Tangents and Normals to Curves Sheet 2 Mark Scheme

Q1.

Question Number	Scheme	Marks
Q (a)	$x=2$: $y=8-8-2+9=7$ (*)	B1 (1)
(b)	$\frac{dy}{dx}=3x^2-4x-1$	M1 A1
	$x=2$: $\frac{dy}{dx}=12-8-1(=3)$	A1ft
	$y-7=3(x-2)$, $\underline{y=3x+1}$	M1, A1 (5)
(c)	$m=-\frac{1}{3}$ (for $-\frac{1}{m}$ with their m)	B1ft
	$3x^2-4x-1=-\frac{1}{3}$, $9x^2-12x-2=0$ or $x^2-\frac{4}{3}x-\frac{2}{9}=0$ (o.e.)	M1, A1
	$\left(x=\frac{12+\sqrt{144+72}}{18}\right)\left(\sqrt{216}=\sqrt{36}\sqrt{6}=6\sqrt{6}\right)$ or $(3x-2)^2=6\rightarrow 3x=2\pm\sqrt{6}$	M1
	$x=\frac{1}{3}\left(2+\sqrt{6}\right)$ (*)	A1cso (5)
		[11]
(a)	B1 there must be a clear attempt to substitute $x=2$ leading to 7 e.g. $2^3-2\times2^2-2+9=7$	
(b)	1st M1 for an attempt to differentiate with at least one of the given terms fully correct. 1st A1 for a fully correct expression 2nd A1ft for sub. $x=2$ in <u>their</u> $\frac{dy}{dx}(\neq y)$ accept for a correct expression e.g. $3\times(2)^2-4\times2-1$ 2nd M1 for use of their "3" (provided it comes from their $\frac{dy}{dx}(\neq y)$ and $x=2$) to find equation of tangent. Alternative is to use (2, 7) in $y=mx+c$ to <u>find a value</u> for c. Award when $c=\ldots$ is seen. **No attempted use of $\frac{dy}{dx}$ in (b) scores 0/5**	
(c)	1st M1 for forming an equation from their $\frac{dy}{dx}(\neq y)$ and their $-\frac{1}{m}$ (must be changed from m) 1st A1 for a correct 3TQ all terms on LHS (condone missing =0) 2nd M1 for proceeding to $x=\ldots$ or $3x=\ldots$ by formula or completing the square for a 3TQ. Not factorising. Condone $\underline{+}$ 2nd A1 for proceeding to given answer with no incorrect working seen. Can still have $\underline{+}$.	
ALT	<u>Verify (for M1A1M1A1)</u> 1st M1 for attempting to square need ≥ 3 correct values in $\frac{4+6+4\sqrt{6}}{9}$, 1st A1 for $\frac{10+4\sqrt{6}}{9}$ 2nd M1 Dependent on 1st M1 in this case for substituting in all terms of their $\frac{dy}{dx}$ 2nd A1cso for cso <u>with a full comment</u> e.g. "the x co-ord of Q is …"	

Q2.

Question Number	Scheme	Marks
(a)	$\left[\frac{dy}{dx}=\right]3kx^2-2x+1$	M1 A1 (2)
(b)	Gradient of line is $\frac{7}{2}$	B1
	When $x=-\frac{1}{2}$: $3k\times\left(\frac{1}{4}\right)-2\times\left(-\frac{1}{2}\right)+1,=\frac{7}{2}$	M1
	$\frac{3k}{4}=\frac{3}{2}\Rightarrow k=2$	A1 A1 (4)
(c)	$x=-\frac{1}{2}\Rightarrow y=k\times\left(-\frac{1}{8}\right)-\left(\frac{1}{4}\right)-\frac{1}{2}-5,=-6$	M1 A1 (2)
		(8 marks)

Q3.

Question number	Scheme	Marks
	(a) $x=1$: $y=-5+4=\underline{-1}$, $x=2$: $y=-16+2=\underline{-14}$ (can be given in (b) or (c))	1st B1 for – 1 2nd B1 for - 14
	$PQ=\sqrt{(2-1)^2+(-14-(-1))^2}=\sqrt{170}$ (*)	M1 A1cso (4)
	(b) $y=x^3-6x^2+4x^{-1}$	M1
	$\frac{dy}{dx}=3x^2-12x-4x^{-2}$	M1 A1
	$x=1$: $\frac{dy}{dx}=3-12-4=-13$ M: Evaluate at one of the points	M1
	$x=2$: $\frac{dy}{dx}=12-24-1=-13$ $\therefore$ Parallel A: Both correct + conclusion	A1 (5)
	(c) Finding gradient of normal $\left(m=\frac{1}{13}\right)$	M1
	$y--1=\frac{1}{13}(x-1)$	M1 A1ft
	$\underline{x-13y-14=0}$ o.e.	A1cso (4)
		13

Q4.

