Question number	Scheme	Marks
1.	Uses $\frac{\mathrm{d}u}{\mathrm{d}x} = 6x$	M1
	To give $\int \frac{1}{u^2} \frac{\mathrm{d}u}{3}$	A1
	Integrates to give $-\frac{1}{3u}$	M1, A1
	Uses correct limits 16 and 4 (or 2 and 0 for x)	M1
	To obtain $-\frac{1}{48} + \frac{1}{12} = \frac{1}{16}$	A1 (6)
		(6 marks)
2.	Differentiates w.r.t. x to give	
	$3x^2, -2x\frac{\mathrm{d}y}{\mathrm{d}x} + 2y, -4 + 3y^2\frac{\mathrm{d}y}{\mathrm{d}x} = 0$	M1, B1, A1
	At (4, 3)	
	$48 - (8y' + 6) - 4 + 27y' = 0$	M1
	$\Rightarrow y' = -\frac{38}{19} = -2$	A1
	$\therefore$ Gradient of normal is $\frac{1}{2}$	M1
	$\therefore y - 3 = \frac{1}{2}(x - 4)$	M1
	i.e. $2y - 6 = x - 4$	
	$x - 2y + 2 = 0$	A1 (8)
		(8 marks)

Question	Mark Scheme	Marks
3. (a)	$\dfrac{1+14x}{(1-x)(1+2x)} \equiv \dfrac{A}{1-x} + \dfrac{B}{1+2x}$ and attempt A and or B	M1
	$A = 5, B = -4$	A1, A1 (3)
(b)	$\displaystyle\int \frac{5}{1-x} - \frac{4}{1+2x}\,dx = [-5\ln\lvert 1-x\rvert - 2\ln\lvert 1+2x\rvert]$	M1 A1
	$= (-5\ln\frac{2}{3} - 2\ln\frac{5}{3}) - (-5\ln\frac{5}{6} - 2\ln\frac{4}{3})$	M1
	$= 5\ln\frac{5}{4} + 2\ln\frac{4}{5}$	
	$= 3\ln\frac{5}{4} = \ln\frac{125}{64}$	M1 A1 (5)
(c)	$5(1-x)^{-1} - 4(1+2x)^{-1}$	B1 ft
	$= 5(1 + x + x^2 + x^3) - 4\left(1 - 2x + \dfrac{(-1)(-2)(2x)^2}{2} + \dfrac{(-1)(-2)(-3)(2x)^3}{6} + \ldots\right)$	M1 A1
	$= 1 + 13x - 11x^2 + 37x^3 \ldots.$	M1 A1 (5)
		(13 marks)
4. (a)	$11 + 4\lambda = 24 + 7\mu$	
	$5 + 2\lambda = 4 + \mu$ — Give 2 of these equations and eliminate variable to find λ or μ, find other	M1
	$6 + 4\lambda = 13 + 5\mu$	
	$5 = 11 + 2\mu$	
	$\therefore \mu = -3;\ \lambda = -2$	A1 A1
	Check in 3rd equation	B1 (4)
(b)	Use $\mu = -3$ or $\lambda = -2$ to obtain $(3, 1, -2)$	M1 A1 (2)
(c)	$\cos\theta = \dfrac{4\times7 + 2\times1 + 4\times5}{\sqrt{4^2+2^2+4^2}\sqrt{7^2+1^2+5^2}} = \dfrac{50}{\sqrt{36}\sqrt{75}}$	M1 A1
	$\therefore \cos\theta = \dfrac{50}{6\times5\sqrt{3}} = \dfrac{50\sqrt{3}}{90} = \dfrac{5\sqrt{3}}{9}$	M1 A1 (4)
		(10 marks)

Question	Mark Scheme	Marks
5. (a)	$\frac{dx}{dt} = -\sin t,\quad \frac{dy}{dt} = 2\cos 2t \;\therefore\; \frac{dy}{dx} = \frac{2\cos 2t}{-\sin t}$	M1 A1 A1 (3)
(b)	$2\cos 2t = 0 \quad \therefore 2t = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}$	M1
	So $t = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$	A1 A1 (3)
(c)	$\left(\frac{1}{\sqrt{2}}, 1\right)\ \left(\frac{1}{\sqrt{2}}, -1\right)\ \left(-\frac{1}{\sqrt{2}}, 1\right)\ \left(-\frac{1}{\sqrt{2}}, -1\right)$	M1 A1 (2)
(d)	$y = 2\sin t\cos t$	M1
	$= 2\sqrt{1-\cos^2 t}\cos t = 2x\sqrt{1-x^2}$	M1 A1 (3)
(e)	$y = -2x\sqrt{1-x^2}$	B1 (1)
		(12 marks)
6. (a)	$R = \int_{\pi}^{2\pi} x^2 \sin\left(\frac{1}{2}x\right) dx = -2x^2\cos\left(\frac{1}{2}x\right) + \int 4x\cos\left(\frac{1}{2}x\right) dx$	M1 A1
	$= -2x^2\cos\left(\frac{1}{2}x\right) + 8x\sin\left(\frac{1}{2}x\right) - \int 8\sin\left(\tfrac{1}{2}x\right)$	M1 A1
	$= -2x^2\cos\left(\frac{1}{2}x\right) + 8x\sin\left(\frac{1}{2}x\right) + 16\cos\left(\tfrac{1}{2}x\right)$	A1
	Use limits to obtain $[8\pi^2 - 16] - [8\pi]$	M1 A1 (7)
(b)	Requires 11.567	B1 (1)
(c) (i)	Area = $\frac{\pi}{4}$, [9.8696 + 0 + 2 × 15.702] (B1 for $\frac{\pi}{4}$ in (i) or $\frac{\pi}{8}$ in (ii))	B1, M1
	= 32.42	A1
(ii)	Area = $\frac{\pi}{8}$ [9.8696 + 0 + 2(14.247 + 15.702 + 11.567)]	M1
	= 36.48	A1 (5)
		(13 marks)

Question	Mark Scheme	Marks
7. (a)	$\frac{\mathrm{d}M}{\mathrm{d}t} = -kM$, where $k > 0$	M1 A1 (2)
(b)	$\frac{\mathrm{d}M}{\mathrm{d}t} = \ln(0.98) \times 10(0.98)^t, = -\,0.02M$	B1, B1 (2)
(c)	$\int \frac{10\,\mathrm{d}M}{10M-1} = -\int k \quad \mathrm{d}t.$	B1
	$\ln(10M - 1) = -\,kt + c$	M1 A1
	At $t = 0$ $M = 10$ $\therefore$ $c = \ln 99$	M1 A1
	At $t = 10$ $M = 8.5$ $\therefore$ $k = \frac{1}{10} \ln \frac{99}{84}$ (= 0 .0164).	M1 A1
	Uses $10M - 1 = 99\,\mathrm{e}^{-kt}$ with values for k and $t = 15$	M1
	To give 7.8 grams accept awrt 7.8	A1 (9)
		(13 marks)

Qn	Specifications Section	AO1	AO2	AO3	AO4	AO5	Totals	Synoptic Marks Total
Q1	5.3	4	2				6	5
Q2	4.1	5	3				8	6
Q3	1, 3, 5.1, 5.4	5	6	2			13	8
Q4	6.1, 6.2, 6.3, 6.5, 6.6	4	5	1			10	4
Q5	2, 4.1,	5	6	1			12	10
Q6	5.1, 5.3, 5.6	4	4			5	13	8
Q7	4.3, 4.2, 5.5	3	2	1	5	2	13	4
	TOTAL	**30**	**28**	**5**	**5**	**7**	**75**	**45**