

WMA01/01: Core Mathematics C12

Question Number	Scheme	Marks			
1. (a)	$5x^2$	B1 (1)			
(b)	$(25x^4)^{-\frac{3}{2}} = \frac{1}{(25x^4)^{\frac{3}{2}}}$ or $(25x^4)^{\frac{3}{2}} = 125x^6$ or better $\frac{1}{125x^6}$	M1 A1 (2) (3 marks)			
2.	$(3-x)^6 = 3^6 + 3^5 \times 6 \times (-x) + 3^4 \times \binom{6}{2} \times (-x)^2$ $= 729, \quad -1458x, \quad +1215x^2$	M1 B1, A1, A1 (4 marks)			
3. (i)	$(5 - \sqrt{8})(1 + \sqrt{2})$ $= 5 + 5\sqrt{2} - \sqrt{8} - 4$ $= 5 + 5\sqrt{2} - 2\sqrt{2} - 4$ $= 1 + 3\sqrt{2}$	Multiplies out brackets correctly. $\sqrt{8} = 2\sqrt{2}$, seen or implied at any point. $1 + 3\sqrt{2}$ or $a = 1$ and $b = 3$			
(ii)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; border-right: 1px solid black; padding: 5px;"> Method 1 Either $\sqrt{80} + \frac{30}{\sqrt{5}} \left(\frac{\sqrt{5}}{\sqrt{5}} \right)$ $= 4\sqrt{5} + \dots$ $= 4\sqrt{5} + 6\sqrt{5}$ </td> <td style="width: 33%; border-right: 1px solid black; padding: 5px;"> Method 2 Or $\left(\frac{\sqrt{400+30}}{\sqrt{5}} \right) \frac{\sqrt{5}}{\sqrt{5}}$ $= \left(\frac{20+\dots}{\dots} \right) \dots$ $= \left(\frac{50\sqrt{5}}{5} \right)$ $= 10\sqrt{5}$ </td> <td style="width: 33%; padding: 5px;"> Method 3 $\sqrt{80} + \frac{\sqrt{900}}{\sqrt{5}} = \sqrt{80} + \sqrt{180}$ $= 4\sqrt{5} + \dots$ $= 4\sqrt{5} + 6\sqrt{5}$ </td> </tr> </table>		Method 1 Either $\sqrt{80} + \frac{30}{\sqrt{5}} \left(\frac{\sqrt{5}}{\sqrt{5}} \right)$ $= 4\sqrt{5} + \dots$ $= 4\sqrt{5} + 6\sqrt{5}$	Method 2 Or $\left(\frac{\sqrt{400+30}}{\sqrt{5}} \right) \frac{\sqrt{5}}{\sqrt{5}}$ $= \left(\frac{20+\dots}{\dots} \right) \dots$ $= \left(\frac{50\sqrt{5}}{5} \right)$ $= 10\sqrt{5}$	Method 3 $\sqrt{80} + \frac{\sqrt{900}}{\sqrt{5}} = \sqrt{80} + \sqrt{180}$ $= 4\sqrt{5} + \dots$ $= 4\sqrt{5} + 6\sqrt{5}$
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As this is a "show that" question – all working should be shown.					

