Question	Answer	Marks	Guidance
1	Finds by elimination $3y+\sqrt{7}y=4$ oe or substitutes $x=11-3y$ into $x-\sqrt{7}y=7$ oe OR Finds by elimination $3y+\sqrt{7}y=21+11\sqrt{7}$ oe or substitutes $y=\frac{11-x}{3}$ into $x-\sqrt{7}y=7$ oe	**M1**	
	$y=\frac{4}{3+\sqrt{7}}$ or $x=\frac{21+11\sqrt{7}}{3+\sqrt{7}}$	**A1**	
	$y=\frac{4}{3+\sqrt{7}}\times\frac{3-\sqrt{7}}{3-\sqrt{7}}$ oe or $x=\frac{21+11\sqrt{7}}{3+\sqrt{7}}\times\frac{3-\sqrt{7}}{3-\sqrt{7}}$ oe	**M1**	**FT** *their* value of x or y providing of equivalent difficulty
	$y=6-2\sqrt{7}$ and $x=6\sqrt{7}-7$	**A2**	**A1** for either and no extra values
2	$2x^3+3x^2-29x+30\,[=0]$	**B1**	
	Uses a correct factor $x-2$ or $x+5$ to find a quadratic factor with at least 2 terms correct	**M1**	
	$(x-2)\to(2x^2+7x-15)\quad[=0]$ or $(x+5)\to(2x^2-7x+6)\quad[=0]$	**A1**	
	Factorises or solves *their* 3-term quadratic: $(x+5)(2x-3)$ [= 0] or $(x-2)(2x-3)$ [= 0] or $[x=]\frac{-7\pm\sqrt{7^2-4(2)(-15)}}{2(2)}$ or $\frac{7\pm\sqrt{(-7)^2-4(2)(6)}}{2(2)}$	**M1**	**dep** on previous **M1**
	x = 2, –5, 1.5	**A1**	

Question	Answer	Marks	Guidance
3(a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2}(1+3x)^{-\frac{1}{2}} \times 3$ oe, isw	**B2**	**B1** for $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2}(1+3x)^{-\frac{1}{2}} \times ...$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2}(...)^{-\frac{1}{2}} \times 3$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = \mathit{their}\,\frac{1}{2}(1+3x)^{\left(\mathit{their}\frac{1}{2}\right)-1} \times 3$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = k(1+3x)^{-\frac{1}{2}} \times 3$, k is a constant, $k \neq \frac{1}{2}$
	$m_{\text{tangent}} = \frac{3}{8}$ or 0.375 or $m_{\text{normal}} = \frac{-2}{3(1+3x)^{-\frac{1}{2}}}$ oe	**B1**	**FT** *their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ if necessary providing at least **B1** previously awarded
	$\left(\mathit{their}\frac{\mathrm{d}y}{\mathrm{d}x}\right) = \frac{3}{8}$ or $\left(\mathit{their}\left(-\frac{\mathrm{d}x}{\mathrm{d}y}\right)\right) = -\frac{8}{3}$	**M1**	**FT** *their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ if necessary providing at least **B1** previously awarded
	(5, 4)	**A1**	
3(b)	$m_{\text{normal}} = -\frac{10}{3}$	**B1**	
	$y - 5 = -\frac{10}{3}(x - 8)$ or $y = \frac{-10}{3}x + c$ and $5 = \left(\frac{-10}{3}\right)(8) + c$ oe soi	**M1**	**FT** *their* m_{normal}
	$y = -\frac{10}{3}x + \frac{95}{3}$	**A1**	**FT** *their* m_{normal}
4(a)	$(3x + 1)\log 2 = (x - 2)\log 5$ oe	**B1**	
	$(3\log 2 - \log 5)x = -\log 2 - 2\log 5$	**M1**	**FT** if of equivalent difficulty
	$x = -8.32$	**A1**	

Question	Answer	Marks	Guidance
4(b)	Writes as a quadratic in e^{2y+1} or states $u = e^{2y+1}$ and writes as a quadratic in u oe, soi	M1	condone one error
	$\left(e^{2y+1}\right)^2 - e^{2y+1} - 6 \quad [=0]$ oe or $u^2 - u - 6 \quad [=0]$ oe	A1	
	$(e^{2y+1}+2)(e^{2y+1}-3) \quad [=0]$ leading to $e^{2y+1} = 3$ or $(u + 2)(u - 3)$ [=0] leading to $e^{2y+1} = 3$	A1	
	$y = 0.0493$ and no other solutions	A1	
5(a)	$\frac{dy}{dx} = -(\cos 2x)^{-2} \times -2\sin 2x = \frac{2\sin 2x}{\cos^2 2x}$ or $\frac{dy}{dx} = \frac{0[\cos 2x] - (-2\sin 2x)}{\cos^2 2x} = \frac{2\sin 2x}{\cos^2 2x}$	B2	**B1** for $-(\cos 2x)^{-2} \times m\sin 2x$ or $\frac{0[\cos 2x] - (m\sin 2x)}{\cos^2 2x}$ where $m = 2$ or $m < 0$
5(b)	$2\tan^2 2x = 5$ or $7\cos^2 2x = 2$ or $7\sin^2 2x = 5$	M1	**FT** *their k*
	$\tan 2x = [\pm]\sqrt{\frac{5}{2}}$ or $\cos 2x = [\pm]\sqrt{\frac{2}{7}}$ or $\sin 2x = [\pm]\sqrt{\frac{5}{7}}$	A1	
	0.503 or 0.5034[26…] rot to 4 or more sf 1.07 or 1.067[36…] rot to 4 or more sf and no extras in range	A2	**A1** for either, ignoring extras
6(a)	$3\left(x + \frac{5}{2}\right)^2 - \frac{155}{4}$	B4	**B2** for $3\left(x + \frac{5}{2}\right)^2$ or $3(x + 2.5)^2$ or **B1** for $\left(x + \frac{5}{2}\right)^2$ or $(x + 2.5)^2$ **B2** for $c = -\frac{155}{4}$ or -38.75 or **B1** for $-\frac{25}{4} \times 3 - 20$ oe
6(b)	Min value $-\frac{155}{4}$ when x is $-\frac{5}{2}$	B2	**FT** *their c* from part **a** and **–***their b* from **(a)** **B1** for either without contradiction

