Question Number	Scheme	Marks
1. (*a*)	$p = 1.357$; $q = 1.382$	B1 B1 (2)
(*b*)	$I \approx \frac{0.5}{2}[1 + 2(1.216 + 1.357 + 1.413) + 1.382]$	B1 M1 A1 ft
	$= 2.589$	A1 (4)
		(6 marks)
2. (*a*)	$\int x\cos 2x\,dx = \frac{x\sin 2x}{2} - \int \frac{\sin 2x}{2}dx$ (integration in correct direction)	M1 A1
	$= \frac{x\sin 2x}{2} + \frac{\cos 2x}{4} (+k)$ (second integration)	M1 A1 (4)
(*b*)	$x\frac{2\sin x\cos x}{2} + \frac{1-2\sin^2 x}{4}\ (+k)$ (use of appropriate double angle formulae)	M1
	$= \frac{1}{2}\sin x(2x\cos x - \sin x) + \frac{1}{4} + k$ for $\frac{1}{4} + k$	A1
	$= \frac{1}{2}\sin x(2x\cos x - \sin x) + C$ ★	A1 cao (3)
		(7 marks)
3. (*a*)	$(1+3x)^{-2} = 1 + (-2)(3x) + \frac{(-2)(-3)}{2!}(3x)^2 + \frac{(-2)(-3)(-4)}{3!}(3x)^3 + ...$	M1
	$= 1, -6x, +27x^2 ...(-108x^3)$	B1 A1 A1 (4)
(*b*)	Using (*a*) to expand $(x+4)(1+3x)^{-2}$ or complete method to find coefficients	M1
	[e.g. Maclaurin or $\frac{1}{3}(1+3x)^{-1} + \frac{11}{3}(1+3x)^{-2}$].	
	$= 4 - 23x, +102x^2, -405x^3 = 4, -23x, +102x^2 ...(-405x^3)$	A1, A1ft, A1ft (4)
		(8 marks)

Question Number	Scheme	Marks
4. (*a*)	$\overrightarrow{AB} = 3\mathbf{b} + 6\mathbf{j} + 6\mathbf{k}$	B1 (1)
(*b*)	$\cos A = \dfrac{-12-48+6}{\sqrt{81}\sqrt{81}} = -\dfrac{2}{3}$	M1 A1 A1 (3)
(*c*)	$\lambda = 4$ at point A and $\lambda = 7$ at point B.	B1 B1
	$\mathbf{r} = -9\mathbf{k} + \lambda(\mathbf{i} + 2\mathbf{j} + 2\mathbf{k})$ represents a line	B1 (3)
(*d*)	$(\lambda\mathbf{i} + 2\lambda\mathbf{j} + (2\lambda - 9)\mathbf{k}) \,.\, (\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}) = 0$	M1
	$\lambda + 4\lambda + \lambda - 18 = 0$. Therefore $\lambda = 2$	M1 A1 (3)
(*e*)	The point is (2, 4, –5)	M1 A1 (2)
		(12 marks)
5. (*a*)	$\dfrac{dy}{dx} = \sqrt{\sin x} + \dfrac{x}{2}(\sin x)^{-\frac{1}{2}}\cos x$	M1 A1
	At A $\sqrt{\sin x} + \dfrac{x}{2}(\sin x)^{-\frac{1}{2}}\cos x = 0$	M1
	$\therefore \sin x + \dfrac{x}{2}\cos x = 0$ (essential to see intermediate line before given answer)	
	$\therefore 2\tan x + x = 0$ *	A1 (4)
(*b*)	$V = \pi\int y^2 dx = \pi\int x^2 \sin x dx$	M1
	$= \pi\left[-x^2\cos x + \int 2x\cos x dx\right]_0^{\pi}$	M1 A1
	$= \pi\left[-x^2\cos x + 2x\sin x - \int 2\sin x dx\right]_0^{\pi}$	M1
	$= \pi\left[-x^2\cos x + 2x\sin x + 2\cos x\right]_0^{\pi}$	A1
	$= \pi\left[\pi^2 - 2 - 2\right]$	M1
	$= \pi\left[\pi^2 - 4\right]$	A1 (7)
		(11 marks)

Question Number	Scheme	Marks
6. (*a*)	$\frac{\mathrm{d}N}{\mathrm{d}t} = -kN$	M1 A1 (2)
(*b*)	$\int \frac{\mathrm{d}N}{N} = \int -k \quad \mathrm{d}t$	B1 ft
	$\ln N = -kt + c$	M1 A1 ft
	$N = \mathrm{e}^{-kt+c} = A\mathrm{e}^{-kt}$	M1 A1 (5)
(*c*)	$3 \times 10^{17} = 7 \times 10^{18}\mathrm{e}^{-8k}$	M1
	$\mathrm{e}^{-k} = \sqrt[8]{\frac{3}{70}} = 0.6745$ or $k = \frac{1}{8}\ln\frac{70}{3}$	M1
	$k = 0.3937$	A1 (3)
(*d*)	$N = 7 \times 10^{18}\ \mathrm{e}^{-0.3937 \times 16}$ or $\frac{3}{70} \times 3 \times 10^{17}$	M1
	$= 1.286 \times 10^{16}$	A1 (2)
		(12 marks)
7. (*a*)	$A = 2, \quad B = -16$	M1 A1 A1 (3)
(*b*)	$A(1-2x)^{-1} + B(2+x)^{-1}$ and attempt at expansion	M1
	$A(1 + 2x + 4x^2 + 8x^3 + ...) + \frac{B}{2}(1 - \frac{x}{2} + \frac{x^2}{4} - \frac{x^3}{8} + ...)$	A1 M1 A1
	$= 10 + 10x^2 + 15x^3 + ...$	A1 (5)
		(8 marks)

Question Number	Scheme	Marks	
8. (*a*)	$\dfrac{dy}{dx} = \dfrac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \dfrac{4\cos\theta}{-5\sin\theta}$	M1 A1	
	Equation of tangent is $y - 4\sin\alpha = \dfrac{4\cos\alpha}{-5\sin\alpha}(x - 5\cos\alpha)$	M1	
	$\therefore\ 5y\sin\alpha + 4x\cos\alpha = 20(\cos^2\alpha + \sin^2\alpha) = 20$ (*)	A1	(4)
(*b*)	$\int y\dfrac{dx}{d\theta}\,d\theta = -\int 4\sin\theta\ 5\sin\theta\ \ d\theta$	M1	
	$= 10\int(\cos 2\theta - 1)\ \ d\theta$	M1	
	$= [5\sin 2\theta - 10\theta]$	M1	
	Area $= 20\pi$	A1 cso	(4)
(*c*)	When $x = 0,\ y = \dfrac{4}{\sin\alpha}$, or when $y = 0,\ x = \dfrac{5}{\cos\alpha}$	B1	
	Area of parallelogram $= 4 \times \dfrac{10}{\sin\alpha\cos\alpha} = \dfrac{80}{\sin 2\alpha}$	M1 A1	
	$\therefore\ A = \dfrac{80}{\sin 2\alpha} - 20\pi$	A1	(4)
(*d*)	$\dfrac{80}{\sin 2\alpha} - 20\pi = 20\pi$	M1 A1	
	$\sin 2\alpha = \dfrac{2}{\pi}$		
	$\alpha = 0.345$	A1	(3)
			(15 marks)