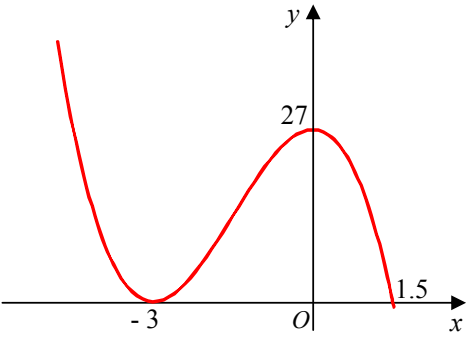
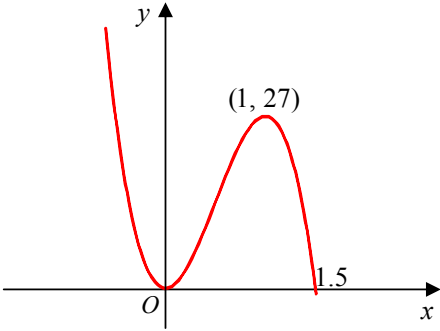
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4. (a)	$\frac{dy}{dx} = 10x^4 - 3x^{-4}$ or $10x^4 - \frac{3}{x^4}$	M1 A1 A1 (3)
(b)	$(\int =) \frac{2x^6}{6} + 7x + \frac{x^{-2}}{-2} = \frac{x^6}{3} + 7x - \frac{x^{-2}}{2} + C$	M1 A1 A1 B1 (4) (7 marks)
5.	$\frac{1}{2} \times 0.25 ; \times \{ 0.5 + 0.2 + 2(0.379 + 0.299 + 0.242) \}$ $\{ = \frac{1}{8}(2.540) \} = 0.3175$ or 0.318	Outside brackets $\frac{1}{2} \times 0.25$ or $\frac{1}{8}$ For structure of $\{ \dots \}$; Correct expression inside brackets which all must be multiplied by their "outside constant". awrt 0.32 B1 aef M1 $A1 \sqrt{\quad}$ A1 4 marks
6. (a)	$f(x) = x^4 + x^3 + 2x^2 + ax + b$ Attempting $f(1)$ or $f(-1)$. $f(1) = 1 + 1 + 2 + a + b = 7$ or $4 + a + b = 7 \Rightarrow a + b = 3$ (as required) AG	M1 A1 * cso (2)
(b)	Attempting $f(-2)$ or $f(2)$. $f(-2) = 16 - 8 + 8 - 2a + b = -8 \quad \{ \Rightarrow -2a + b = -24 \}$ Solving both equations simultaneously to get as far as $a = \dots$ or $b = \dots$ Any one of $a = 9$ or $b = -6$ Both $a = 9$ and $b = -6$	M1 A1 dM1 A1 A1 cso (5) (7 marks)

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7. (a)	$(a_2 =) 6 - c$	B1 (1)
(b)	$a_3 = 3(\text{their } a_2) - c \quad (= 18 - 4c)$ $a_1 + a_2 + a_3 = 2 + "(6 - c)" + "(18 - 4c)"$ $"26 - 5c" = 0$ So $c = 5.2$	M1 M1 A1ft A1 o.e. (4) (5 marks)
8. (a)	Attempts $b^2 - 4ac$ for $a = (k + 3)$, $b = 6$ and their c . $c \neq k$ $b^2 - 4ac = 6^2 - 4(k + 3)(k - 5)$ $-4k^2 + 8k + 96$ As $b^2 - 4ac > 0$, then $-4k^2 + 8k + 96 > 0$ and so, $k^2 - 2k - 24 < 0$	M1 A1 B1 A1* (4)
(b)	Attempts to solve $k^2 - 2k - 24 = 0$ to give $k =$ (\Rightarrow Critical values, $k = 6, -4.$) $k^2 - 2k - 24 < 0$ gives $-4 < k < 6$	M1 M1 A1 (3) (7 marks)
9. (a)	$\log_3 3x^2 = \log_3 3 + \log_3 x^2$ or $\log y - \log x^2 = \log 3$ or $\log y - \log 3 = \log x^2$ $\log_3 x^2 = 2 \log_3 x$ Using $\log_3 3 = 1$ and deduces answer.	B1 B1 B1 (3)
(b)	$3x^2 = 28x - 9$ Solves $3x^2 - 28x + 9 = 0$ to give $x = \frac{1}{3}$ or $x = 9$	M1 M1 A1 (3) (6 marks)

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Question Number	Scheme	Marks
<p>10. (a) (b) i</p>	<p>{Coordinates of A are} (4.5, 0)</p>  <p>Horizontal translation -3 and their ft 1.5 on positive x-axis</p> <p>Maximum at 27 marked on the y-axis</p>	<p>B1 M1 A1 ft B1 (3)</p>
<p>(b) ii</p>	 <p>Correct shape, minimum at (0, 0) and a maximum within the first quadrant.</p> <p>1.5 on x-axis</p> <p>Maximum at (1, 27)</p>	<p>M1 A1 ft B1 (3)</p>
<p>(c)</p>	<p>{k =} -17</p>	<p>B1 (1) (8 marks)</p>

