(\angle ACD)}{5} = \frac{\sin 72^\circ}{12.407 \dots}$	M1
	22.5°	A1
	The obtuse value 157.5° is impossible, because $157.5^\circ + 72^\circ > 180^\circ$	B1
		(3)
(c)	$\text{Area } ABC = \frac{1}{2} \times 6 \times 9 \times \sin 110^\circ = 25.37 \dots$	M1
	Angle $CAD = 180^\circ - 72^\circ - 22.54^\circ = 85.46^\circ$, area	
	$ACD = \frac{1}{2} \times 5 \times 12.407 \dots \times \sin 85.46^\circ = 30.92 \dots$	M1
	56.3 m^2	A1
	Premature rounding (for example $AC = 12$) usually loses the final A mark.	(3)
Total for Question 6: 8 marks		



Question 7

9 marks

Part	Scheme	Marks
(a)	$Q(45^\circ, 0)$ P : maximum where $\cos 2x = -1$, i.e. $2x = 180^\circ$ $P(90^\circ, 4)$	B1 M1 A1 (3)
(b)	$5 = k - 4 \cos 60^\circ = k - 2$ $k = 7$	M1 A1 (2)
(c)	Minimum value $7 - 4 = 3$ where $\cos 2x = 1$ $(0, 3), (180^\circ, 3)$ and $(360^\circ, 3)$ <i>All three points are needed for A1: $x = 0^\circ$ and $x = 360^\circ$ are inside the interval.</i>	M1 A1ft (2)
(d)	Rearranges to $-4 \cos 2x = 2 - \frac{x}{45}$ and draws the line $y = 2 - \frac{x}{45}$ through $(0, 2)$ and $(90^\circ, 0)$, reaching $y = -6$ at $x = 360^\circ$ 3 solutions, because the line crosses C three times <i>The crossings are near $x = 51^\circ, 144^\circ$ and 205°. After $x = 270^\circ$ the line is below C all the way to $x = 360^\circ$ (it ends at $-6 < -4$).</i>	M1 A1 (2)
Total for Question 7: 9 marks		



Question 8

8 marks

Part	Scheme	Marks
(a)	$x = 0: y = 2 \sin 60^\circ = (0, \sqrt{3})$ $x + 60^\circ = 180^\circ \text{ or } 360^\circ$ $(120^\circ, 0) \text{ and } (300^\circ, 0)$	B1 M1 A1 (3)
(b)	Maximum $(30^\circ, 2)$ Minimum $(210^\circ, -2)$	B1 B1 (2)
(c)	$-2 < k < 2$ $-2 < k < 2, k \neq \sqrt{3}$ <i>When $k = \sqrt{3}$ the line meets C three times: at $x = 0^\circ, 60^\circ$ and 360°. When $k = \pm 2$ it meets C once.</i>	M1 A1 (2)
(d)	4 $y = 2 \sin(2x + 60^\circ)$ has period 180° , so two complete cycles: $2x + 60^\circ = 150^\circ, 390^\circ, 510^\circ, 750^\circ$.	B1 (1)
Total for Question 8: 8 marks		



Question 9

8 marks

Part	Scheme	Marks
(a)	180°	B1 (1)
(b)	$\tan 45^\circ = 1$ and $\frac{45}{45} = 1$, so $x = 45^\circ$ is a solution *	B1* (1)
(c)	(i) 3 ($x = -45^\circ, 0^\circ, 45^\circ$) (ii) 5 (iii) Each interval $180n^\circ < x < 180n^\circ + 90^\circ$ for $n = 1, 2, \dots, 49$ adds one solution, and the same for negative x 101 (ii): the new solutions are in $180^\circ < x < 270^\circ$ and $-270^\circ < x < -180^\circ$, where $\tan x$ is positive and increases without limit. There are none where $\tan x$ and the line have opposite signs. (iii): 50 positive, 50 negative and $x = 0^\circ$. Common wrong answers are 100 (missing the origin) and 200.	B1 B1 M1 A1 (4)
(d)	The line $y = -\frac{x}{45}$ passes through O with negative gradient; it meets the branch in $90^\circ < x < 180^\circ$ once and the branch in $-180^\circ < x < -90^\circ$ once 3, since the graphs also meet at the origin For $0 < x < 90^\circ$, $\tan x > 0$ while the line is negative; for $-90^\circ < x < 0$ the signs are reversed, so there are no other solutions.	M1 A1 (2)
Total for Question 9: 8 marks		



Question 10

9 marks

Part	Scheme	Marks
(a)	$\frac{\sin C}{10} = \frac{\sin 30^\circ}{6} \Rightarrow \sin C = \frac{5}{6}$ 56.4° Obtuse: 123.6° <i>Giving 56.4° as the final answer scores M1 A1 A0: the question states that angle ACB is obtuse.</i>	M1 A1 A1 (3)
(b)	$6^2 = 10^2 + x^2 - 2 \times 10 \times x \cos 30^\circ$ $\cos 30^\circ = \frac{\sqrt{3}}{2}, \text{ so } 36 = 100 + x^2 - 10\sqrt{3}x \Rightarrow x^2 - 10\sqrt{3}x + 64 = 0 \quad *$ $x = \frac{10\sqrt{3} \pm \sqrt{300 - 256}}{2} = 5\sqrt{3} \pm \sqrt{11}$ C is obtuse, so C is the nearer of the two points to A: $AC = 5\sqrt{3} - \sqrt{11} \quad *$	M1 A1* M1 A1* (4)
(c)	D gives the other root: $AD = 5\sqrt{3} + \sqrt{11}$, so $CD = AD - AC$ $2\sqrt{11}$ cm <i>Alternative: triangle BCD is isosceles with base angles 56.4°, so $CD = 2 \times 6 \cos(\angle BDC) = 12 \times \frac{\sqrt{11}}{6}$.</i>	M1 A1 (2)
Total for Question 10: 9 marks		

