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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	own PDF	
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	3	
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.



6

Chapter 6: Trigonometric Identities and Equations

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

Question 1

4 marks

Part	Scheme	Marks
(a)	$\cos^2 \theta = 1 - \frac{5}{9} = \frac{4}{9}$ Obtuse, so $\cos \theta = -\frac{2}{3}$	M1 A1 (2)
(b)	$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\sqrt{5}}{3} \div \left(-\frac{2}{3}\right)$ $-\frac{\sqrt{5}}{2}$	M1 A1 (2)
Total for Question 1: 4 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	$x = 48.6^\circ$ $48.6^\circ, 131.4^\circ$	B1 B1 (2)
(b)	$\tan x = -\frac{5}{3}$ Principal value -59.0° , adds 180° $121.0^\circ, 301.0^\circ$	M1 M1 A1 (3)
Total for Question 2: 5 marks		



Question 3

4 marks

Part	Scheme	Marks
	$\sin\left(x - \frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$ $x - \frac{\pi}{6} = \frac{\pi}{3} \text{ or } \frac{2\pi}{3}$ Adds $\frac{\pi}{6}$ $x = \frac{\pi}{2}, \frac{5\pi}{6}$	M1 A1 M1 A1 (4)
Total for Question 3: 4 marks		

Question 4

6 marks

Part	Scheme	Marks
(a)	$\cos^4 x - \sin^4 x = (\cos^2 x - \sin^2 x)(\cos^2 x + \sin^2 x)$ $= \cos^2 x - \sin^2 x$ using $\cos^2 x + \sin^2 x = 1$ $= 1 - \sin^2 x - \sin^2 x = 1 - 2\sin^2 x$ *	M1 M1 A1* (3)
(b)	$1 - 2\sin^2 x = \frac{1}{2} \Rightarrow \sin x = \pm \frac{1}{2}$ Two correct values $30^\circ, 150^\circ, 210^\circ, 330^\circ$ <i>The negative root $\sin x = -\frac{1}{2}$ gives the two solutions in the third and fourth quadrants.</i>	M1 A1 A1 (3)
Total for Question 4: 6 marks		

Question 5

4 marks

Part	Scheme	Marks
	$2x - 30^\circ = 60^\circ$ Uses the period: $2x - 30^\circ = 60^\circ$ or 240° (in $-30^\circ \leq 2x - 30^\circ < 330^\circ$) Solves for x $x = 45^\circ, 135^\circ$	M1 M1 M1 A1 (4)
Total for Question 5: 4 marks		



Question 6

8 marks

Part	Scheme	Marks
(a)	$3 \frac{\sin x}{\cos x} \sin x = 8 \Rightarrow 3 \sin^2 x = 8 \cos x$ $3(1 - \cos^2 x) = 8 \cos x$ $3 \cos^2 x + 8 \cos x - 3 = 0$ *	M1 M1 A1* (3)
(b)	$(3 \cos x - 1)(\cos x + 3) = 0$; $\cos x = -3$ is impossible $\cos x = \frac{1}{3}$, so $x = 70.5^\circ$ 70.5°, 289.5°	M1 A1 A1 (3)
(c)	$2\theta = 70.5^\circ$ or 289.5° (in $0 \leq 2\theta < 360^\circ$) 35.3°, 144.7°	M1 A1 (2)
Total for Question 6: 8 marks		

Question 7

8 marks

Part	Scheme	Marks
(a)	The student divided by $\sin x$, which may be zero so the solutions of $\sin x = 0$ have been lost	B1 B1 (2)
(b)	$\sin x(5 \cos x - 2) = 0$ $\sin x = 0$: $x = 0^\circ, 180^\circ, 360^\circ$ $\cos x = 0.4$: $x = 66.4^\circ, 293.6^\circ$ 0°, 66.4°, 180°, 293.6°, 360°	M1 A1 A1 A1 (4)
(c)	$0 \leq 3x \leq 1080^\circ$: $\sin 3x = 0$ gives 7 values and $\cos 3x = 0.4$ gives 6 values 13	M1 A1 (2)
Total for Question 7: 8 marks		



Question 8

8 marks

Part	Scheme	Marks
(a)	$4(1 - \sin^2 x) - 4 \sin x = 1$ $4 \sin^2 x + 4 \sin x - 3 = 0$ *	M1 A1* (2)
(b)	$(2 \sin x - 1)(2 \sin x + 3) = 0$ $\sin x = -\frac{3}{2}$ is rejected because $-1 \leq \sin x \leq 1$ $\sin x = \frac{1}{2}$ $x = \frac{\pi}{6}, \frac{5\pi}{6}$	M1 B1 A1 A1 (4)
(c)	Two solutions in each interval of length 2π , and there are five such intervals 10	M1 A1 (2)
Total for Question 8: 8 marks		

Question 9

9 marks

Part	Scheme	Marks
(a)	If $\cos x = 0$ then $\sin^2 x = 1$ and the equation becomes $2 = 0$, so $\cos x \neq 0$ Divides by $\cos^2 x$ and uses $\tan x = \frac{\sin x}{\cos x}$ $2 \tan^2 x + 5 \tan x - 3 = 0$ *	B1 M1 A1* (3)
(b)	$(2 \tan x - 1)(\tan x + 3) = 0$ $\tan x = \frac{1}{2}$: $26.6^\circ, 206.6^\circ$ $\tan x = -3$: $108.4^\circ, 288.4^\circ$ $26.6^\circ, 108.4^\circ, 206.6^\circ, 288.4^\circ$	M1 A1 A1 A1 (4)
(c)	Acute solution has $\tan x = \frac{1}{2}$: a right-angled triangle with sides 1, 2 and hypotenuse $\sqrt{5}$ (or $\sin^2 x + \cos^2 x = 1$ with $\sin x = \frac{1}{2} \cos x$) $\sin x = \frac{\sqrt{5}}{5}$	M1 A1 (2)
Total for Question 9: 9 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	$\frac{1}{2} \times 5 \times 8 \sin \theta = 12$, so $\sin \theta = \frac{3}{5}$ *	B1* (1)
(b)	$\cos^2 \theta = 1 - \frac{9}{25} = \frac{16}{25}$ $\cos \theta = \frac{4}{5}$ or $\cos \theta = -\frac{4}{5}$	M1 A1 (2)
(c)	$BC^2 = 5^2 + 8^2 - 2 \times 5 \times 8 \cos \theta$ $\cos \theta = \frac{4}{5}$: $BC^2 = 25$, so $BC = 5$ $\cos \theta = -\frac{4}{5}$: $BC^2 = 153$, so $BC = 3\sqrt{17}$	M1 A1 A1 (3)
(d)	$-\frac{3}{4}$	B1 (1)
(e)	$\tan(x - 20^\circ) = \frac{3}{5}$ $x - 20^\circ = 30.96^\circ$ or 210.96° $51.0^\circ, 231.0^\circ$	M1 M1 A1 (3)
Total for Question 10: 10 marks		

