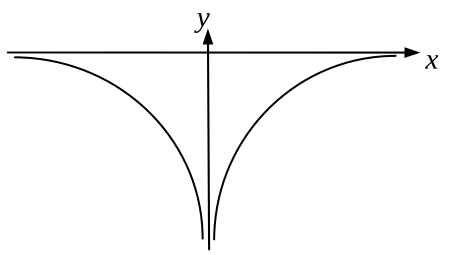
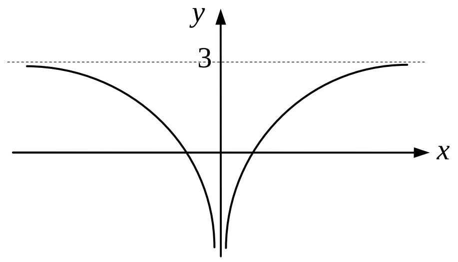
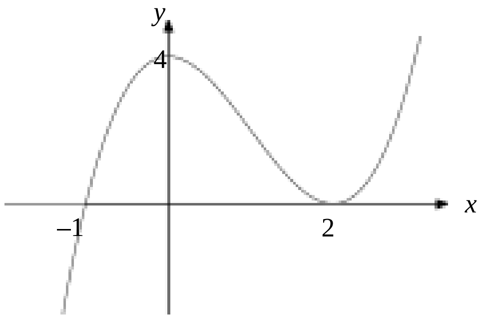
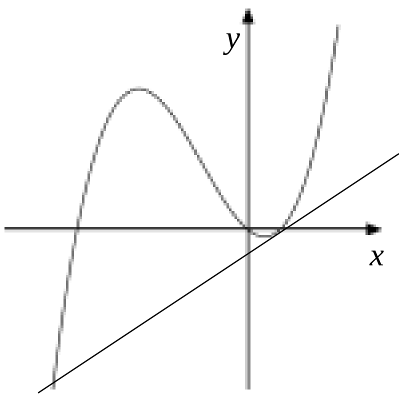
1 (i)	1	B1	1	
(ii)	$\frac{1}{3}$	M1		$\frac{1}{9^{\frac{1}{2}}}$ or $\frac{1}{\sqrt{9}}$ soi
		A1	2 [3]	cao
2 (i)		B1*		Reasonably correct curve for $y=-\frac{1}{x^2}$ in 3rd and 4th quadrants only
		B1 dep*	2	Very good curves in curve for $y=-\frac{1}{x^2}$ in 3rd and 4th quadrants **SC** If 0, very good single curve in either 3rd or 4th quadrant and nothing in other three quadrants. **B1**
(ii)		M1		Translation of their $y=-\frac{1}{x^2}$ vertically
		A1	2	Reasonably correct curve, horizontal asymptote soi at $y = 3$
(iii)	$y=-\frac{2}{x^2}$	B1	1 [5]	
3 (i)	$\frac{12(3-\sqrt{5})}{(3+\sqrt{5})(3-\sqrt{5})}$	M1		Multiply numerator and denom by $3-\sqrt{5}$
	$=\frac{12(3-\sqrt{5})}{9-5}$	A1		$(3+\sqrt{5})(3-\sqrt{5})=9-5$
	$=9-3\sqrt{5}$	A1	3	
(ii)	$3\sqrt{2}-\sqrt{2}$	M1		Attempt to express $\sqrt{18}$ as $k\sqrt{2}$
	$=2\sqrt{2}$	A1	2 [5]	

4 (i)	$(x^2-4x+4)(x+1)$	M1		Attempt to multiply a 3 term quadratic by a linear factor or to expand all 3 brackets with an appropriate number of terms (including an x^3 term)
		A1		Expansion with at most 1 incorrect term
	$=x^3-3x^2+4$	A1	3	Correct, simplified answer
(ii)		B1		+ve cubic with 2 or 3 roots
		B1		Intercept of curve labelled (0, 4) or indicated on y-axis
		B1	3	(–1, 0) and turning point at (2, 0) labelled or indicated on x-axis and no other x intercepts
			6	
5	$k=x^2$ $4k^2+3k-1=0$	M1*		Use a substitution to obtain a quadratic or factorise into 2 brackets each containing x^2
	$(4k-1)(k+1)=0$	M1 dep		Correct method to solve a quadratic
	$k=\frac{1}{4}$ (or k = -1)	A1		
	$x=\pm\frac{1}{2}$	M1 A1	5	Attempt to square root to obtain x $\pm\frac{1}{2}$ and no other values
			5	
6	$y=2x+6x^{-\frac{1}{2}}$	M1		Attempt to differentiate
	$\frac{dy}{dx}=2-3x^{-\frac{3}{2}}$	A1		$kx^{-\frac{3}{2}}$
		A1		Completely correct expression (no +c)
	When x = 4, gradient = $2-\frac{3}{\sqrt{4^3}}$	M1		Correct evaluation of either $4^{-\frac{3}{2}}$ or $4^{-\frac{1}{2}}$
	$=\frac{13}{8}$	A1	5	
			5	
7	$2(6-2y)^2+y^2=57$	M1*		substitute for x/y or attempt to get an equation in 1 variable only
		A1		correct unsimplified expression
	$2(36-24y+4y^2)+y^2=57$ $9y^2-48y+15=0$	A1		obtain correct 3 term quadratic
	$3y^2-16y+5=0$ $(3y-1)(y-5)=0$	M1 dep		correct method to solve 3 term quadratic
	$y=\frac{1}{3}$ or y = 5	A1		
	$x=\frac{16}{3}$ or x = -4	A1	6	**SC** If A0 A0, one correct pair of values, spotted or from correct factorisation **www B1**
			6	

