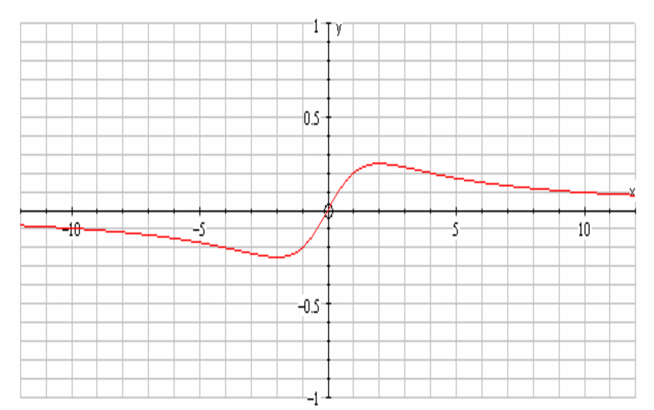
Question Number	Scheme	Marks
	Either $\quad$ f.t. on $\frac{1}{a}$	
1.	Obtains centre (0, 6.5)	B1
	Finds radius or diameter by Pythagoras Theorem, to obtain r = 2.5 or $r^2 = 6.25$	M1, A1
	$x^2 + (y-6.5)^2 = 2.5^2$ or $x^2 + y^2 - 13y + 36 = 0$	B1 (4)
	Or	
	$\frac{y-8}{x+2} \times \frac{y-5}{x-2} = -1$ $\quad$ Gradients multiplied and put = to -1	B1 M1A1
	$x^2 + y^2 - 13y + 36 = 0$	B1 (4)
	Or	
	Obtains centre (0, 6.5)	B1
	$x^2 + (y-6.5)^2 = r^2$ or $x^2 + y^2 - 13y + c = 0$	B1
	substitutes either (2 , 5) or (-2 , 8)	M1
	$x^2 + (y-6.5)^2 = 2.5^2$ or $x^2 + y^2 - 13y + 36 = 0$	A1 (4)
2. (a)	$na = -6,$ $\quad$ $\frac{n(n-1)}{2}a^2 = 27$	B1, B1
	Attempts solution by eliminating variable e.g. $\frac{n(n-1)36}{n^2} = 54$ or $-\frac{6}{a}(-\frac{6}{a}-1)a^2 = 54$	M1
	n = -2, $\quad$ a = 3	A1, A1 (5)
(b)	$\frac{(-2)(-3)(-4)3^3}{6} = -108$ $\quad$ for M1 allow a instead of a^3	M1 A1 (2)
(c)	$\lvert x \rvert < \frac{1}{3}$ or $-\frac{1}{3} < x < \frac{1}{3}$	B1 f.t. (1)

Question Number	Scheme	Marks
3. (a)	$10x, +(2y+2x\frac{dy}{dx}), -6y\frac{dy}{dx}=0$	M1,(B1),A1
	At (1 , 2) $10+(4+2\frac{dy}{dx})-12\frac{dy}{dx}=0$	M1
	$\therefore \frac{dy}{dx}=\frac{14}{10}=1.4 \; or \; \frac{7}{5} \; or \; 1\frac{2}{5}$	A1 (5)
(b)	The gradient of the normal is $-\frac{5}{7}$	M1
	Its equation is $y-2=-\frac{5}{7}(x-1)$ (allow tangent)	M1
	$y=-\frac{5}{7}x+2\frac{5}{7}$ or $y=-\frac{5}{7}x+\frac{19}{7}$	A1cao (3)
4. (a)	Uses the remainder theorem with $x=\frac{1}{2}$, or long division, and puts remainder = 0	M1
	To obtain $p+2q=-35$ or any correct equivalent (allow more than 3 terms)	A1
	Uses the remainder theorem with $x=1$, or long division, and puts remainder = $\pm$ 7	M1
	To obtain $p+q=-21$ or any correct equivalent (allow more than 3 terms)	A1
	Solves simultaneous equations to give *p* = -7, and *q* = - 14	M1 A1 (6)
(b)	Then $6x^3-7x^2-14x+8=(2x-1)\left(3x^2-2x-8\right)$	M1 A1 ft
	So f(x) = (2x – 1)(3x + 4)(x – 2)	B1 (3)

