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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	3	
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.



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Chapter 2: Quadratics

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

Question 1

5 marks

Part	Scheme	Marks
(a)	$(3x - 2)(x + 4) = 0$ (or the formula with $a = 3$, $b = 10$, $c = -8$) $x = \frac{2}{3}, x = -4$	M1 A1 (2)
(b)	$x = \frac{6 \pm \sqrt{(-6)^2 - 4 \times 2 \times 1}}{2 \times 2} = \frac{6 \pm \sqrt{28}}{4}$ $\sqrt{28} = 2\sqrt{7}$ $x = \frac{3 \pm \sqrt{7}}{2}$ Accept $\frac{6 \pm 2\sqrt{7}}{4}$ for the second M1 only. Decimal answers with no working score 0. Completing the square is an equally valid method.	M1 M1 A1 (3)
Total for Question 1: 5 marks		

Question 2

5 marks

Part	Scheme	Marks
(a)	$a = 2$ $2(x^2 - 6x) + 23 = 2(x - 3)^2 - 18 + 23$ $2(x - 3)^2 + 5$	B1 M1 A1 (3)
(b)	5	B1ft (1)
(c)	$\frac{1}{5}$ (c): the reciprocal is largest when $2x^2 - 12x + 23$ is smallest. Follow through $\frac{1}{\text{their } c}$ for $c > 0$.	B1ft (1)
Total for Question 2: 5 marks		



Question 3

6 marks

Part	Scheme	Marks
(a)	$5 + 4x - x^2 = 5 - [(x - 2)^2 - 4]$ $9 - (x - 2)^2$, so $p = 9$, $q = -2$	M1 A1 (2)
(b)	A $\cap$ -shaped parabola y intercept (0, 5) x intercepts $(-1, 0)$ and $(5, 0)$, from $(x - 2)^2 = 9$ Maximum point (2, 9) <i>Coordinates may be written on the sketch or in the working. The maximum is follow through from their p and q.</i>	B1 B1 B1 B1ft (4)
Total for Question 3: 6 marks		

Question 4

4 marks

Part	Scheme	Marks
(a)	$b^2 - 4ac = 0$: $k^2 - 4 \times 3 \times 12 = 0$ $k = 12$ or $k = -12$	M1 A1 (2)
(b)	Substitutes one value and solves, e.g. $3x^2 + 12x + 12 = 3(x + 2)^2 = 0$ $k = 12$: $x = -2$ $k = -12$: $x = 2$ <i>Accept use of $x = -\frac{b}{2a}$ for the repeated root. The root must be matched to its value of k.</i>	M1 A1 (2)
Total for Question 4: 4 marks		



Question 5

6 marks

Part	Scheme	Marks
(a)	$(x^2 - 1)(x^2 - 9) = 0$ $x^2 = 1$ or $x^2 = 9$ $x = \pm 1, x = \pm 3$ <i>M1: treats the equation as a quadratic in x^2 (a substitution $u = x^2$ is fine). All four values are needed for the final A1.</i>	M1 A1 A1 (3)
(b)	$(2\sqrt{x} - 1)(\sqrt{x} - 3) = 0$ $\sqrt{x} = \frac{1}{2}$ or $\sqrt{x} = 3$ $x = \frac{1}{4}, x = 9$	M1 A1 A1 (3)
Total for Question 5: 6 marks		

Question 6

7 marks

Part	Scheme	Marks
(a)	$f(x) = a(x+2)(x-6)$ Uses (0, 9): $-12a = 9$, so $a = -\frac{3}{4}$ $f(x) = -\frac{3}{4}x^2 + 3x + 9$ <i>Omitting the constant a (using $(x+2)(x-6)$) scores M0. A method using $ax^2 + bx + c$ with three points is equally valid.</i>	M1 M1 A1 (3)
(b)	$-\frac{3}{4}(x^2 - 4x) + 9 = -\frac{3}{4}[(x-2)^2 - 4] + 9$ $12 - \frac{3}{4}(x-2)^2$	M1 A1 (2)
(c)	$(2, 12)$	B1ft (1)
(d)	$k < 12$ <i>The line $y = k$ must cross C twice, so it must be below the maximum. $k \leq 12$ scores B0.</i>	B1ft (1)
Total for Question 6: 7 marks		



