



eClassroom

INTERNATIONAL A LEVEL MATHEMATICS • PURE 4

Pure Mathematics 4

Exam Questions by Topic: Mark Scheme

Pearson Edexcel International Advanced Level (WMA14/01) • 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 Proof Proof by contradiction: irrational numbers, primes, integers, inequalities	10	73	own PDF	
2 Partial Fractions Linear and repeated factors, improper fractions	10	78	own PDF	
3 Coordinate Geometry in the (x, y) Plane Parametric equations and conversion to Cartesian form	10	76	own PDF	
4 Binomial Expansion $(a + bx)^n$ for rational n , validity, using partial fractions	10	81	3	
5 Differentiation Parametric and implicit differentiation, rates of change	10	81	own PDF	
6 Integration Volumes of revolution, substitution, parts, partial fractions, differential equations	10	86	own PDF	
7 Vectors 3D vectors, vector equations of lines, intersections, scalar product	10	82	own PDF	

[Question booklet](#)

[Free courses](#)

[More worksheets](#)



Join students already acing their exams.

Book your FREE lesson at www.eclassroom.org.uk

Page 1 of 10

How to use this mark scheme

The same marking rules Pearson examiners use for WMA14.

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.

Marking a proof. A proof by contradiction earns its final mark only when it has all three parts: a clear assumption at the start (“Assume there is ...”), correct deductions in the right order, and a statement of the contradiction with a conclusion. A sketch or calculator values are not a proof.



Join students already acing their exams.

Book your FREE lesson at www.eclassroom.org.uk

4

Chapter 4: Binomial Expansion

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

Question 1

5 marks

Part	Scheme	Marks
(a)	Takes out $9^{-\frac{1}{2}} = \frac{1}{3}: \frac{1}{3} \left(1 + \frac{4}{9}x\right)^{-\frac{1}{2}}$ Expands with $\left(\frac{4}{9}x\right)$ and correct coefficients, e.g. $\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!} \left(\frac{4x}{9}\right)^2$ Two correct simplified terms $\frac{1}{3} - \frac{2}{27}x + \frac{2}{81}x^2 - \frac{20}{2187}x^3$ <i>Taking out 9 or 3 instead of $\frac{1}{3}$ is B0 but can score M1. The factor $\frac{1}{3}$ must multiply every term.</i>	B1 M1 A1 A1 (4)
(b)	$x < \frac{9}{4}$	B1 (1)
Total for Question 1: 5 marks		

Question 2

6 marks

Part	Scheme	Marks
(a)	$1 + \frac{1}{3}(-6x) + \frac{\frac{1}{3}\left(-\frac{2}{3}\right)}{2}(-6x)^2$ $1 - 2x$ $1 - 2x - 4x^2$	M1 A1 A1 (3)
(b)	Constant term: $a = 3$ x terms: $-2a + b = -7$, so $b = -1$ x^2 terms: $-4a - 2b = c$, so $c = -10$ <i>The x^2 term has two parts: $3 \times (-4x^2)$ and $(-x) \times (-2x)$. Missing the second gives $c = -12$.</i>	B1 M1 A1 (3)
Total for Question 2: 6 marks		



Join students already acing their exams.

Book your FREE lesson at www.eclassroom.org.uk

Question 3

6 marks

Part	Scheme	Marks
(a)	$nk = -2$ $\frac{n(n-1)}{2}k^2 = 6$ Substitutes $k = -\frac{2}{n}$: $\frac{n(n-1)}{2} \times \frac{4}{n^2} = 6 \Rightarrow 2(n-1) = 6n$ $n = -\frac{1}{2}, k = 4$	B1 B1 M1 A1 (4)
(b)	$\frac{(-\frac{1}{2})(-\frac{3}{2})(-\frac{5}{2})}{6} \times 4^3 = -20$	B1ft (1)
(c)	$ x < \frac{1}{4}$	B1ft (1)
Total for Question 3: 6 marks		

