

	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	<p>ans: $f'(x) = 2e^{-2x}(2\sec^2 4x - \tan 4x)$</p> <ul style="list-style-type: none"> •¹ knows to use product rule •² differentiates e^{-2x} correctly •³ differentiates $\tan 4x$ correctly 	<p>(3 marks)</p> <ul style="list-style-type: none"> •¹ •² $-2e^{-2x}$ •³ $4\sec^2 4x$
(b)	<p>ans: $\frac{dy}{dx} = \frac{x(1 - \ln 5x) - 1}{x(x-1)^2}$</p> <ul style="list-style-type: none"> •¹ knows to use quotient rule •² differentiates correctly •³ correct simplification for $\frac{dy}{dx}$ 	<p>(3 marks)</p> <ul style="list-style-type: none"> •¹ •² $\frac{x-1}{x} - \ln 5x$ •³ $\frac{x-1 - x \ln 5x}{x(x-1)^2}$
2	<p>ans: $t = \frac{31}{9}$</p> <ul style="list-style-type: none"> •¹ correct augmented matrix •² 1st modified system •³ 2nd modified system •⁴ 3rd modified system •⁵ solve for t 	<p>(4 marks)</p> <ul style="list-style-type: none"> •¹ $\begin{pmatrix} 1 & 2 & -3 & -7 \\ 4 & -1 & 2 & 9 \\ 3 & -2 & t & 13 \end{pmatrix}$ •² $\begin{pmatrix} 1 & 2 & -3 & -7 \\ 0 & -9 & 14 & 37 \\ 3 & -2 & t & 13 \end{pmatrix}$ •³ $\begin{pmatrix} 1 & 2 & -3 & -7 \\ 0 & -9 & 14 & 37 \\ 0 & -8 & t+9 & 34 \end{pmatrix}$ •⁴ $\begin{pmatrix} 1 & 2 & -3 & -7 \\ 0 & -9 & 14 & 37 \\ 0 & 0 & t - \frac{31}{9} & 34 \end{pmatrix}$ •⁵ $t = \frac{31}{9}$
3	<p>ans: -108</p> <ul style="list-style-type: none"> •¹ correct use of binomial ••^{2&3} simplify terms •⁴ correct term 	<p>(4 marks)</p> <ul style="list-style-type: none"> • $(a^3)^4 + 4(a^3)^3\left(-\frac{3}{a}\right) + 6(a^3)^2\left(-\frac{3}{a}\right)^2 + 4(a^3)\left(-\frac{3}{a}\right)^3 + \left(-\frac{3}{a}\right)^4$ ••^{2&3} $a^{12} - 12a^8 + 54a^4 - 108 + \frac{81}{a^4}$ •⁴ -108

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4	<p>ans: $2\sec^3 \theta + 2\sec \theta \tan^3 \theta + 6\sec^2 \theta \tan \theta$</p> <ul style="list-style-type: none"> ••^{1&2} correct terms for 1st derivative •³ correct use of product rule. ••^{4&5} remaining terms 	<p>(5 marks)</p> <ul style="list-style-type: none"> ••^{1&2} $2\sec \theta \tan \theta + 3\sec^2 \theta$ •³ $2\sec \theta \sec^2 \theta + 2\sec \theta \tan^2 \theta + 3(2\sec \theta \sec \theta \tan \theta)$ •^{4&5}
5	<p>ans: $\frac{1}{(1+\sqrt{x})^2} - \frac{2}{(1+\sqrt{x})} + C$</p> <ul style="list-style-type: none"> •¹ correct substitution for dx •² correct substitution in integral •³ re-arranges integral •⁴ integrates correctly •⁵ answer 	<p>(5 marks)</p> <ul style="list-style-type: none"> •¹ $dx = 2(u-1)du$ •² $\int \frac{2(u-1)}{u^3} du$ •³ $2\int (u^{-2} - u^{-3}) du$ •⁴ $2\left(\frac{-1}{u} + \frac{1}{2u^2}\right) + C$ •⁵
6	<p>ans: $(x-4)^2 + y^2 = 25$</p> <ul style="list-style-type: none"> •¹ correct statement •² correct method •³ simplifying •⁴ answer 	<p>(4 marks)</p> <ul style="list-style-type: none"> •¹ $x-4+iy =5$ •² $z = \sqrt{(x-4)^2 + y^2} = 5$ •³ $(x-4)^2 + y^2 = 5^2$ •³ $(x-4)^2 + y^2 = 25$
7	<p>ans: a suitable counter-example</p> <ul style="list-style-type: none"> •¹ suitable value for n •² statement 	<p>(2 marks)</p> <ul style="list-style-type: none"> •¹ $n = 2 \Rightarrow 15$ or $n = 5 \Rightarrow 125$ •² "The statement is false because"
8(a)	<p>ans: (-20, -15) and (20, 17)</p> <ul style="list-style-type: none"> •¹ correct use of formula $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$ •² make $\frac{dy}{dx} = 0$ and solve for t ••^{3&4} substitutes to find co-ordinates 	<p>(4 marks)</p> <ul style="list-style-type: none"> •¹ $\frac{dy}{dx} = \frac{12-3t^2}{10}$ •² $t = \pm 2$ ••^{3&4} answer
(b)	<p>ans: min @ (-20, -15) and max @ (20, 17)</p> <ul style="list-style-type: none"> •¹ finds $\frac{d^2y}{dx^2}$ •^{2&3} correct natures 	<p>(3 marks)</p> <ul style="list-style-type: none"> •¹ $\frac{d^2y}{dx^2} = \frac{-60t}{1000} = \frac{-3t}{50}$ •^{2&3} answer

