

Question	Answer	Marks	Partial Marks
1	$3x + 2 > 8 + x \rightarrow x > 3$	B1	
	$-3x - 2 > 8 + x$	M1	Correct inequality oe
	$x < -2.5$	A1	
2	$x^2 + x\left(\frac{2}{3}x - 2\right) = 9$	M1	Eliminate y
	$5x^2 - 6x - 27 = 0$	A1	
	$(x - 3)(5x + 9) = 0$	M1	Factorise or formula
	$(3, 0)$	A1	Or both x values
	$\left(-\frac{9}{5}, -\frac{16}{5}\right)$	A1	
3	Uses $\lg 100 = 2$ or $3\lg x = \lg x^3$.	B1	
	Uses $\lg a + \lg b = \lg ab$ or $\lg a - \lg b = \lg\left(\frac{a}{b}\right)$	B1	
	$\lg\left(\frac{100x^3}{y}\right)$	B1	Correct final answer
4(a)	$\frac{dy}{dx} = \frac{\cos x - 3\sin x}{\sin x + 3\cos x}$	3	M1 for attempt at chain rule must have function in numerator and denominator A1 for denominator A1 for numerator
(b)	$-2 \cos x - 3 \cos x = \sin x - 6 \sin x$	M1	Expand and collect terms in $\sin x$ and $\cos x$
	$1 = \tan x$	M1	Use $\frac{\sin x}{\cos x} = \tan x$
	$x = \frac{\pi}{4}$	A1	Must be radians
5	$a^5 + 5a^4bx + 10a^3b^2x^2$	2	B1 for powers or for coefficients
	$a^5 + (a^5 + 5a^4b)x + (10a^3b^2 + 5a^4b)x^2$	2	M1 for multiplying to obtain 5 terms A1 for all correct
	$a^5 = 32 \rightarrow a = 2$	A1	
	$32 + 80b = -208 \rightarrow b = -3$	A1	
	$10 \times 8 \times 9 + 5 \times 16 \times -3 = c \rightarrow c = 480$	A1	

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6(a)	$\tan 15^\circ = \frac{\sqrt{3}-1}{\sqrt{3}+1}$	M1	Correct use of tan
	$\tan 15^\circ = \frac{(\sqrt{3}-1)}{(\sqrt{3}+1)} \times \frac{(\sqrt{3}-1)}{(\sqrt{3}-1)}$	M1	Multiply by $(\sqrt{3}-1)$
	$\tan 15^\circ = 2 - \sqrt{3}$	A1	AG So all working must be seen
6(b)	$(BC)^2 = (\sqrt{3}-1)^2 + (\sqrt{3}+1)^2$	M1	Correct use of Pythagoras
	$BC = \sqrt{8}$ or $2\sqrt{2}$	A1	
7(a)	$p\left(\frac{1}{2}\right) = 2\left(\frac{1}{8}\right) - 3\left(\frac{1}{4}\right) - 23\left(\frac{1}{2}\right) + 12 = 0$	B1	Working must be seen
7(b)	$p(x) = (2x-1)(x^2 - x - 12)$	2	M1 for terms x^2 and -12 A1 for $-x$
	$p(x) = (2x-1)(x-4)(x+3)$	2	M1 for solving quadratic A1 for all three correct factors
	$f(x) = 0 \rightarrow x = \frac{1}{2}, 4, -3$	A1	
8(a)	$40 = A \times b^{10}$ and $45 = A \times b^{13}$	B1	
	$b^3 = \frac{45}{40}$	M1	Divide to find b^3 .
	$b = 1.04$	A1	
	$A = 27$	A1	
8(b)	59	B1	$P = 27 \times 1.04^{20}$
8(c)	$100 = 27 \times 1.04^t$	M1	Insert $P = 100$ in their expression
	$t = \frac{\log\left(\frac{100}{27}\right)}{\log 1.04}$ oe	M1	Rearrange to make t the subject
	$t = 33.4 \rightarrow$ Year 2034	A1	
9(a)	$v = 2e^{2t} - 10e^t - 12$ $a = 4e^{2t} - 10e^t$	3	M1 for correctly differentiating e^{2t} . A1 for v correct A1 for a correct