Question Number	Scheme	Marks
5. (a)	Area of triangle = $\frac{1}{2}\times 30\times 3\pi^2$ (= 444.132) Accept 440 or 450	B1 (1)
(b)	**Either** Area shaded = $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} 30\sin 2t.32t\mathrm{d}t$	M1 A1
	$=\left[-480t\cos 2t+\int 480\cos 2t\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$	M1 A1
	$=\left[-480t\cos 2t+240\sin 2t\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$	A1 ft
	$= 240(\pi-1)$	M1A1 (7)
	or $\int_{\frac{\pi}{2}}^{\frac{\pi}{4}} 60\cos 2t.(16t^2\text{-}\pi^2)\mathrm{d}t$	M1 A1
	$=\left[(30\sin 2t(\pi^2-16t^2)-480t\cos 2t+\int 480\cos 2t\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$	M1 A1
	$=\left[-480t\cos 2t+240\sin 2t\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$	A1 ft
	$= 240(\pi-1)$	M1 A1 (7)
(c)	Percentage error = $\frac{240(\pi-1)-estimate}{240(\pi-1)}\times 100$ = 13.6% (Accept answers in the range 12.4% to 14.4%)	M1 A1 (2)

Question Number	Scheme	Marks
6. (a)	Uses $\dfrac{A}{(2x-3)}+\dfrac{B}{(x+1)}$	M1
	Considers –2x + 13 = A (x + 1) + B (2x –3) and substitutes x = -1 **or** x = 1.5, or compares coefficients and solves simultaneous equations	M1
	To obtain A = 4 and B = -3.	A1, A1 (4)
(b)	Separates variables $\int \frac{1}{y}\,\mathrm{d}y = \int \frac{4}{2x-3} - \frac{3}{x+1}\,\mathrm{d}x$	M1
	$\ln y = 2\ln(2x-3) - 3\ln(x+1) + C$	A1, B1 ft
	Substitutes to give $\ln 4 = 2\ln 1 - 3\ln 3 + C$ and finds C (ln 108)	M1
	$\ln y = \ln(2x-3)^2 - \ln(x+1)^3\ (+\ln 108)$	M1
	$= \ln \dfrac{C(2x-3)^2}{(x+1)^3}$	A1
	$\therefore y = \dfrac{108(2x-3)^2}{(x+1)^3}$	A1 cso (7)
	Or $y = e^{2\ln(2x-3)-3\ln(x+)+\ln 108}$ special case M1 A2	

Question Number	Scheme	Marks
7. (a)	$\frac{dy}{dx} = \frac{(4+x^2)-x(2x)}{(4+x^2)^2}$ or (fr Need numerical answers for M1 $x^2)^{-2}$	M1 A1
	Solve $\frac{dy}{dx}$=0 to obtain (2, ¼) , and (-2, -¼) or (2 and –2 A1, full solution A1)	M1 A1, A1
		(5)
(b)	When x = 2, $\frac{d^2y}{dx^2}$=-0.0625 <0 thus maximum	B1
		M1
	When x = -2, $\frac{d^2y}{dx^2}$=0.0625 >0 thus minimum.	B1
		(3)
(c)		
	Shape for -2 ≤ x ≤ 2	B1
	Shape for x > 2	B1
	Shape for x <2	B1
		(3)

Question Number	Scheme	Marks
8. (a)	Any two of $1+\lambda = -2+$ [illegible]; $3+2\lambda = 3+$ [illegible]; $5-\lambda = -4+4\mu$ (Need two of these for M1)	M1
	Solve simultaneous equations to obtain μ = 2, **or** λ = 1	M1 A1
	\ intersect at (2 , 5 , 4)	M1 A1
	Check in the third equation or on second line	B1 (6)
(b)	$1\times 2+2\times 1+(-1)\times 4=0$ \ perpendicular	M1 A1 (2)
(c)	P is the point (3, 7, 3) [i.e. <u>L</u> = 2] and R is the point (4, 6, 8) [i.e. <u>M</u> = 3]	M1 A1
	$PQ=\sqrt{1^2+2^2+(-1)^2}=\sqrt{6}$ $RQ=\sqrt{2^2+1^2+4^2}=\sqrt{21}$ $PR=\sqrt{27}$	M1 A1 ft
	The area of the triangle = $\frac{1}{2}\times\sqrt{6}\times\sqrt{21}=\frac{3\sqrt{14}}{2}$	M1 A1 (6)
	Or area = $\frac{1}{2}\times\sqrt{6}\times\sqrt{27}\sin P$ where sin P = $\frac{\sqrt{7}}{3}$ = $\frac{3\sqrt{14}}{2}$ Or area = $\frac{1}{2}\times\sqrt{21}\times\sqrt{27}\sin R$ where sin R = $\frac{\sqrt{2}}{3}$ = $\frac{3\sqrt{14}}{2}$ *(must be simplified)*	