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MA01- Unit 1 Pure Mathematics 1

Mark scheme

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Key to mark scheme abbreviations

M	Mark is for method
m	Mark is dependent on one or more M marks and is for method
A	Mark is dependent on M or m marks and is for accuracy
B	Mark is independent of M or m marks and is for method and accuracy
E	Mark is for explanation
√**or ft**	Follow through from previous incorrect result
CAO	Correct answer only
CSO	Correct solution only
AWFW	Anything which falls within
AWRT	Anything which rounds to
ACF	Any correct form
AG	Answer given
SC	Special case
oe	Or equivalent
A2, 1	2 or 1 (or 0) accuracy marks
–*x* EE	Deduct *x* marks for each error
NMS	No method shown
PI	Possibly implied
SCA	Substantially correct approach
sf	Significant figure(s)
dp	Decimal place(s)

Q	Answer	Mark	Comments
1(a)(i)	3	B1	
1(a)(ii)	5	B1	
1(b)	$\begin{pmatrix} -3 \\ 5 \end{pmatrix}$	B1ft B1ft	B1 for each component ft minus their a ft their b
	Total	**4**	

Q	Answer	Mark	Comments
2(a)	$5 \times 3 \times \sqrt{8 \times 12}$ or $15\sqrt{96}$ or $30\sqrt{24}$ or $10\sqrt{2} \times 6\sqrt{3}$	M1	
	$60\sqrt{6}$	A1	CSO NMS $= 0$
2(b)	$\dfrac{3\sqrt{7} - 4\sqrt{6}}{2\sqrt{7} + \sqrt{6}} \times \dfrac{2\sqrt{7} - \sqrt{6}}{2\sqrt{7} - \sqrt{6}}$	M1	Multiplies numerator and denominator by the conjugate of the denominator
	(Numerator =) $6(\sqrt{7})^2 - 3\sqrt{7}\sqrt{6} - 8\sqrt{6}\sqrt{7} + 4(\sqrt{6})^2$ or $42 - 3\sqrt{42} - 8\sqrt{42} + 24$	M1	Must be a correct four or three term expression. Allow one error
	(Denominator =) $(2\sqrt{7})^2 - (\sqrt{6})^2$ or $28 - 6$ or 22	B1	Must be seen as a denominator
	$\dfrac{6 - \sqrt{42}}{2}$	A1	NMS $= 0$
	Total	**6**	

Q	Answer	Mark	Comments
3(a)(i)	$y = \frac{4}{5}x - \frac{8}{5}$	M1	Attempt at $y = mx + c$ Or $\frac{\Delta y}{\Delta x}$ with two correct points
	(gradient =) $\frac{4}{5}$	A1	Condone error in c if gradient is correct
3(a)(ii)	$4x - 5 \times 0 = 8$	M1	Substituting $y = 0$ into equation of L
	$(2, 0)$	A1	
3(b)(i)	(gradient of AB =) $\frac{-5}{4}$	B1ft	ft $\frac{-1}{\textit{their gradient of } L}$
	their gradient of $AB \times (2 - 4) = k - 9$	M1	
	$(k =) \frac{23}{2}$	A1ft	oe. ft correct k for their gradient of AB provided B1 awarded
3(b)(ii)	their gradient of $AB \times (x - 4) = y - 9$	M1	or y $=$ (their m)$x + c$ and attempt at c using $x = 4, y = 9$ or $x = 2, y =$ their k
	$\frac{-5}{4}(x - 4) = y - 9$ or $y = 14 - \frac{5}{4}x$	A1	
	$5x + 4y - 56 = 0$ or $-5x - 4y + 56 = 0$	B1	
	Total	**10**	

Q	Answer	Mark	Comments
4(a)(i)	$23 = 5k + 17$	M1	Condone 1.2 oe embedded
	$k = 1.2$	A1	oe
4(a)(ii)	$u_3 = 44.6$	B1	oe
	$u_4 = 70.52$	B1ft	oe. ft their $u_3 \times 1.2 + 17$