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9(b)	$v = 0 \rightarrow e^{2t} - 5e^t - 6 = 0$ $\rightarrow (e^t + 1)(e^t - 6) = 0$	M1	Factorise quadratic Solve and discard $e^t = -1$
	$e^t = 6$	A1	
	$t = \ln 6 = 1.79$	A1	
9(c)	$t = \ln 6 \rightarrow a = 4 \times 36 - 10 \times 6 = 84$	2	M1 for inserting <i>their</i> value of t into a
10(a)	$\frac{dy}{dx} = -\frac{(1+x)}{x} = -\left(\frac{1}{x} + 1\right)$	2	M1 for using $m_1 \times m_2 = -1$
	$y = -\ln x - x + C$	2	M1 for integrating $\frac{1}{x}$ A1 for all correct including C
	$4 = -\ln 1 - 1 + C$ $C = 5 \rightarrow y = 5 - \ln x - x$	A1	Insert (1, 4) and arrive at correct answer. AG
10(b)	$x = 3 \rightarrow y = 2 - \ln 3$ and $\frac{dy}{dx} = -\frac{1}{3} - 1 = -\frac{4}{3}$	B1	
	$\frac{y - (2 - \ln 3)}{x - 3} = -\frac{4}{3}$	M1	
	$y = -\frac{4}{3}x + 6 - \ln 3$ or $y = -1.33x + 4.90$	A1	
11(a)	$\frac{dy}{dx} = x \times \frac{1}{2}(16 - x^2)^{-\frac{1}{2}} \times (-2x) + (16 - x^2)^{\frac{1}{2}}$	3	B1 for $\frac{d}{dx}(16 - x^2)^{\frac{1}{2}}$ $= \frac{1}{2}(16 - x^2)^{-\frac{1}{2}} \times (-2x)$ M1 for product rule A1 for all correct
	$\frac{dy}{dx} = 0 \rightarrow (16 - x^2)^{\frac{1}{2}} = \frac{x^2}{(16 - x^2)^{\frac{1}{2}}}$ $x^2 = 8$ $(2\sqrt{2}, 8)$	3	M1 for setting $\frac{dy}{dx} = 0$ and attempt to solve M1 for obtaining $x^2 = k$ A1

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11(b)	$\frac{3}{2}(16-x^2)^{\frac{1}{2}} \times (-2x)$	2	M1 for attempt at chain rule A1 for all correct unsimplified
	$\text{Area} = \int_1^3 x(16-x^2)^{\frac{1}{2}} dx = \left[-\frac{1}{3}(16-x^2)^{\frac{3}{2}} \right]_1^3$ $= -\frac{1}{3} \left[7^{\frac{3}{2}} - 15^{\frac{3}{2}} \right] = 13.2$	3	M1 for obtaining $k(16-x^2)^{\frac{3}{2}}$ A1 for obtaining $k = -\frac{1}{3}$ A1 for 13.2
12(a)	$\tan CAB = \frac{4}{3}$	M1	Correct use of tan oe
	$CAB = 0.927$	A1	isw
12(b)	$\text{Angle } CBD = 2\left(\frac{\pi}{2} - 0.927\right) = 1.287$	B1	
	Perimeter $= 3(2\pi - 2 \times 0.927) + 4(2\pi - 1.287)$ $= 13.287 + 19.985$ $= 33.3$	3	M1 for correct plan of two arcs A1 for either arc A1
12(c)	Area of two right-angled triangles $= \frac{1}{2} \times 3 \times 4 \times 2 = 12$	B1	
	Area of Sectors $= \frac{3^2}{2}(2\pi - 2 \times 0.927) + \frac{4^2}{2}(2\pi - 1.287)$ $= 19.93 + 39.97$ Total = 71.9	3	M1 for correct plan of two sectors plus triangles A1 for either sector A1