8 (i)	$2(x^2 + \frac{5}{2}x)$	B1		$\left(x+\frac{5}{4}\right)^2$
	$= 2\left[\left(x+\frac{5}{4}\right)^2 - \frac{25}{16}\right]$	M1		$q = -2p^2$
	$= 2\left(x+\frac{5}{4}\right)^2 - \frac{25}{8}$	A1	3	$q = -\frac{25}{8}$ c.w.o.
(ii)	$\left(-\frac{5}{4}, -\frac{25}{8}\right)$	B1√ B1√	2	
(iii)	$x = -\frac{5}{4}$	B1	1	
(iv)	$x(2x+5) > 0$	M1		Correct method to find roots
		A1		0, $-\frac{5}{2}$ seen
	$x < -\frac{5}{2}$, $x > 0$	M1		Correct method to solve quadratic inequality.
		A1	4 **10**	(not wrapped, strict inequalities, no 'and')
9 (i)	$\frac{4+p}{2} = -1$, $\frac{5+q}{2} = 3$	M1		Correct method (may be implied by one correct coordinate)
	p = -6 q = 1	A1 A1	3	
(ii)	$r^2 = (4 - {}^-1)^2 + (5-3)^2$	M1		Use of $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ for either radius or diameter
	$r = \sqrt{29}$	A1	2	
(iii)	$(x+1)^2 + (y-3)^2 = 29$	M1		$(x+1)^2$ and $(y-3)^2$ seen
		M1		$(x \pm 1)^2 + (y \pm 3)^2 =$ their r^2
	$x^2 + y^2 + 2x - 6y - 19 = 0$	A1	3	Correct equation in correct form
(iv)	gradient of radius = $\frac{3-5}{-1-4}$	M1		uses $\frac{y_2 - y_1}{x_2 - x_1}$
	$= \frac{2}{5}$	A1		oe
	gradient of tangent = $-\frac{5}{2}$	B1√		oe
	$y - 5 = -\frac{5}{2}(x-4)$	M1		correct equation of straight line through (4, 5), any non-zero gradient
	$y = -\frac{5}{2}x + 15$	A1	5 **13**	oe 3 term equation e.g. $5x + 2y = 30$

10(i)	$\frac{dy}{dx} = 6x^2 + 10x - 4$	B1 B1		1 term correct Completely correct (no +c)
	$6x^2 + 10x - 4 = 0$	M1*		Sets their $\frac{dy}{dx} = 0$
	$2(3x^2 + 5x - 2) = 0$ $(3x - 1)(x + 2) = 0$	M1 dep*		Correct method to solve quadratic
	$x = \frac{1}{3}$ or $x = -2$	A1		**SC** If A0 A0, one correct pair of values, spotted or from correct factorisation **www** **B1**
	$y = -\frac{19}{27}$ or $y = 12$	A1	6	
(ii)	$-2 < x < \frac{1}{3}$	M1 A1	2	Any inequality (or inequalities) involving both their x values from part (i) Allow ≤ and ≥
(iii)	When $x = \frac{1}{2}$, $6x^2 + 10x - 4 = \frac{5}{2}$	M1		Substitute $x = \frac{1}{2}$ into their $\frac{dy}{dx}$
	and $2x^3 + 5x^2 - 4x = -\frac{1}{2}$	B1		Correct y coordinate
	$y + \frac{1}{2} = \frac{5}{2}\left(x - \frac{1}{2}\right)$	M1		Correct equation of straight line using their values. Must use their $\frac{dy}{dx}$ value not e.g. the negative reciprocal
	$10x - 4y - 7 = 0$	A1	4	Shows rearrangement to given equation **CWO** throughout for A1
(iv)		B1 B1	2 **14**	Sketch of a cubic with a tangent which meets it at 2 points only +ve cubic with max/min points and line with +ve gradient as tangent to the curve to the right of the min **SC1** **B1** Convincing algebra to show that the cubic $8x^3 + 20x^2 – 26x + 7 = 0$ factorises into $(2x – 1)(2x – 1)(x + 7)$ **B1** Correct argument to say there are 2 distinct roots **SC2 B1** Recognising y = 2.5x -7/4 is tangent from part (iii) **B1** As second B1 on main scheme