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Question Number	Scheme	Marks
11. (a)	Curve: $y = -x^2 + 2x + 24$, Line: $y = x + 4$ $\{\text{Curve} = \text{Line}\} \Rightarrow -x^2 + 2x + 24 = x + 4$ $x^2 - x - 20 \{= 0\} \Rightarrow (x - 5)(x + 4) \{= 0\} \Rightarrow x = \dots$ So, $x = 5, -4$ So corresponding y -values are $y = 9$ and $y = 0$	B1 M1 A1 B1ft (4)
(b)	$\left\{ \int (-x^2 + 2x + 24) dx \right\} = -\frac{x^3}{3} + \frac{2x^2}{2} + 24x \{+ c\}$ $\left[-\frac{x^3}{3} + \frac{2x^2}{2} + 24x \right]_{-4}^5 = (\dots) - (\dots)$ $\left\{ \left(-\frac{125}{3} + 25 + 120 \right) - \left(\frac{64}{3} + 16 - 96 \right) \right\} = \left(103\frac{1}{3} \right) - \left(-58\frac{2}{3} \right) = 162$ Area of $\Delta = \frac{1}{2}(9)(9) = 40.5$ So area of R is $162 - 40.5 = 121.5$	M1: $x^n \rightarrow x^{n+1}$ for any one term. 1 st A1 at least two out of three terms correct. 2 nd A1 for <u>correct answer</u> . M1 A1 A1 dM1 M1 M1 A1 oe cao (7) (11 marks)

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Question Number	Scheme	Marks
12. (a)	$(10-2)^2 + (7-1)^2$ or $\sqrt{(10-2)^2 + (7-1)^2}$ $(x \pm 2)^2 + (y \pm 1)^2 = k$ (k a positive <u>value</u>) $(x-2)^2 + (y-1)^2 = 100$ (Accept 10^2 for 100) (Answer only scores full marks)	M1 A1 M1 A1 (4)
12. (b)	(Gradient of radius) $= \frac{7-1}{10-2} = \frac{6}{8}$ (or equiv.) Must be seen in part (b) Gradient of tangent $= \frac{-4}{3}$ (Using perpendicular gradient method) $y-7 = m(x-10)$ $y-7 = \frac{-4}{3}(x-10)$ or equivalent (ft gradient of <u>radius</u> , dep. on <u>both</u> M marks)	B1 M1 M1 A1ft (4)
12. (c)	$\sqrt{r^2 - \left(\frac{r}{2}\right)^2}$ Condone sign slip if there is evidence of correct use of Pythag. $= \sqrt{10^2 - 5^2}$ or numerically exact equivalent. $PQ (= 2\sqrt{75}) = 10\sqrt{3}$ Simplest surd form $10\sqrt{3}$ required for final mark.	M1 A1 A1 (3) (11 marks)

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13. (a)	$kr^2 + cxy = 4 \quad \text{or} \quad kr^2 + c[(x+y)^2 - x^2 - y^2] = 4$ $\frac{1}{4}\pi x^2 + 2xy = 4$ $y = \frac{4 - \frac{1}{4}\pi x^2}{2x} = \frac{16 - \pi x^2}{8x} \quad *$	M1 A1 B1 cso (3)
(b)	$P = 2x + cy + k\pi r \quad \text{where } c = 2 \text{ or } 4 \text{ and } k = \frac{1}{4} \text{ or } \frac{1}{2}$ $P = \frac{\pi x}{2} + 2x + 4\left(\frac{4 - \frac{1}{4}\pi x^2}{2x}\right) \text{ or } P = \frac{\pi x}{2} + 2x + 4\left(\frac{16 - \pi x^2}{8x}\right) \text{ o.e.}$ $P = \frac{\pi x}{2} + 2x + \frac{8}{x} - \frac{\pi x}{2} \quad \text{so} \quad P = \frac{8}{x} + 2x \quad *$	M1 A1 A1 (3)
(c)	$\left(\frac{dP}{dx}\right) = -\frac{8}{x^2} + 2$ $-\frac{8}{x^2} + 2 = 0 \Rightarrow x^2 = ..$ <p>and so $x = 2$ o.e. (ignore extra answer $x = -2$)</p> $P = 4 + 4 = 8 \text{ (m)}$	M1 A1 M1 A1 B1 (5) (11 marks)

