Question Number	Scheme	Marks
1(a)	$\frac{3(x+1)}{(x+2)(x-1)} \equiv \frac{A}{x+2} + \frac{B}{x-1}$, and correct method for finding A or B	M1
	$A = 1$, $B = 2$	A1, A1 (3)
(b)	$f'(x) = -\frac{1}{(x+2)^2} - \frac{2}{(x-1)^2}$	M1 A1
	Argument for negative, including statement that square terms are positive for all values of x. (f.t. on wrong values of A and B)	A1ft✓
		(3)
2 (a)	$a = 4$, $b = 5$ (both are required)	B1 (1)
(b)	$(x-4)^2 + (y-5)^2 = 25$	M1A1ft (2)
(c)	Finding the distance between centre and (8, 17), $\sqrt{[(8-a)^2 + (17-b)^2}$	M1
	Complete method to find PT, i.e. use Pythagoras theorem and subtraction,	M1
	$PT = 11.6$	A1 (3)

Question Number	Scheme	Marks
3(a)	Using $f(\pm 2) = 3$	M1
	Showing that p = 6 ✸, with no wrong working seen.	A1 (2)
	S.C. If p = 6 used and the remainder is shown to be 3 award B1	
(b)	Attempt to find quotient when dividing (n + 2) into f(n) or attempting to equate coefficients.	M1
	Quotient = $n^2 + 4n + 3$, or finding either q = 1 or r = 3	A1
	Finding both q = 1 and r = 3	A1 (3)
(c)	The product of three consecutive numbers must be divisible by 3	M1
	Complete argument	A1 (2)
4. (a)	$(1+3x)^{-2} = 1 + (-2)(3x) + \frac{(-2)(-3)}{2!}(3x)^2 + \frac{(-2)(-3)(-4)}{3!}(3x)^3 + ...$ = 1, – 6x, + 27x^2 ...(–108x^3)	M1 B1, A1, A1 (4)
(b)	Using (a) to expand $(x+4)(1+3x)^{-2}$ or complete method to find coefficients [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)	M1 A1,A1ft,A1ft (4)

Question Number	Scheme	Marks
6(a)	$\mathbf{r} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k} \pm \lambda(4\mathbf{i} - 5\mathbf{j} + 3\mathbf{k})$ or $\mathbf{r} = 5\mathbf{i} - 3\mathbf{j} \pm \lambda(4\mathbf{i} - 5\mathbf{j} + 3\mathbf{k})$ (or any equivalent vector equation)	M1A1 (2)
(b)	Show that $\mu = -3$	B1 (1)
(c)	Using $\cos\theta = \frac{(4\mathbf{i}-5\mathbf{j}+3\mathbf{k}).(\mathbf{i}-2\mathbf{j}+2\mathbf{k})}{\sqrt{(4^2+5^2+3^2)}\sqrt{(1^2+2^2+2^2)}}$	M1
	$= \frac{20}{15\sqrt{2}} = \frac{4}{3\sqrt{2}}$ (ft on 4i – 5j + 3k) num, denom.	A1ft A1ft
	$\theta = 19.5°$ (allow 19 or 20 if no wrong working is seen)	A1 (4)
(d)	Shortest distance = AC sin θ	M1
	AC = $\sqrt{((a-1)^2 + 2^2 + (b+3)^2)}$ (= 3)	M1A1
	Shortest distance = 1 unit	A1 (4)
	Alternatives	
	Since $X = (1+4\lambda, 2-5\lambda, -3+3\lambda)$	
	$\mathbf{CX} = (-1+4\lambda)\mathbf{i} + (2-5\lambda)\mathbf{j} + (-2+3\lambda)\mathbf{k}$	M1
	Use Scalar product $\mathbf{CX}.(4\mathbf{i}-5\mathbf{j}+3\mathbf{k}) = 0$, OR differentiate $\lvert\mathbf{CX}\rvert$ or $\lvert\mathbf{CX}\rvert^2$ and equate to zero,	M1
	to obtain $\lambda = 0.4$	A1
	and thus $\lvert\mathbf{CX}\rvert = 1$	A1 (4)