Question 4

6 marks

Part	Scheme	Marks
(a)	$x+7 \equiv A(x-2)+B(1+x); x=-1: A=-2; x=2: B=3$ $-\frac{2}{1+x} + \frac{3}{x-2}$	M1 A1 (2)
(b)	Writes $\frac{3}{x-2} = -\frac{3}{2}\left(1-\frac{x}{2}\right)^{-1}$ Expands both: $-2(1-x+x^2)$ and $-\frac{3}{2}\left(1+\frac{x}{2}+\frac{x^2}{4}\right)$ $-\frac{7}{2} + \frac{5}{4}x - \frac{19}{8}x^2$ Expanding $3(x-2)^{-1}$ as $3(1-2x)^{-1}$, or as $3(-2)(1-\dots)$, is the scheme-of-work error: $(x-2)^{-1} = -\frac{1}{2}\left(1-\frac{x}{2}\right)^{-1}$	M1 M1 A1 (3)
(c)	Valid for $ x < 1$ and $ x < 2$: $ x < 1$	B1 (1)
Total for Question 4: 6 marks		



Question 5

6 marks

Part	Scheme	Marks
(a)	$(4-x)^{-\frac{1}{2}} = \frac{1}{2} \left(1 - \frac{x}{4}\right)^{-\frac{1}{2}}$ Expands with $\left(-\frac{x}{4}\right)$ and correct coefficients Two correct simplified terms $\frac{1}{2} + \frac{x}{16} + \frac{3x^2}{256} + \frac{5x^3}{2048}$	B1 M1 A1 A1 (4)
(b)	$x = 1: (4-1)^{-\frac{1}{2}} = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} \approx \frac{1181}{2048}, \text{ so } \sqrt{3} \approx 3 \times \frac{1181}{2048}$ $\sqrt{3} \approx \frac{3543}{2048}$ <i>Oct 2024 report: the series approximated "the reciprocal of what they were asked to find". Giving $\frac{1181}{2048}$ as the approximation to $\sqrt{3}$ scores M0.</i>	M1 A1 (2)
Total for Question 5: 6 marks		



Question 6

11 marks

Part	Scheme	Marks
(a)	$(1+x)^{\frac{1}{2}} = 1 + \frac{1}{2}x - \frac{1}{8}x^2 + \frac{1}{16}x^3$ Expands $(1-x)^{-\frac{1}{2}}$ with $(-x)$ $(1-x)^{-\frac{1}{2}} = 1 + \frac{1}{2}x + \frac{3}{8}x^2 + \frac{5}{16}x^3$	B1 M1 A1 (3)
(b)	$\sqrt{\frac{1+x}{1-x}} = (1+x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$ and multiplies, collecting terms to x^3 $x^2: \frac{3}{8} + \frac{1}{4} - \frac{1}{8} = \frac{1}{2}$ $x^3: \frac{5}{16} + \frac{3}{16} - \frac{1}{16} + \frac{1}{16} = \frac{1}{2}$, so $1+x + \frac{1}{2}x^2 + \frac{1}{2}x^3$ *	M1 A1 A1* (3)
(c)	$ x < 1$	B1 (1)
(d)	$x = \frac{1}{5}: \sqrt{\frac{6/5}{4/5}} = \sqrt{\frac{3}{2}} = \frac{\sqrt{6}}{2}$, so $\sqrt{6} \approx 2\left(1 + \frac{1}{5} + \frac{1}{50} + \frac{1}{250}\right)$ $\frac{306}{125}$	M1 A1 (2)
(e)	$\frac{\left \frac{306}{125} - \sqrt{6}\right }{\sqrt{6}} \times 100$ 0.061%	M1 A1 (2)
Total for Question 6: 11 marks		



Question 7

11 marks

Part	Scheme	Marks
(a)	$6x^2 + 3 \equiv A(1 - 2x)^2 + B(1 + x)(1 - 2x) + C(1 + x)$ $x = -1: 9 = 9A, A = 1; x = \frac{1}{2}: \frac{9}{2} = \frac{3}{2}C, C = 3$ x^2 coefficients: $6 = 4A - 2B$ $A = 1, B = -1, C = 3$	B1 M1 M1 A1 (4)
(b)	$(1 + x)^{-1} = 1 - x + x^2$ $(1 - 2x)^{-1} = 1 + 2x + 4x^2$ and $(1 - 2x)^{-2} = 1 + 4x + 12x^2$ Combines: $(1 - x + x^2) - (1 + 2x + 4x^2) + 3(1 + 4x + 12x^2)$ $3 + 9x + 33x^2$	M1 M1 M1 A1 (4)
(c)	$(1 + x)^{-1}$ needs $ x < 1$ and $(1 - 2x)^{-1}, (1 - 2x)^{-2}$ need $ x < \frac{1}{2}$; both must hold, so $ x < \frac{1}{2}$	B1 (1)
(d)	The x^n terms are $(-1)^n, -2^n$ and $3(n+1)2^n$ (from $\binom{-2}{n}(-2)^n = (n+1)2^n$) $(-1)^n + 2^n(3n+3-1) = (-1)^n + (3n+2)2^n$ * Check: $n = 2$ gives $1 + 8 \times 4 = 33$, matching part (b).	M1 A1* (2)
Total for Question 7: 11 marks		