Question Number	Scheme		Marks
(a)	$y = 2x^3 + kx^2 + 5x + 6$		
	$\left(\frac{dy}{dx} =\right) 6x^2 + 2kx + 5$	M1: $x^n \to x^{n-1}$ for one of the terms including $6 \to 0$ A1: Correct derivative	M1 A1
			[2]
(b)	Gradient of given line is $\frac{17}{2}$	Uses or states $\frac{17}{2}$ or equivalent e.g. 8.5. Must be stated or used in (b) and not just seen as part of $y = \frac{17}{2}x + \frac{1}{2}$.	B1
	$\left(\frac{dy}{dx}\right)_{x=-2} = 6(-2)^2 + 2k(-2) + 5$	Substitutes $x = -2$ into their derivative (**not** the curve)	M1
	$"24 - 4k + 5" = "\frac{17}{2}" \Rightarrow k = \frac{41}{8}$	dM1: Puts their expression = their $\frac{17}{2}$ (Allow BOD for 17 or -17 but **not** the normal gradient) and solves to obtain a value for k. **Dependent on the previous method mark.** A1: $\frac{41}{8}$ or $5\frac{1}{8}$ or 5.125	dM1 A1
	Note: $6x^2 + 2kx + 5 = \frac{17}{2}x + \frac{1}{2}$ scores no marks on its own but may score the first M mark if they substitute $x = -2$ into the lhs. If they rearrange this equation and then substitute $x = -2$, this scores no marks.		
			[4]
(c)	$y = -16 + 4k - 10 + 6 = 4"k" - 20 = \frac{1}{2}$	M1: Substitutes $x = -2$ and their numerical k into $y = \ldots$ A1: $y = \frac{1}{2}$	M1 A1
	Allow the marks for part (c) to be scored in part (b).		
			[2]
(d)	$y - "\frac{1}{2}" = "\frac{17}{2}"(x - {}^{-}2) \Rightarrow -17x + 2y - 35 = 0$ or $y = "\frac{17}{2}"x + c \Rightarrow c = \ldots \Rightarrow -17x + 2y - 35 = 0$ or $2y - 17x = 1 + 34 \Rightarrow -17x + 2y - 35 = 0$	M1: Correct attempt at linear equation with their 8.5 gradient (not the normal gradient) using $x = -2$ and their $\frac{1}{2}$ A1: cao (allow any integer multiple)	M1 A1
			[2]
			10 marks

Q5.

(a)	$\left(\frac{dy}{dx}=\right)\frac{3}{2}x^2-\frac{27}{2}x^{\frac{1}{2}}-8x^{-2}$	M1A1A1A1 (4)
(b)	$x=4 \;\Rightarrow\; y=\frac{1}{2}\times 64-9\times 2^3+\frac{8}{4}+30$ $=32-72+2+30 \qquad = \underline{-8}$ *	M1 A1cso (2)
(c)	$x=4 \;\Rightarrow\; y'=\frac{3}{2}\times 4^2-\frac{27}{2}\times 2-\frac{8}{16}$ $=24-27-\frac{1}{2}= \qquad -\frac{7}{2}$ Gradient of the normal $=-1\div"\frac{7}{2}"$ Equation of normal: $y--8=\frac{2}{7}(x-4)$ $\underline{7y-2x+64=0}$	M1 A1 M1 M1A1ft A1 (6) 12
Question Number	Scheme	Marks
	Notes	
(a)	1st M1 for an attempt to differentiate $x^n \to x^{n-1}$ 1st A1 for one correct term in x 2nd A1 for 2 terms in x correct 3rd A1 for all correct x terms. No 30 term and no $+c$.	
(b)	M1 for substituting $x=4$ into $y=$ and attempting $4^{\frac{3}{2}}$ A1 note this is a printed answer	
(c)	1st M1 Substitute x = 4 into y' (allow slips) A1 Obtains -3.5 or equivalent 2nd M1 for correct use of the perpendicular gradient rule using their gradient. (May be slip doing the division) Their gradient must have come from y' 3rd M1 for an attempt at equation of tangent or normal at P 2nd A1ft for correct use of their changed gradient to find **normal** at P. Depends on 1st, 2nd and 3rd Ms 3rd A1 for any equivalent form with integer coefficients	

Q6.

