Question Number	Scheme	Marks
1 (a)	$(1+\left(-\frac{1}{2}\right)(-2x)+\frac{(-\frac{1}{2})(-\frac{3}{2})}{1.2}(-2x)^2+\frac{(-\frac{1}{2})(-\frac{3}{2})(-\frac{5}{2})}{1.2.3}(-2x)^3+....)$	M1 (corr bin coeffs) M1 (powers of $-2x$)
	$=1+x,+\frac{3}{2}x^2+\frac{5}{2}x^3+...$	A1, A1 (4)
Alternative	May use McLaurin f(0)=1 and $f'(0)=1$ to obtain 1st two terms 1 + x Differentiates two further times and uses formula with correct factorials to give $\frac{3}{2}x^2+\frac{5}{2}x^3$	M1 A1 M1 A1 (4)
(b)	$(100-200x)^{-\frac{1}{2}}=100^{-\frac{1}{2}}(1-2x)^{-\frac{1}{2}}$. So series is $\frac{1}{10}$(previous series)	M1A1 ft (2)
2	Uses f(2) = 0 to give 16 – 4 + 2a + b = 0	M1 A1
	Uses f(-1) = 6 to give -2 – 1 +-a + b = 6	M1 A1
	Solves simultaneous equations to give a = -7, and b = 2	M1 A1 A1 (7)
3 (a)	Uses circle equation $(x-4)^2+(y-3)^2=(\sqrt{5})^2$	M1 A1
	Multiplies out to give $x^2-8x+16+y^2-6y+9=5$ and thus $x^2+y^2-8x-6y+20=0$ **(*)**	A1 (3)
Alternative	Or states equation of circle is $x^2+y^2+2gx+2fy+c=0$ has centre (-g, -f) and so g = - 4 and f = - 3 Uses $g^2+f^2-c=r^2$ to give $c=3^2+4^2-\sqrt{5}^2$, i.e. c = 20 $x^2+y^2-8x-6y+20=0$	M1 A1 A1 (3)
(b)	y = 2x meets the circle when $x^2+(2x)^2-8x-6(2x)+20=0$ $5x^2-20x+20=0$ Solves and substitutes to obtain x = 2 and y = 4. Coordinates are (2, 4)	M1 A1 M1 A1 (4)
	Or Implicit differentiation attempt , $2x+2y\frac{dy}{dx}-8-6\frac{dy}{dx}=0$ Uses y = 2x and $\frac{dy}{dx}$=2 to give 10x – 20 = 0. Thus x =2 and y =4	M1 A1 M1 A1 (4)

Question Number	Scheme	Marks
4.(a)	$\text{f}'(x)=(x^2+1)\times\frac{1}{x}+\ln x\times 2x$	M1 A1
	$\text{f}'(\text{e})=(\text{e}^2+1)\times\frac{1}{\text{e}}+2\text{e}\;=3\text{e}+\frac{1}{\text{e}}$	M1 A1
		(4)
(b)	$(\frac{x^3}{3}+x)\ln x-\int(\frac{x^3}{3}+x)\frac{1}{x}dx$	M1 A1
	$=(\frac{x^3}{3}+x)\ln x-\int(\frac{x^2}{3}+1)dx$	
	$=\left[(\frac{x^3}{3}+x)\ln x-(\frac{x^3}{9}+x)\right]_1^e$	A1
	$=\frac{2}{9}e^3+\frac{10}{9}$	M1 A1
		(5)
5. (a)	$\frac{9+4x^2}{9-4x^2}=-1+\frac{18}{(3+2x)(3-2x)}$, so A = - 1	B1
	Uses 18 = B (3– 2x) + C (3+2x) and attempts to find B and C	M1
	B = 3 and C = 3	A1 A1
	Or	(4)
	Uses $9+4x^2$ = $A(9-4x^2)$+ B (3– 2x) + C (3+2x) and attempts to find A, B and C	M1
	A = -1, B = 3 and C = 3	A1, A1, A1
		(4)
(b)	Obtains $Ax+\frac{B}{2}\ln(3+2x)-\frac{C}{2}\ln(3-2x)$	M1 A1
	Substitutes limits and subtracts to give 2 $A+\frac{B}{2}\ln(5)-\frac{C}{2}\ln(\frac{1}{5})$	M1 A1ft
	= -2 +3ln5 or –2 +ln125	A1
		(5)