Question 8

10 marks

Part	Scheme	Marks
(a)	$A = \frac{1}{8}$	B1 (1)
(b)	$(2 - kx)^{-3} = \frac{1}{8} \left(1 - \frac{kx}{2}\right)^{-3}$ and expands $B = \frac{3k}{16}$ and $C = \frac{3k^2}{16}$ $\frac{3k^2}{16} = \frac{6k}{16} \Rightarrow k^2 - 2k = 0$ *	M1 A1 A1* (3)
(c)	$k(k - 2) = 0$ and $k > 0$: $k = 2$ $D = \frac{1}{8} \times \frac{(-3)(-4)(-5)}{6} \times (-1)^3$ $D = \frac{5}{4}$	B1 M1 A1 (3)
(d)	$ 2x < 2$: $ x < 1$	B1ft (1)
(e)	$2 - 2x = 1.9$ gives $x = 0.05$: $\frac{1}{8} + \frac{3}{8}(0.05) + \frac{3}{4}(0.05)^2 + \frac{5}{4}(0.05)^3$ 0.1458	M1 A1 (2)
Total for Question 8: 10 marks		



Question 9

10 marks

Part	Scheme	Marks
(a)	Angle $OTP = 90^\circ$ (tangent and radius), so $d^2 = (R+h)^2 - R^2 = 2Rh + h^2$ $d = \sqrt{2Rh \left(1 + \frac{h}{2R}\right)} = \sqrt{2Rh} \left(1 + \frac{h}{2R}\right)^{\frac{1}{2}} *$	M1 A1* (2)
(b)	Expands $\left(1 + \frac{h}{2R}\right)^{\frac{1}{2}}$ with $\left(\frac{h}{2R}\right)$ $1 + \frac{h}{4R}$ $\frac{\frac{1}{2} \left(-\frac{1}{2}\right)}{2} \left(\frac{h}{2R}\right)^2 = -\frac{h^2}{32R^2} *$	M1 A1 A1* (3)
(c)	$\left \frac{h}{2R}\right < 1$ with $h > 0$: $0 < h < 2R$	B1 (1)
(d)	Exact: $d = \sqrt{2 \times 6400 \times 400 + 400^2} = \sqrt{5280000} = 2297.8$ Simple: $\sqrt{5120000} = 2262.7$; percentage error $\frac{2297.8 - 2262.7}{2297.8} \times 100$ 1.5%	M1 M1 A1 (3)
(e)	$d^2 = 2Rh + h^2 > 2Rh$ since $h > 0$, so $d > \sqrt{2Rh}$	B1 (1)
Total for Question 9: 10 marks		



Question 10

10 marks

Part	Scheme	Marks
(a)	Expands with $(2x)$ and $n = \frac{3}{2}$ $1 + 3x + \frac{3}{2}x^2 - \frac{1}{2}x^3, \text{ i.e. } 1 + 3x + \frac{3}{2}x^2 - \frac{1}{2}x^3$	M1 A1 A1 A1 (4)
(b)	$ x < \frac{1}{2}$	B1 (1)
(c)	Assume C_1 and C_2 meet at some x with $0 < x < \frac{1}{2}$ $1 + 3x + \frac{3}{2}x^2 - \frac{1}{2}x^3 = 2 + x + \frac{5}{2}x^2 \Rightarrow \frac{1}{2}x^3 + x^2 - 2x + 1 = 0$ $\frac{1}{2}x^3 + (x-1)^2 = 0, \text{ where } (x-1)^2 > 0 \text{ and } \frac{1}{2}x^3 > 0 \text{ for } 0 < x < \frac{1}{2}$ So the left-hand side is positive and cannot be 0: a contradiction. C_1 and C_2 do not meet * <i>As in the June 2024 scheme, the contradiction needs a reason for both terms being positive, and a conclusion. The figure is not a proof.</i>	B1 M1 M1 A1* (4)
(d)	C_1 is only an approximation (the terms in x^4 and higher are left out), so the true curve could meet C_2 even though C_1 does not	B1 (1)
Total for Question 10: 10 marks		