Question	Answer	Marks	Guidance
6(c)	$3\left(y^{\frac{1}{3}}+\frac{5}{2}\right)^2=\frac{155}{4}$ soi	**M1**	**FT** an expression of correct form from **(a)**
	Rearranges as far as: $y^{\frac{1}{3}}=-\frac{5}{2}\pm\sqrt{\frac{155}{12}}$ soi	**A1**	
	y = 1.31 or –226	**A1**	
7	$\frac{a(1-r^3)}{1-r}=17.5$ oe or $a+ar+ar^2=17.5$ oe	**B1**	
	$\frac{a}{1-r}=20$	**B1**	
	Correctly eliminates *a* or eliminates *r*	**M1**	**FT** *their* equations providing at least **B1** awarded
	$20(1-r^3)=17.5$ or $a^3-60a^2+1200a-7000=0$	**A1**	
	$r=\frac{1}{2}$, $a=10$	**A2**	**A1** for either
8(a)	Product rule attempted	**M1**	at most one error
	$\left[\frac{dy}{dx}=\right]\sin x+x\cos x$ oe	**A1**	
8(b)	$\left[\text{When } x=\frac{\pi}{2}\right]y=\frac{\pi}{2}$	**B1**	
	$\left[\text{When } x=\frac{\pi}{2}\right]\frac{dy}{dx}=1$	**M1**	**FT** *their* derivative providing at least M1 awarded in **(a)**
	$y=x$	**A1**	
8(c)	$x\sin x+\cos x+c$	**B3**	**B2** for $x\sin x+\cos x$ or **B1** for $\left[\int x\cos x\,dx=\right]x\sin x-\int\sin x\,dx$
8(d)	$\frac{\pi}{4}\sin\frac{\pi}{4}+\cos\frac{\pi}{4}-(0+\cos 0)$	**M1**	
	0.26	**A1**	
9(a)	$(\ln(3x+2))^2+1$ oe isw	**B1**	

Question	Answer	Marks	Guidance
9(b)	$\ln(3x + 2) = [\pm]\ 2$	**B1**	
	$e^2 = 3x + 2$	**M1**	**FT** $\ln(3x + 2) = k$, where $k > 0$
	$x = \dfrac{e^2 - 2}{3}$ as only solution	**A1**	
9(c)	$\ln(3\ln(3x + 2) + 2)$	**B1**	
	their$(3\ln(3x + 2) + 2) = e$	**M1**	**FT** *their* $gg(x)$ with at most one error
	$3\ln(3x + 2) + 2 = e$	**A1**	
	$\ln(3x + 2) = \dfrac{e - 2}{3}$ or 0.239[42…]	**M1**	**FT** *their* $a\ln(3x + 2) + b = e$, where a and b are non-zero constants
	$3x + 2 = e^{\frac{e-2}{3}}$ or $3x + 2 = 1.270[52…]$	**A1**	
	awrt –0.243	**A1**	
10(a)	$\left[v = \int \dfrac{-45}{(t+1)^2}\,dt =\right] \dfrac{-45(t+1)^{-1}}{-1} + C$ or better	**B2**	**B1** for $\left[v = \int \dfrac{-45}{(t+1)^2}\,dt =\right] k(t+1)^{-1}$
	$50 = \dfrac{their\,45}{0+1} + C$	**M1**	
	$[v =]\dfrac{45}{t+1} + 5$	**A1**	
10(b)	$[F(t) =]\quad [45\ln(t+1) + 5t]_1^{10}$	**B2**	**B1** for (*their* 45)$\ln(t + 1)$
	F(10) – F(1)	**M1**	**dep** on at least **B1**
	122 (m) or 121.7[13…] rot to 4 or more sf	**A1**	**dep** on all previous marks awarded

Question	Answer	Marks	Guidance
11(a)	1080	**3**	**M2** for a fully correct method e.g. [starts with 1, 2, 4, 5 and ends in 3, 6] $4 \times 6 \times 5 \times 4 \times 2$ or 960 **and** [starts with 3 and ends in 6] $1 \times 6 \times 5 \times 4 \times 1$ or 120 **OR** [ends with 6 and starts with 1, 2, 3, 4, 5] $5 \times 6 \times 5 \times 4 \times 1$ or 600 **and** [ends with 3 and starts with 1, 2, 4, 5] $4 \times 6 \times 5 \times 4 \times 1$ or 480 or **M1** for a partially correct method equivalent to one of the above two steps
11(b)	2160	**3**	**M2** for a fully correct method e.g. [starts with 1, 3, 5 and ends in 2, 4, 6, 8] $3 \times 6 \times 5 \times 4 \times 4$ or 1440 **and** [starts with 2 or 4 and ends in 6, 8 or one of 2 or 4] $2 \times 6 \times 5 \times 4 \times 3$ or 720 **OR** [ends with 6, 8 and starts with 1, 2, 3, 4, 5] $5 \times 6 \times 5 \times 4 \times 2$ or 1200 **and** [ends with 2, 4 and starts with 1, 3, 5 or one of 2 or 4] $4 \times 6 \times 5 \times 4 \times 2$ or 960 or **M1** for a partially correct method equivalent to one of the above two steps