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14. (a)	$\sin(x + 45^\circ) = \frac{2}{3}$, so $(x + 45^\circ) = 41.8103\dots$ ($\alpha = 41.8103\dots$)	$\sin^{-1}\left(\frac{2}{3}\right)$ or awrt 41.8 or awrt 0.73°	M1
	So, $x + 45^\circ = \{138.1897\dots, 401.8103\dots\}$ and $x = \{93.1897\dots, 356.8103\dots\}$	$x + 45^\circ =$ either "180 – their α " or "360° + their α " Either awrt 93.2° or awrt 356.8° Both awrt 93.2° and awrt 356.8°	M1 A1 A1
14. (b)	$2(1 - \cos^2 x) + 2 = 7 \cos x$ $2 \cos^2 x + 7 \cos x - 4 = 0$	Applies $\sin^2 x = 1 - \cos^2 x$ Correct 3 term, $2 \cos^2 x + 7 \cos x - 4 \{= 0\}$	M1 A1 oe
	$(2 \cos x - 1)(\cos x + 4) \{= 0\}$, $\cos x = \dots$ $\cos x = \frac{1}{2}$, $\{\cos x = -4\}$	Valid attempt at solving and $\cos x = \dots$ $\cos x = \frac{1}{2}$	M1 A1 cso
$\left(\beta = \frac{\pi}{3}\right)$ $x = \frac{\pi}{3}$ or 1.04719...° $x = \frac{5\pi}{3}$ or 5.23598...°	Either $\frac{\pi}{3}$ or awrt 1.05° Either $\frac{5\pi}{3}$ or awrt 5.24° or $2\pi -$ their β	B1 B1 ft	(10 marks)

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15. (a)	$9^2 = 4^2 + 6^2 - 2 \times 4 \times 6 \cos \alpha \Rightarrow \cos \alpha = \dots$ $\cos \alpha = \frac{4^2 + 6^2 - 9^2}{2 \times 4 \times 6} \left(= -\frac{29}{48} = -0.604.. \right)$ $\alpha = 2.22 \quad *$ (NB $\alpha = 2.219516005$)	Correct use of cosine rule leading to a value for $\cos \alpha$ M1 cso (2.22 must be seen here) A1 (2)
(b)	$2\pi - 2.22 (= 4.06366\dots)$ $\frac{1}{2} \times 4^2 \times "4.06"$ 32.5	$2\pi - 2.22$ or awrt 4.06 B1 Correct method for major sector area. Allow $\pi - 2.22$ for the major sector angle. M1 awrt 32.5 A1 (3)
Or (b)	Alternative method: Circle – Minor sector $\pi \times 4^2$ $\pi \times 4^2 - \frac{1}{2} \times 4^2 \times 2.22 = 32.5$ $= 32.5$	Correct expression for circle area. B1 Correct method for circle - minor sector area. M1 awrt 32.5 A1 (3)
(c)	Area of triangle = $\frac{1}{2} \times 4 \times 6 \times \sin 2.22 (= 9.56)$ So area required = "9.56" + "32.5" $= 42.1 \text{ cm}^2$ or 42.0 cm^2	Correct expression for the area of triangle XYZ B1 Their Triangle XYZ (Not triangle ZXW) + (part (b) answer or correct attempt at major sector) M1 awrt 42.1 or 42.0 (Or <u>just</u> 42). A1 (3)
(d)	Arc length = $4 \times 4.06 (= 16.24)$ Or $8\pi - 4 \times 2.22$ Perimeter = ZY + WY + Arc Length Perimeter = 27.2 or 27.3	M1: $4 \times \text{their } (2\pi - 2.22)$ M1 A1ft Or circumference – minor arc A1: Correct ft expression $9 + 2 + \text{Any Arc}$ awrt 27.2 or awrt 27.3 A1 (4)
		(12 marks)

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16. (a)	$17 \times 1.5 = 25.5(\text{km})$	B1 (1)
(b)	Use $l = a + (n-1)d$ with $a = 1.5$, $d = 0.25$ and $n = 17$ So $l = 5.5$	M1 A1 (2)
(c)	Use $S = \frac{a(1-r^n)}{1-r}$ with $a = 1.5$, and $n = 17$ And $r = 1.05$ So $S = 38.76(\text{km})$	M1 A1 A1 (3)
(d)	Total distance running is $S = \frac{n}{2} \{2a + (n-1)d\}$ $= 59.5(\text{km})$ So total in three sports is $123.76(\text{km})$	M1 A1 B1 (3)
(e)	Uses $ar^{n-1} > 40$ so $1.5 \times (1.05)^{n-1} > 40$ with their r $(1.05)^{n-1} > 26.7$ so $(n-1)\log 1.05 > \log 26.7$ $n-1 > 67.297$ So 69th day of training.	M1 M1 M1 A1 (4)
		(13 marks)