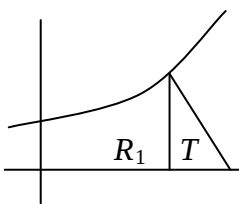


Question Number	Scheme	Marks
1. (a)	$1.5 \sin 2x + 2 \cos 2x = R \sin (2x + \alpha) = R[\sin 2x \cos \alpha + \cos 2x \sin \alpha]$ $R = \sqrt{1.5^2 + 2^2} = 2.5$ Full method for R or R^2 $\tan \alpha = \frac{2}{1.5}, \Rightarrow \alpha = 0.927$ Full method for $\tan \alpha, \sin \alpha, \cos \alpha$	M1, A1 M1, A1 (4)
(b)	$3 \sin x \cos x = 1.5 \sin 2x$ $4 \cos^2 x = 2[2 \cos^2 x] = 2(\cos 2x + 1)$ $\therefore 3 \sin x \cos x + 4 \cos^2 x = 1.5 \sin 2x + 2 \cos 2x + 2$	M1 A1 (2)
(c)	Maximum value of $1.5 \sin 2x + 2 \cos 2x = R$ Maximum value of $3 \sin x \cos x + 4 \cos^2 x = R + 2$ or 4.5	M1 A1 ft (2)
		(8 marks)
2. (a)	$x^2 + 1 \equiv A(1+x)(3-x) + B(3-x) + C(1+x); \quad A = -1$ $2 = 4B, \quad B = \frac{1}{2}; \quad 10 = 4C, \quad C = \frac{5}{2}$	B1 M1 A1; A1 (4)
(b)	$\int (-1 + \frac{1}{2(1+x)} + \frac{5}{2(3-x)}) dx$ $= -x + \frac{1}{2} \ln(1+x) - \frac{5}{2} \ln(3-x)$ $\int_0^2 f(x) = (-2 + \frac{1}{2} \ln 3) - (-\frac{5}{2} \ln 3) = -2 + 3 \ln 3$	M1A1✓ A1✓ M1A1 (5)
		(9 marks)

Question Number	Scheme	Marks
3.	(a) 4, 4.84, 7.06 (b) $I \approx \frac{1}{2} \times 0.25 [6.06 + 7.06 + 2(4.32 + 4 + 4.84)]$ $= \frac{1}{2} \times 0.25 [39.44]$ $= 4.93$ or 4.9 (AWRT 4.93 or just 4.9) (c) $\int_{0.5}^{1.5} \left(\frac{3}{x} + x^4 \right) dx = \left[3 \ln x + \frac{1}{5} x^5 \right]_{0.5}^{1.5}$ $= \left(3 \ln 1.5 + \frac{1}{5} 1.5^5 \right) - \left(3 \ln 0.5 + \frac{1}{5} 0.5^5 \right)$ $= 3 \ln 3 + 1.5125$ or $3 \ln 3 + \frac{121}{80}$ (d) $[4.93 - (c)] \times 100 = 2.53\%$ (i.e. $< 3\%$) (c) AWRT 2.5%	B2/1/0 (2) B1 [M1 A1] A1 (4) M1 A1 M1 A1 (4) M1, A1 (2) (12 marks)
4.	(a) Area of triangle = $\frac{1}{2} \times 30 \times 3\pi^2$ (= 444.132) Accept 440 or 450 (b) Area shaded = $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} 30 \sin 2t \cdot 32t dt$ $= \left[-480t \cos 2t + \int 480 \cos 2t \right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$ $= \left[-480t \cos 2t + 240 \sin 2t \right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$ $= 240(\pi - 1)$ (c) Percentage error = $\frac{240(\pi - 1) - \text{estimate}}{240(\pi - 1)} \times 100 = 13.6\%$ (Accept answers in the range 12.4% to 14.4%)	B1 (1) M1 A1 M1 A1 A1 ft M1A1 (7) M1 A1 (2) (10 marks)
5.	(a) $(1 + \frac{5}{15})^{-\frac{1}{2}} = (\frac{4}{3})^{-\frac{1}{2}}$, $= (\frac{3}{4})^{\frac{1}{2}} = \frac{\sqrt{3}}{2}$; $= \sin 60^\circ$ $1 + 5x(-\frac{1}{2}) + \frac{(5x)^2}{2}(-\frac{1}{2})(-\frac{3}{2}) + \frac{(5x)^3}{6}(-\frac{1}{2})(-\frac{3}{2})(-\frac{5}{2}) \dots$ (b) $= 1 - \frac{5}{2}x + \frac{75}{8}x^2 - \frac{625}{16}x^3 \dots$ (c) $= 1 - \frac{5}{2}\left(\frac{1}{15}\right) + \frac{75}{8}\left(\frac{1}{15}\right)^2 - \frac{625}{16}\left(\frac{1}{15}\right)^3 \dots = 0.863(4259..)$ (d) $\sin 60^\circ - (\text{Ans}) \approx 0.0026$	M1,A1;A1 (3) M1, B1, A1, A1 (4) M1 A1 (2) A1 (1) (10 marks)