4(b)	$t = t^2 - 12$	M1	Substituting t for t_n and t_{n+1} Allow other letters for t
	$t_1 = -3$	A1	Both correct answers given but NMS scores 1 out of 3 marks
	$t_1 = 4$	A1	
	Total	**7**	

	Answer	Mark	Comments
5(a)	$(1+2x)^3 =$ $[1] + 3(2x) + 3(2x)^2 + [(2x)^3]$	M1	For either (1), 3, 3, (1) oe unsimplified Or $\binom{3}{1}(2x) + \binom{3}{2}(2x)^2$ oe PI
	$a = 6$ or $b = 12$	A1	Accept $6x$ or $12x^2$
	$a = 6$ and $b = 12$	A1	
5(b)	$\left(\frac{dy}{dx}\right) = 6 + 24x + 24x^2$	M1	One term correct
		A1	Another term correct
		A1	Third correct term
5(c)	$6 + 24x + 24x^2 = -10$	M1	ft expression for $\frac{dy}{dx}$ from Question **5(b)**
	$3x^2 + 3x + 2 = 0$ or $24x^2 + 24x + 6 + 10 = 0$ or $24x^2 + 24x + 16 = 0$	M1	Rearranges their quadratic equation (simplified or unsimplified) with RHS equal to zero
	Discriminant = -15	B1ft	Correctly calculates the discriminant for their quadratic equation
	Since the discriminant is negative there are no real roots and therefore C does not have a tangent parallel to L	E1	Correct conclusion from totally correct working Be convinced

5(c) ALT	Gradient of $L = -10$	B1	
	$\frac{dy}{dx} > 0$ [for all x]	B1	For stating value of derivative is greater than zero for all values of x. Accept written in words.
	Since the gradient of L is negative and the gradient of any tangent to C is always positive then C does not have a tangent parallel to L.	E2	E1. Statement comparing positivity and negativity. E1. Statement saying that they do not have parallel tangents.
	Total	**10**	

Q	Answer	Mark	Comments
6(a)	$4x^3$ or $13x^2$ or $\frac{12}{3}x^3$ or $\frac{26}{2}x^2$	B1	For correctly integrating either term in x^2 or term in x. Condone errors with signs
	$y = 4x^3 - 13x^2 - 12x + c$	B1	CSO. May be unsimplified. Condone omission of $+c$
	$-45 = 4(3^3) - 13(3^2) - 12(3) + c$	M1	For using $x = 3$ and $y = -45$ to form an equation in c based on their integration. Do not condone omission of $+c$ at this stage
	$y = 4x^3 - 13x^2 - 12x$	A1	CSO
6(b)	$(y =)\ x(4x^2 - 13x - 12)$	B1	For correctly removing factor of x
	$(y =)\ x(4x \pm 3)(x \pm 4)$	M1	For attempt to factorise the quadratic term. Condone errors in signs
	$(y =)\ x(4x + 3)(x - 4)$	A1	CSO
6(c)	For correct positive cubic graph with three distinct intercepts with the x axis	B1	
	For curve passing through the origin	B1	
	Correct coordinates $\left(-\frac{3}{4}, 0\right), (4,0), (0,0)$ oe for intercepts marked on the x axis	B1	Condone omission of origin labelled provided curve clearly passes through the origin. Accept values for intercepts given as labels
	Total	**10**	

Q	Answer	Mark	Comments
7(a)(i)	$(u_3 =)\ 378$	B1	
7(a)(ii)	Geometric (sequence)	E1	
7(b)(i)	$r = \frac{-3}{4}$ and $\lvert r \rvert < 1$ or $\left\lvert \frac{-3}{4} \right\rvert < 1$ or $-1 < r < 1$ or $-1 < \frac{-3}{4} < 1$	E1	Must state the correct value for r and give the condition for convergence
7(b)(ii)	$(S_\infty =)\ \dfrac{672}{1 - \frac{-3}{4}}$	M1	Uses sum to infinity formula
	$(S_\infty =)\ 384$	A1	
	Total	**5**	

