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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	3	
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.



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Chapter 4: The Binomial Expansion

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

Question 1

4 marks

Part	Scheme	Marks
	Correct binomial coefficients with powers of 2 and $3x$, e.g. $\binom{5}{1}2^4(3x)$	M1
	$32 + 240x$	B1
	One of $720x^2$ or $1080x^3$	A1
	$32 + 240x + 720x^2 + 1080x^3$	A1
		(4)
Total for Question 1: 4 marks		

Question 2

4 marks

Part	Scheme	Marks
(a)	$\binom{7}{3}3^4(-2x)^3 = 35 \times 81 \times (-8)x^3$	M1
	$-22\,680$	A1
		(2)
(b)	$\binom{7}{5}3^2(-2)^5 = 21 \times 9 \times (-32)$	M1
	-6048	A1
	<i>The sign comes from $(-2)^3$ and $(-2)^5$. Leaving x^3 or x^5 in a "coefficient" is condoned once.</i>	
		(2)
Total for Question 2: 4 marks		

Question 3

5 marks

Part	Scheme	Marks
(a)	Coefficient of x^2 : $\binom{8}{2}k^2 = 28k^2$	M1
	$28k^2 = 112 \Rightarrow k^2 = 4$	M1
	$k = 2$ (as $k > 0$)	A1
		(3)
(b)	$\binom{8}{3}k^3 = 56 \times 8$	M1
	448	A1ft
		(2)
Total for Question 3: 5 marks		



Question 4

5 marks

Part	Scheme	Marks
(a)	$1 + \binom{10}{1} \left(-\frac{x}{4}\right) + \binom{10}{2} \left(-\frac{x}{4}\right)^2$	M1
	$1 - \frac{5}{2}x$	A1
	$1 - \frac{5}{2}x + \frac{45}{16}x^2$	A1
		(3)
(b)	$1 - \frac{x}{4} = 0.99$, so $x = 0.04$, substituted into their expansion	M1
	0.9045	A1
	$1 - 0.1 + 0.0045 = 0.9045$. The true value is 0.9044 to 4 d.p., so the estimate is very close because x is small.	(2)
Total for Question 4: 5 marks		

Question 5

4 marks

Part	Scheme	Marks
	$(1 - 2x)^5 = 1 - 10x + 40x^2 + \dots$	M1
	$1 - 10x + 40x^2$	A1
	Combines both products: $3 \times 40 + 1 \times (-10)$	M1
	110	A1
	Using only 3×40 (one of the two products) is the most common error: M1 A1 M0 A0.	
		(4)
Total for Question 5: 4 marks		



Question 6

8 marks

Part	Scheme	Marks
(a)	$A = 64$	B1 (1)
(b)	$B = {}^6_1 2^5 p = 192p$ and $D = {}^6_3 2^3 p^3 = 160p^3$ Both correct $320p^3 = 2880p \Rightarrow p^2 = 9$ (as $p \neq 0$) $p = -3$	M1 A1 M1 A1 (4)
(c)	$C = {}^6_2 2^4 p^2 = 240 \times 9$ 2160	M1 A1 (2)
(d)	$p^6 = 729$	B1 (1)
Total for Question 6: 8 marks		

Question 7

8 marks

Part	Scheme	Marks
(a)	$na = 20$ $\frac{n(n-1)}{2} a^2 = 180$ Eliminates a : $\frac{n(n-1)}{2} \times \frac{400}{n^2} = 180$ $400(n-1) = 360n \Rightarrow 40n = 400$, so $n = 10$ * $a = 2$	B1 B1 M1 A1* A1 (5)
(b)	${}^{10}_3 2^3 = 960$	B1 (1)
(c)	Compares coefficients ${}^{10}_r 2^r$: ..., 8064, 13440, 15360, 11520, ... 15360 , the coefficient of x^7 The coefficients increase while $\frac{2(10-r)}{r+1} > 1$, i.e. up to $r = 7$.	M1 A1 (2)
Total for Question 7: 8 marks		



Question 8

8 marks

Part	Scheme	Marks
(a)	General term $\binom{6}{r} (x^2)^{6-r} \left(-\frac{2}{x}\right)^r$ $= \binom{6}{r} (-2)^r x^{12-2r-r} = \binom{6}{r} (-2)^r x^{12-3r}$ *	M1 A1* (2)
(b)	$12 - 3r = 0 \Rightarrow r = 4: \binom{6}{4} (-2)^4$ 240	M1 A1 (2)
(c)	$12 - 3r = 3 \Rightarrow r = 3: \binom{6}{3} (-2)^3$ -160	M1 A1 (2)
(d)	$12 - 3r = 2$ gives $r = \frac{10}{3}$ r must be a whole number, so there is no term in x^2	M1 A1 (2)
Total for Question 8: 8 marks		

Question 9

9 marks

Part	Scheme	Marks
(a)	Expands both: $(1+x)^5 = 1 + 5x + 10x^2 + 10x^3 + 5x^4 + x^5$ The odd powers cancel $2 + 20x^2 + 10x^4$	M1 M1 A1 (3)
(b)	Substitutes $x = \sqrt{2}$: $2 + 20 \times 2 + 10 \times 4$ $= 2 + 40 + 40 = 82$ *	M1 A1* (2)
(c)	$2 + 20y^2 + 10y^4 = 242 \Rightarrow y^4 + 2y^2 - 24 = 0$ $(y^2 + 6)(y^2 - 4) = 0$ $y^2 = 4$ ($y^2 = -6$ has no real solutions) $y = \pm 2$	M1 M1 A1 A1 (4)
Total for Question 9: 9 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	$2^5 + \binom{5}{1}2^4(ax) + \binom{5}{2}2^3(ax)^2$ $32 + 80ax$ $32 + 80ax + 80a^2x^2$	M1 A1 A1 (3)
(b)	Coefficient of x : $80a - 32b = 16$ Coefficient of x^2 : $80a^2 - 80ab = 0$ $80a(a - b) = 0$ and $a \neq 0$, so $b = a$ * $48a = 16$ $a = \frac{1}{3}$	M1 M1 A1* M1 A1 (5)
(c)	x^3 term of $(2 + ax)^5$ is $\binom{5}{3}2^2a^3 = \frac{40}{27}$; coefficient = $\frac{40}{27} - b \times 80a^2$ $\frac{40}{27} - \frac{80}{27} = -\frac{40}{27}$	M1 A1 (2)
Total for Question 10: 10 marks		