Question Number	Scheme	Marks
6.	(a) $x \tan x, - \int \tan x \, dx$ $= x \tan x + [\ln \cos x]$ (or equivalent) $= \frac{\pi}{4} + \ln \cos \frac{\pi}{4}$ $= \frac{\pi}{4} + \ln \frac{1}{\sqrt{2}} = \frac{\pi}{4} - \frac{1}{2} \ln 2$ * (b) $V = \pi \int_0^{\frac{\pi}{4}} x \sec^2 x \, dx$ $= \frac{\pi^2}{4} - \frac{\pi}{2} \ln 2 = 1.38$ (c) $\frac{dy}{dx} = \frac{1}{2} x^{-\frac{1}{2}} \sec x + x^{\frac{1}{2}} \sec x \tan x$ 2.05	M1, A1 [M1 A1] M1 M1 (6) M1 A1 (2) M1 A1 A1 (3) (11 marks)
7.	(a) M is $(0, 7)$ $\frac{dy}{dx} = 2e^x$ Attempt $\frac{dy}{dx}$ $\therefore$ gradient of normal is $-\frac{1}{2}$ ft their $y'(0)$ $\therefore$ equation of normal is $y - 7 = -\frac{1}{2}(x - 0)$ or $x + 2y = 14$ (b) $y = 0, x = 14$ $\therefore N$ is $(14, 0)$ (*) (c)  $\int (2e^x + 5) \, dx = [2e^x + 5x]$ some correct $\int$ $R_1 = \int_0^{\ln 4} (2e^x + 5) \, dx = (2 \times 4 + 5 \ln 4) - (2 + 0)$ M1 limits used $= 6 + 5 \ln 4$ A1 $T = \frac{1}{2} \times 13 \times (14 - \ln 4)$ Area of T B1 $T = 13(7 - \ln 2)$; $R_1 = 6 + 10 \ln 2$ Use of $\ln 4 = 2 \ln 2$ B1 $R = T + R_1,$ $R = 97 - 3 \ln 2$ M1, A1 (7) (12marks)	B1 M1 M1 A1 (4) B1 cso (1) M1 M1 limits used A1 B1 B1 M1, A1 (7) (12marks)

Question Number	Scheme	Marks
8.	(a) $\mathbf{r} = (9\mathbf{i} - 2\mathbf{j} + \mathbf{k}) + \lambda(-3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k})$ (or any correct alternative)	M1,A1 (2)
	(b) Uses their line equation, or recognises B is mid point of AC or merely writes down $p=6, q=11$	M1, A1 (2)
	(c) Calculates $\overrightarrow{OC} \bullet \overrightarrow{AB}$	M1
	Uses $\cos \alpha = \frac{OC \bullet AB}{ OC AB }$ to obtain α .	M1
	$\cos \alpha = \frac{70}{\sqrt{166}\sqrt{50}}, \alpha = 39.8^\circ$ (accept 39.79 or 40)	A1 (3)
	(d) Let OD be $(9\mathbf{i} - 2\mathbf{j} + \mathbf{k}) + t(-3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k})$	M1
	Use scalar product $OD \cdot AB = 0$	M1
	Obtains equation in t and solves to obtain $t = 0.6$ (or equivalent)	M1A1
	Uses their t , to obtain $7.2\mathbf{i} + 0.4\mathbf{j} + 4\mathbf{k}$.	M1, A1 (6)
		(13marks)