Q	Answer	Mark	Comments
8(a)(i)	$\int (x^2 - 8x + x^{-2} + 7)dx$	B1	Correct conversion of $\frac{1}{x^2}$ to x^{-2} PI
	$\frac{x^3}{3} - 4x^2 - x^{-1} + 7x + c$	M1	For term in either x^3 or x^2 correct, simplified or unsimplified
		B1	For three terms correct simplified and including $-x^{-1}$
		A1	All correct and simplified. Must have $+c$
8(a)(ii)	$\left(\frac{125}{3} - 100 - \frac{1}{5} + 35\right) - \left(\frac{8}{3} - 16 - \frac{1}{2} + 14\right)$	M1	Correct substitution of correct limits obtaining $F(5) - F(2)$ for their F Condone powers not evaluated
	-23.7 or $\frac{-237}{10}$	A1	

8(b)	$3 \times \left(\frac{4.75 + 7.96}{2}\right)$	M1	Correct method for finding the area of the trapezium
	19.065	A1	oe Accept -19.065
	$23.7 - 19.065$	M1	oe. ft their value from Question **8(a)** provided that their 23.7 is positive and their final answer to Question **8(a)** was negative
	4.635	A1	oe
	Total	**10**	

Q	Answer	Mark	Comments
9(a)	$C = \frac{v}{25} + 100v^{-1}$	B1	Correct conversion of $\frac{1}{v}$ to v^{-1} in a correct formula
	$\left(\frac{dC}{dv} =\right) \frac{1}{25} - \frac{100}{v^2}$	B1	Both terms correct
	$\frac{1}{25} - \frac{100}{v^2} = 0$	M1	Setting their derivative equal to zero
	$v = 50$ [km/h]	A1	CSO. Ignore $v = -50$ given in addition to $v = 50$
	$\left(\frac{d^2C}{dv^2} =\right) \frac{200}{v^3}$	B1ft	For correct differentiation of their $\left(\frac{dC}{dv}\right)$
	$v = 50 \Rightarrow \frac{d^2C}{dv^2} = \frac{1}{625}$	M1	For clear intention to evaluate the value of their second derivative at their v
	$\frac{d^2C}{dv^2} > 0$ when $v = 50 \Rightarrow C$ will be a minimum for this value of v	E1	Clear explanation resulting from completely correct working. Be convinced
9(b)	$v = 50 \Rightarrow C_{min} = 4$ and 1270×4	M1	For calculating C_{min} for their v and attempt to multiply their C_{min} by 1270
	5080 dollars	A1	Must have correct units.
	Total	**9**	

Q	Answer	Mark	Comments
10(a)	$p^2+bp+c=p^2-3mp+2n$ or $p^2+bp+c=0$ and $p^2-3mp+2n=0$	B1	Application of the Factor Theorem to show either two correct quadratic expressions equated, or two correct equations in p set to equal zero
	$\mathrm{p}(b+3m)=2n-c$	M1	Correct manipulation of their $p^2+bp+c=p^2-3mp+2n$ isolating p on one side and factorised
	$p=\dfrac{2n-c}{b+3m}$	A1	CSO. Dependent upon first two marks awarded
10(b)	No real roots ⇒ $b^2-4ac<0$	B1	Condition for no real roots stated or used
	$(3k+1)^2-4(3(k+3))<0$ or $9k^2+6k+1-12k-36<0$	M1	Correct inequality unsimplified. Condone $+36$. Must include <0
	$9k^2-6k-35<0$	A1	Correct inequality with collected terms
	$(3k+5)(3k-7)$	M1	Correct factorisation of the quadratic expression or correct unsimplified quadratic equation formula $k=\frac{-(-6)\pm\sqrt{(-6)^2-4\times9\times(-35)}}{2\times9}$
	$k=\frac{-5}{3}$ and $k=\frac{7}{3}$	A1	oe. For correct critical values. Fractions must be fully simplified, or decimal equivalents must be exact.
	$\dfrac{-5}{3}<k<\dfrac{7}{3}$	A1	oe. For correct inequality. Fractions must be fully simplified, or decimal equivalents must be exact.
	Total	**9**	