

Question	Answer	Marks	Partial Marks
1	$4x + 9 = 6 - 5x$ oe or $4x + 9 = 5x - 6$ oe	M1	
	$x = -\frac{1}{3}, x = 15$ mark final answer	A2	not from wrong working; no extras A1 for $x = 15$ ignoring extras implies M1 if no extras seen If M0 then SC1 for any correct value with at most one extra value
	<i>Alternative method:</i> M1 for $(4x + 9)^2 = (6 - 5x)^2$ oe soi		
	A1 for $9x^2 - 132x - 45 = 0$ oe		
	A1 for $x = -\frac{1}{3}, x = 15$ only; mark final answer		
2	Uses $b^2 - 4ac$ with at most one error in substitution: $(-3(k+1))^2 - 4(k)(25) * 0$	M1	
	$9k^2 - 82k + 9 * 0$	A1	
	Factorises or solves <i>their</i> 3-term quadratic	M1	
	$k = \frac{1}{9}$ or 9; mark final answer	A1	
3(a)	$a = 2, b = 1, c = -1$	B2	B1 for any two correct
3(b)	Finds three correct critical values: -1.5 to -1.4 inclusive -0.4 0.8 to 0.9 inclusive	B1	
	A correct pair of inequalities	B2	B1 for either inequality correct

Question	Answer	Marks	Partial Marks
4	Correctly eliminates one unknown: $\frac{4}{(-2y)^2} + \frac{5}{4y^2} = 1$ or $\frac{4}{x^2} + \frac{5}{4\left(-\frac{x}{2}\right)^2} = 1$	M1	
	Simplifies and rearranges e.g. : $\frac{4}{4y^2} + \frac{5}{4y^2} = 1 \rightarrow 4 + 5 = 4y^2$ or $\frac{4}{x^2} + \frac{5}{x^2} = 1 \rightarrow 4 + 5 = x^2$	M1	FT omitted brackets; condone one slip
	$y = \pm \frac{3}{2}$ and $x = \pm 3$ oe	A2	A1 for $y = \pm \frac{3}{2}$ or $x = \pm 3$
	$\sqrt{(3 - -3)^2 + (1.5 - -1.5)^2}$	M1	FT <i>their</i> $y = \pm \frac{3}{2}$ and $x = \pm 3$ provided that no FT coordinate is 0
	$\sqrt{45}$ or $3\sqrt{5}$ indicated as final answer	A1	
5(a)	$\left[\frac{d(x^3)}{dx}\right] = 3x^2$ and $x = \sqrt[3]{512}$ soi OR $\left[\frac{d(\sqrt[3]{V})}{dV}\right] = \frac{1}{3}V^{-\frac{2}{3}}$	B1	
	$\frac{dx}{dt} = \frac{dV}{dt} \times \frac{dx}{dV}$ oe, soi	B1	
	$\frac{480}{3(8)^2}$ oe	M1	FT <i>their</i> $\frac{dV}{dx} = k(8)^2$ or $\frac{dx}{dV} = k(512)^{\frac{2}{3}} k \neq 0$
	2.5 oe	A1	
5(b)	$12(8) \times \text{their } 2.5$ soi	M1	FT <i>their</i> 8 provided it is not 512
	240	A1	FT provided at least M1 earned in (a)

Question	Answer	Marks	Partial Marks
6(a)	$\sqrt{16^2 + 7.5^2 - 2(16)(7.5)\cos\frac{2\pi}{7}}$ $+(16 - 7.5) + 16 \times \frac{2\pi}{7}$ oe, soi	M2	M1 for $\sqrt{16^2 + 7.5^2 - 2(16)(7.5)\cos\frac{2\pi}{7}} + (16 - 7.5)$ or for $16 \times \frac{2\pi}{7}$ seen
	35.6 or 35.6 to 35.614	A1	
6(b)	$\frac{1}{2} \times 16^2 \times \frac{2\pi}{7} -$ $\frac{1}{2} \times 16 \times 7.5 \times \sin\left(\frac{2\pi}{7}\right)$ oe	M2	M1 for either $\frac{1}{2} \times 16^2 \times \frac{2\pi}{7}$ or $\frac{1}{2} \times 16 \times 7.5 \times \sin\left(\frac{2\pi}{7}\right)$
	68[.0] or 67.98 to 68.0	A1	
7(a)	$\frac{dy}{dx} = 3x^2 - 8x + 6$	B1	
	Finds <i>their</i> $\left. \frac{dy}{dx} \right _{x=3}$	M1	condone one slip
	$m_{T_1} = 9$	A1	
	$y - 8 = \textit{their} 9(x - 3)$ or $y = 9x + c$ and $8 = 9(3) + c$	M1	
	$y = 9x - 19$ cao	A1	
7(b)(i)	$m_{T_2} = \frac{1}{\textit{their} 9}$	B1	FT <i>their</i> 9
7(b)(ii)	[Uses $y = x$ in <i>their</i> ($y = 9x - 19$) to form] <i>their</i> ($x = 9x - 19$) or <i>their</i> ($y = 9y - 19$) oe and solves for x or y or solves e.g. <i>their</i> $(9x - 19) = \textit{their} \frac{x + 19}{9}$	M1	
	$\left(\frac{19}{8}, \frac{19}{8}\right)$ oe	A1	FT equal x and y coordinates providing at least 3 marks earned in (a)
8(a)(i)	479 001 600 oe	B1	
8(a)(ii)	$3 \times 10! \times 4$ oe	M1	
	43 545 600 oe	A1	