Question Number	Scheme	Marks
5. (a)	$\frac{\mathrm{d}V}{\mathrm{d}t} = 30 - \frac{2}{15}V$	M1A1
	$\Rightarrow -15\frac{\mathrm{d}V}{\mathrm{d}t} = -450 + 2V$, no wrong working seen	A1* (3)
(b)	Separating the variables $\Rightarrow -\frac{15}{2V-450}\mathrm{d}V = \mathrm{d}t$	M1
	Integrating to obtain $-\frac{15}{2}\ln\lvert 2V-450\rvert = t$ OR $-\frac{15}{2}\ln\lvert V-225\rvert = t$	dM1 A1
	Using limits correctly or finding c $(-\frac{15}{2}\ln 1550$ *OR* $-\frac{15}{2}\ln 775)$	M1
	$\ln\frac{2V-450}{1550} = -\frac{2}{15}t$, or equivalent	A1
	Rearranging to give $V = 225 + 775e^{-\frac{2}{15}t}$.	dM1A1 (7)
(c)	$V = 225$	B1 (1)

Question Number	Scheme	Marks
7(a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = -2e^{-2x}\sqrt{x} + \frac{e^{-2x}}{2\sqrt{x}}$	M1 A1 A1
	Putting $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and attempting to solve	dM1
	$x = \frac{1}{4}$	A1 (5)
(b)	Volume $= \pi\int_0^1 (\sqrt{x}e^{-2x})^2\mathrm{d}x \quad = \pi\int_0^1 xe^{-4x}\mathrm{d}x$	M1 A1
	$\int xe^{-4x}\mathrm{d}x = -\frac{1}{4}xe^{-4x} + \int \frac{1}{4}e^{-4x}\mathrm{d}x$	M1 A1
	$= -\frac{1}{4}xe^{-4x} - \frac{1}{16}e^{-4x}$	A1 ft
	Volume = $\pi[-\frac{1}{4}e^{-4} - \frac{1}{16}e^{-4}] - [-\frac{1}{16}] = \frac{\pi}{16}[1 - 5e^{-4}]$	M1 A1 (7)

Question Number	Scheme	Marks
8 (a)	$\cos(A+A)=\cos^2 A-\sin^2 A$	M1
	$=\cos^2 A-(1-\cos^2 A)=2\cos^2 A-1$	A1 (2)
(b)	$[x=2,\theta=\frac{\pi}{4};x=\sqrt{6},\theta=\frac{\pi}{3}]$	B1
	$x=2\sqrt{2}\sin\theta,\frac{\mathrm{d}x}{\mathrm{d}\theta}=2\sqrt{2}\cos\theta$	B1
	$\int\sqrt{8-x^2}\mathrm{d}x=\int 2\sqrt{2}\cos\theta 2\sqrt{2}\cos\theta\mathrm{d}\theta=\int 8\cos^2\theta\mathrm{d}\theta$	M1A1
	Using $\cos 2\theta=2\cos^2\theta-1$ to give $\int 4(1+\cos 2\theta)\mathrm{d}\theta$	dM1
	$=4\theta+2\sin 2\theta$	A1ft
	Substituting limits to give $\frac{1}{3}\pi+\sqrt{3}-2$ or given result	A1 (7)
(c)	$\frac{dy}{d\theta}=\frac{-2\sin 2\theta}{1+\cos 2\theta}$	B1
	Using the chain rule, with $\frac{dx}{d\theta}=\sec\theta\tan\theta$ to give $\frac{\mathrm{d}y}{\mathrm{d}x}(=-2\cos\theta)$	M1
	Gradient at the point where $\theta=\frac{\pi}{3}$ is –1.	A1ft
	Equation of tangent is $y+\ln 2=-(x-2)$ (o.a.e.)	M1A1 (5)