Question Number	Scheme	Marks
6 (a)	$\frac{dC}{dt} = -kC$; rate of decrease/negative sign; k constant of proportionality/positive constant	B1 (1)
(b)	$\int \frac{\mathrm{d}C}{C} = -k\int \mathrm{d}t$	M1
	$\therefore \ln C = -kt + \ln A$	M1
	$\therefore C = Ae^{-kt}$	A1 (3)
(c)	At $t = 0$ $C = C_0$, $\therefore A = C_0$	B1
	and at $t = 4$ $C = \frac{1}{10}C_0$, $\therefore \frac{1}{10}C_0 = C_0 e^{-4k}$,	M1
	$\therefore \frac{1}{10} = e^{-4k}$ and $\therefore -4k = \ln\frac{1}{10}$, $\therefore k = \frac{1}{4}\ln 10$	M1, A1 (4)
7 (a)	Solves $9+2\lambda = 1$ *or* $7+2\lambda = -1$ to give $\lambda = -4$ so $p = 3$	M1 A1
	Solves $9+2\lambda = 7$ *or* $7+\lambda = 6$ to give $\lambda = -1$ so $q = 5$	M1 A1 (4)
(b)	$\lvert 6\mathrm{i} + 6\mathrm{j} + 3\mathrm{k}\rvert = 9$ so unit vector is $\frac{1}{9}$(6**i** +6**j** +3**k)**	M1 A1 (2)
(c)	$\cos\theta = \frac{2\times 2 + 2\times 1 + 1\times 2}{3\times 3}$	M1 A1
	$\therefore \cos\theta = \frac{8}{9}$	A1 (3)
(d)	Write down two of $9+2\lambda = 3+2\mu$, $7+2\lambda = 2+\mu$ or $7+\lambda = 3-2\mu$	B1 B1
	Solve to obtain $\mu = 1$ or $\lambda = -2$	M1 A1
	Obtain coordinates (5, 3, 5)	A1 (5)

Question Number	Scheme	Marks
8(a)	$\frac{dx}{dt} = -3a\sin 3t, \quad \frac{dy}{dt} = a\cos t$ therefore $\frac{dy}{dx} = \frac{\cos t}{-3\sin 3t}$	M1 A1
	When $x = 0, t = \frac{\pi}{6}$	B1
	Gradient is $-\frac{\sqrt{3}}{6}$	M1
	Line equation is $(y - \frac{1}{2}a) = -\frac{\sqrt{3}}{6}(x - 0)$	M1 A1
		(6)
(b)	Area beneath curve is $\int a\sin t(-3a\sin 3t)dt$	M1
	$= -\frac{3a^2}{2}\int(\cos 2t - \cos 4t)dt$	M1
	$-\frac{3a^2}{2}\left[\frac{1}{2}\sin 2t - \frac{1}{4}\sin 4t\right]$	M1 A1
	Uses limits 0 and $\frac{\pi}{6}$ to give $\frac{3\sqrt{3}a^2}{16}$	M1 A1
	Area of triangle beneath tangent is $\frac{1}{2}\times\frac{a}{2}\times\sqrt{3}a = \frac{\sqrt{3}a^2}{4}$	M1 A1
	Thus required area is $\frac{\sqrt{3}a^2}{4} - \frac{3\sqrt{3}a^2}{16} = \frac{\sqrt{3}a^2}{16}$	A1
		(9)
N.B.	The integration of the product of two sines is worth 3 marks (lines 2 and 3 of scheme to part (b))	
	If they use parts	
	$\int \sin t\sin 3t dt = -\cos t\sin 3t + \int 3\cos 3t\cos t dt$	M1
	$= -\cos t\sin 3t + 3\cos 3t\sin t + \int 9\sin 3t\sin t dt$	
	$8I = \cos t \sin 3t - 3\cos 3t\sin t$	M1 A1