Question	Answer	Marks	Partial Marks
8(a)(iii)	$5! \times 8 \times 7!$ oe	M1	
	4 838 400 oe	A1	
8(b)(i)	9C_3	M1	
	84	A1	
8(b)(ii)	${}^3C_1 \times {}^4C_1 \times {}^5C_1$ oe	M1	
	60	A1	
9(a)	Identifies the correct term: ${}^5C_2 \times (2k)^3 \times \left(-\frac{1}{k}\right)^2$ [x^2] oe, soi	B1	
	$10 \times \frac{8k^3}{k^2} = 160$ soi	M1	FT only for correct term with bracketing errors; condone one slip in simplification
	$k = 2$ nfw	A1	
9(b)(i)	$1 + 18x + 135x^2$	B2	B1 for any 2 terms correct or for all 3 correct terms listed but not summed or M1 for a correct unsimplified expansion e.g. : $1 + 6(3x) + 15(3x)^2$
9(b)(ii)	Uses constant/coefficient of x to find $a = -2$ only	B2	B1 for both $a = 2$ and -2 or for both $a = \frac{17}{9}$ and -2
	$b = 469$ only	B1	FT <i>their</i> calculated value of a
10(a)(i)	Range f^{-1} : $0.5 \leq f^{-1} \leq 1.5$	B1	
	Domain f^{-1} : $0 \leq x \leq \frac{2\sqrt{2}}{3}$ oe	B2	B1 for 0 and $\frac{2\sqrt{2}}{3}$ in an incorrect inequality or for $x \geq 0$ or $x \leq \frac{2\sqrt{2}}{3}$

Question	Answer	Marks	Partial Marks
10(a)(ii)	Correctly collects terms ready to factorise e.g. $4x^2 - 4x^2y^2 = 1$ or $4y^2x^2 - 4y^2 = -1$ or simplifies to subject in one term only e.g. $\frac{1}{4y^2} = 1 - x^2$ or $-\frac{1}{4x^2} = y^2 - 1$ oe	M1	
	Correctly factorises and/or rearranges at least as far as: $x^2 = \frac{1}{4 - 4y^2}$ or $y^2 = \frac{-1}{4x^2 - 4}$ oe	M1	FT only if of equivalent difficulty
	$[f^{-1}(x) =] \sqrt{\frac{1}{4 - 4x^2}}$ or $[y =] \sqrt{\frac{-1}{4x^2 - 4}}$ oe, isw	A1	
10(b)	Correct order of composition: $gf(x) = e^{\left(\frac{\sqrt{4x^2-1}}{2x}\right)^2}$	M1	
	$gf(x) = e^{\left(1 - \frac{1}{4x^2}\right)}$ isw	A1	
11(a)(i)	$\frac{(10x-1)^{-5}}{-5 \times 10} (+c)$ isw	B2	B1 for $k \frac{(10x-1)^{-5}}{-5} (+c)$, where $k \neq \frac{1}{10}$
11(a)(ii)	$\int \left(4x^5 + 20x^2 + \frac{25}{x}\right) dx$	B1	
	$\frac{4}{6}x^6 + \frac{20}{3}x^3 + 25 \ln x + c$	B2	B1 for any 3 terms correct
11(b)(i)	$3 \sec^2(3x+1)$	B2	B1 for $k \sec^2(3x+1)$ where $k \neq 3$

Question	Answer	Marks	Partial Marks
11(b)(ii)	$\int \frac{\sec^2(3x+1)}{2} dx = \frac{\tan(3x+1)}{6}$ oe, soi	B1	
	$-\int \sin x dx = \cos x$ oe	B1	
	$F\left(\frac{\pi}{10}\right) - F\left(\frac{\pi}{12}\right)$ where $F(x) = k_1 \tan(3x+1) + k_2 \cos x$ oe	M1	
	0.322 or 0.3222[32...] rot to 4 figs	A1	
12	For $0 \leq t \leq 2$: $\int \frac{t}{2e} dt = \frac{t^2}{4e}$	B1	
	For $t > 2$: $\int e^{-\frac{t}{2}} dt = -2e^{-\frac{t}{2}} + \frac{3}{e}$ oe	B2	B1 for $\int e^{-\frac{t}{2}} dt = -2e^{-\frac{t}{2}}(+c)$ oe
	$-2e^{-\frac{3}{2}} + \frac{3}{e} - \frac{1}{4e}$ OR $\left(-2e^{-\frac{3}{2}} + \frac{3}{e} - \frac{1}{e}\right) + \left(\frac{1}{e} - \frac{1}{4e}\right)$	M2	M1 for [s(1) =] $\frac{1}{4e}$ and [s(3) =] $-2e^{-\frac{3}{2}} + \text{their } \frac{3}{e}$ or at least one term correct in the difference: $\left(-2e^{-\frac{3}{2}} + \text{their } \frac{3}{e}\right) - \frac{1}{4e}$ or for one bracket correct in: $\left(-2e^{-\frac{3}{2}} + \text{their } \frac{3}{e} - \frac{1}{e}\right) + \left(\frac{1}{e} - \frac{1}{4e}\right)$
	0.565 or 0.5654 to 0.56541 nfw	A1	

Question	Answer	Marks	Partial Marks
12	Alternative method (using def int): M1* for $= \left[\frac{t^2}{4e} \right]_1$		
	M1 for $\left(\frac{4}{4e} - \frac{1}{4e} \right) \text{oe}$ (dep*)		
	M1** for $\left[-2e^{-\frac{t}{2}} \right]_2^3$		
	M1 for $\left(-2e^{-\frac{3}{2}} + \frac{2}{e} \right) \text{oe}$ (dep**)		
	M1 for $\left(-2e^{-\frac{3}{2}} + \frac{2}{e} \right) + \left(\frac{4}{4e} - \frac{1}{4e} \right)$ oe		
	A1 for 0.565 or 0.5654 to 0.56541 nfww		