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9(a)	<p>ans: $6x + 1 + \frac{4}{x} + \frac{3}{x+1} - \frac{1}{x-1}$</p> <ul style="list-style-type: none"> •¹ starts division correctly •² completes division correctly •³ starts to find partial fractions •⁴ expresses f(x) correctly 	<p>(4 marks)</p> <ul style="list-style-type: none"> •¹ $x^3 - x \sqrt{6x^4 - x^3 + 0x^2 - 5x - 4}$ •² $6x + 1 + \frac{6x^2 - 4x - 4}{x^3 - x}$ •³ $C(x+1)(x-1) + Dx(x-1) + Ex(x+1)$ •⁴ answer
(b)	<p>ans: Proof</p> <ul style="list-style-type: none"> •¹ integrates correctly •² substitutes correctly ••^{3&4} completes proof 	<p>(4 marks)</p> <ul style="list-style-type: none"> •¹ $\left[3x^2 + x + 4\ln x + 3\ln x+1 - \ln x-1 \right]_2^3$ •² $(27 + 3 + 4\ln 3 + 3\ln 4 - \ln 2) - (12 + 2 + 4\ln 2 + 3\ln 3 - \ln 1)$ ••^{3&4} $16 + \ln 3 - 5\ln 2 + 3\ln 4$
10	<p>ans: Proofs</p> <ul style="list-style-type: none"> •¹ uses complex conjugate •² Correct substitution •³ use of DeMoivre •⁴ re-arrange using 1st result •⁵ result 	<p>(5 marks)</p> <ul style="list-style-type: none"> •¹ $w^{-1} = \frac{1}{w} = \frac{1}{\cos \theta + i \sin \theta} \times \frac{\cos \theta - i \sin \theta}{\cos \theta - i \sin \theta} = \frac{\cos \theta - i \sin \theta}{\cos^2 \theta - i^2 \sin^2 \theta} =$ •² $(\cos \theta + i \sin \theta)^k + \frac{1}{(\cos \theta + i \sin \theta)^k}$ •³ $(\cos k\theta + i \sin k\theta) + \frac{1}{(\cos k\theta + i \sin k\theta)}$ •⁴ $(\cos k\theta + i \sin k\theta) + \cos k\theta - i \sin k\theta$ •⁵ $2 \cos k\theta$
11	<p>ans: $2 - 5e^{-1} \cong 0.1606$</p> <ul style="list-style-type: none"> •¹ use of formula •² 2nd use of formula •³ integrates correctly •⁴ substitution of limits •⁵ correct evaluation 	<p>(5 marks)</p> <ul style="list-style-type: none"> •¹ $\left[-x^2 e^{-x}\right]_0^1 + \int_0^1 2xe^{-x} dx$ •² $\dots \left[-2xe^{-x}\right]_0^1 + \int_0^1 2e^{-x} dx$ •³ $\left[-2e^{-x}\right]_0^1$ •⁴ $-e^{-1} - 2e^{-1} - 2e^{-1} + 2e^0$ •⁵ $2 - 5e^{-1}$
12(a)	<p>ans: -155</p> <ul style="list-style-type: none"> •¹ finds d •² finds u_{11} 	<p>(2 marks)</p> <ul style="list-style-type: none"> •¹ $u_3 = 2d + u_1 = 5 \Rightarrow d = -20$ •² $u_{11} = 2a + 10d = -155$

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(b)	<p>ans: $67\frac{1}{2}$</p> <ul style="list-style-type: none"> •¹ finds r •² correct formula •³ answer 	<p style="text-align: right;">(3 marks)</p> <ul style="list-style-type: none"> •¹ $45r^2 = 5 \Rightarrow r = \frac{1}{3}$ only as $r > 0$ •² $S_{\infty} = \frac{a}{1-r}$ •³ $S_{\infty} = \frac{45}{1-\frac{1}{3}}$
13	<p>ans: $y = \ln\left(2 - \frac{1}{x}\right)$</p> <ul style="list-style-type: none"> •¹ separates variables •² correct integration •³ finds C •⁴ answer 	<p style="text-align: right;">(4 marks)</p> <ul style="list-style-type: none"> •¹ $\int e^y dy = \int x^{-2} dx$ •² $e^y = -x^{-1} + C$ •³ $1 = -1 + C \Rightarrow C = 2$ •⁴ $y = \ln\left(2 - \frac{1}{x}\right)$
14(a)	<p>ans: EVEN</p> <ul style="list-style-type: none"> •¹ method •² answer 	<p style="text-align: right;">(2 marks)</p> <ul style="list-style-type: none"> •¹ $f(-x) = \frac{(-x)^2 - 25}{(-x)^4 - 4} = f(x)$ •²
(b)	<p>ans: $x = \pm 2$</p> <ul style="list-style-type: none"> •¹ method •² correct integration 	<p style="text-align: right;">(2 marks)</p> <ul style="list-style-type: none"> •¹ $x^2 - 4 = 0 \Rightarrow x = \sqrt{4}$ •² $x = \pm 2$
(c)	<p>ans: $y = 1$</p> <ul style="list-style-type: none"> •¹ method •² process •³ answer 	<p style="text-align: right;">(3 marks)</p> <ul style="list-style-type: none"> •¹ $x^2 + 0x - 4 \sqrt{x^2 + 0x - 25}$ •² $1 - \frac{21}{x^2 - 4}$ •³
(d)	<p>ans: $\left(0, \frac{25}{4}\right)$</p> <ul style="list-style-type: none"> •¹ method •² finds derivative correctly •³ answer 	<ul style="list-style-type: none"> •¹ •² $21(x^2 - 4)^{-2} 2x = \frac{42x}{(x^2 - 4)^2}$ •³ $f'(x) = 0 \Rightarrow x = 0 \Rightarrow y = \frac{25}{4}$

Total: 76 marks