Question 7

8 marks

Part	Scheme	Marks
(a)	$B = 5$ $-5\left(t^2 - \frac{12}{5}t\right) + 2 = -5(t - 1.2)^2 + 7.2 + 2$ $9.2 - 5(t - 1.2)^2$	B1 M1 A1 (3)
(b)	(i) 9.2 m (ii) 1.2 seconds	B1ft B1ft (2)
(c)	Solves $5t^2 - 12t - 2 = 0$: $t = \frac{12 \pm \sqrt{144 + 40}}{10}$, or $(t - 1.2)^2 = 1.84$ $t = 2.56$ seconds <i>The negative root must be rejected. Accept 2.56 with no units.</i>	M1 A1 (2)
(d)	A valid limitation, e.g. air resistance is ignored; the stone is modelled as a particle; the ground is assumed to be flat; the model does not apply after the stone hits the ground.	B1 (1)
Total for Question 7: 8 marks		

Question 8

6 marks

Part	Scheme	Marks
(a)	$(k + 3)x^2 + 6x + (k - 5) = 0$ and uses $b^2 - 4ac > 0$ $36 - 4(k + 3)(k - 5) > 0 \Rightarrow 36 - 4k^2 + 8k + 60 > 0$ $\Rightarrow 4k^2 - 8k - 96 < 0 \Rightarrow k^2 - 2k - 24 < 0$ * <i>A1* cso: the constant term $k - 5$ must be used, and the inequality sign must be correct throughout, including when dividing by -4.</i>	M1 M1 A1* (3)
(b)	$(k - 6)(k + 4) = 0$: critical values 6 and -4 $-4 < k < 6$ $-4 < k < 6, k \neq -3$ <i>B1: when $k = -3$ the equation is $6x - 8 = 0$, which is linear with only one root, so $k = -3$ must be excluded.</i>	M1 A1 B1 (3)
Total for Question 8: 6 marks		



Question 9

9 marks

Part	Scheme	Marks
(a)	$2x^2 - 3x + 5 = kx - x^2 + 2$ $3x^2 - 3x - kx + 3 = 0 \Rightarrow 3x^2 - (k+3)x + 3 = 0$ *	M1 A1* (2)
(b)	Exactly one point: $b^2 - 4ac = 0$, $(k+3)^2 - 4 \times 3 \times 3 = 0$ $(k+3)^2 = 36 \Rightarrow k+3 = \pm 6$ $k = 3, k = -9$	M1 M1 A1 (3)
(c)	$k = 3: 3x^2 - 6x + 3 = 0 \Rightarrow 3(x-1)^2 = 0$, so $x = 1$ $(1, 4)$	M1 A1 (2)
(d)	$(k+3)^2 - 36 < 0$, with critical values 3 and -9 $-9 < k < 3$	M1 A1 (2)
Total for Question 9: 9 marks		



Question 10

9 marks

Part	Scheme	Marks
(a)	$(x^2 - 3)^2 - 9$ attempted $(x^2 - 3)^2 - 9$, so $p = -3, q = -9$	M1 A1 (2)
(b)	$(x^2 - 3)^2 = 25 \Rightarrow x^2 - 3 = \pm 5$ $x^2 = 8$ (rejecting $x^2 = -2$) $x = \pm 2\sqrt{2}$	M1 M1 A1 (3)
(c)	$(x^2 - 3)^2 \geq 0$, so $f(x) \geq -9$ for all x , so $f(x)$ cannot equal -10	B1 (1)
(d)	$(x^2 - 3)^2 = A + 9 \Rightarrow x^2 = 3 \pm \sqrt{A + 9}$ Four solutions need two different positive values of x^2 : $A + 9 > 0$ and $3 - \sqrt{A + 9} > 0$ $-9 < A < 0$ <i>When $A = 0$ there are three solutions ($x = 0, \pm\sqrt{6}$) and when $A = -9$ there are two. A correct sketch of the W-shaped graph, with minimum points $(\pm\sqrt{3}, -9)$ and the local maximum at $(0, 0)$, used to justify both ends of the range, scores full marks.</i>	M1 M1 A1 (3)
Total for Question 10: 9 marks		