Question Number	Scheme	Marks
	$C: y = 2x - 8\sqrt{x} + 5, \quad x \geqslant 0$	
(a)	So, $y = 2x - 8x^{\frac{1}{2}} + 5$	
	$\frac{dy}{dx} = 2 - 4x^{-\frac{1}{2}} + \{0\} \qquad (x > 0)$	M1 A1 A1
		[3]
(b)	(When $x = \frac{1}{4}$, $y = 2(\frac{1}{4}) - 8\sqrt{(\frac{1}{4})} + 5$ so) $\quad y = \frac{3}{2}$	B1
	(gradient $= \frac{dy}{dx} =$) $2 - \frac{4}{\sqrt{(\frac{1}{4})}}$ $\{= -6\}$	M1
	Either: $y - "\frac{3}{2}" = "-6"(x - \frac{1}{4})$ **or**: $y = "-6"x + c$ and $"\frac{3}{2}" = "-6"(\frac{1}{4}) + c \Rightarrow c = "3"$	dM1
	So $\underline{y = -6x + 3}$	A1
		[4]
(c)	Tangent at Q is parallel to $2x - 3y + 18 = 0$	
	($y = \frac{2}{3}x + 6 \Rightarrow$) Gradient $= \frac{2}{3}$. so tangent gradient is $\frac{2}{3}$	B1
	So, $"2 - \frac{4}{\sqrt{x}}" = "\frac{2}{3}"$ — Sets their gradient function = their numerical gradient.	M1
	$\Rightarrow \frac{4}{3} = \frac{4}{\sqrt{x}} \Rightarrow x = 9$ — Ignore extra answer $x = -9$	A1
	When $x = 9$, $y = 2(9) - 8\sqrt{9} + 5 = -1$ — Substitutes their found x into equation of curve.	dM1
	$y = -1$.	A1
		[5]
		12 marks
	Notes	
(a)	**M1**: Evidence of differentiation, so $x^n \to x^{n-1}$ at least once so $x^1 \to 1$ or x^0 or $x^{\frac{1}{2}} \to x^{-\frac{1}{2}}$ not just $5 \to 0$	
	A1: Any two of the three terms correct – do not need to see zero – the 5 disappearing is sufficient; need not be simplified.	
	A1: $2 - 4x^{-\frac{1}{2}}$ Both terms correct, and simplified. Do not need to include domain $x > 0$	
(b)	**B1**: Obtaining $y = 3/2$ or fractional or decimal equivalent (no working need be seen)	
	M1: An attempt to substitute $x = \frac{1}{4}$ into $\frac{dy}{dx}$ to establish **gradient**. This may be implied by −6 or $m = -6$ but not $y = -6$. Can earn this M mark if they go on to use $m = \frac{1}{6}$ or use their numerical value of $\frac{dy}{dx}$.	
	dM1: This depends on previous method mark. Complete method for obtaining the equation of the tangent, using their **tangent** gradient and their value for y_1 (obtained from $x = ¼$, allow slip) i.e. $y - y_1 = m_T(x - \frac{1}{4})$ with their tangent gradient and their y_1 or uses $y = mx + c$ with $(\frac{1}{4}$, their $y_1)$ and their tangent gradient.	
	A1: $y = -6x + 3$ or $y = 3 - 6x$ or $a = -6$ and $b = 3$	
(c)	**B1**: For the value 2/3 **not** 2/3 x **not** -3/2	
	M1: Sets their gradient function dy/dx = their numerical gradient	
	A1: Obtains $x = 9$	
	dM1: Substitutes their x (from gradient equation) into original equation of curve C i.e. original expression $y =$	
	A1: $(9, -1)$ or $x = 9, y = -1$, or just $y = -1$	
	Special Cases: In (b) Finds normal could get B1 M1 M0 A0 i.e. max of 2/4	
	In (c) Uses **perpendicular** instead of **parallel** then award B0 M1 A0 M1 A0 i.e max 2/5 – see over	

Q7.

Question Number	Scheme		Marks
(a)	$f'(4) = 30 + \frac{6-5\times 4^2}{\sqrt{4}}$	Attempts to substitutes $x = 4$ into $f'(x) = 30 + \frac{6-5x^2}{\sqrt{x}}$ or their algebraically manipulated $f'(x)$	M1
	$f'(4) = -7$	Gradient = -7	A1
	$y-(-8) = "-7" \times (x-4)$ or $y = "-7"x + c \Rightarrow -8 = "-7" \times 4 + c \Rightarrow c = \ldots$	Attempts an equation of a tangent using their numeric $f'(4)$ which has come from substituting $x = 4$ into the given $f'(x)$ or their algebraically manipulated $f'(x)$ and $(4,-8)$ with the 4 and -8 correctly placed. If using $y = mx + c$, must reach as far as $c = \ldots$	M1
	$y = -7x + 20$	Cao. Allow $y = 20 - 7x$ and allow the "$y =$" to become "detached" but it must be present at some stage. E.g. $y = \ldots$ $= -7x + 20$	A1
			(4)

Question Number	Scheme		Marks
(b)	**Allow the marks in (b) to score in (a) i.e. mark (a) and (b) together**		
	$\Rightarrow f(x) = 30x + 6\frac{x^{\frac{1}{2}}}{0.5} - 5\frac{x^{\frac{5}{2}}}{2.5}(+c)$	M1: $30 \to 30x$ or $\frac{6}{\sqrt{x}} \to \alpha x^{\frac{1}{2}}$ or $-\frac{5x^2}{\sqrt{x}} \to \beta x^{\frac{5}{2}}$ (these cases only) A1: Any 2 correct terms which can be simplified or un-simplified. This includes the powers – so allow $-\frac{1}{2}+1$ for $\frac{1}{2}$ and allow $\frac{3}{2}+1$ for $\frac{5}{2}$ (With or without $+ c$) A1: All 3 terms correct which can be simplified or un-simplified. (With or without $+ c$)	M1A1A1
	Ignore any spurious integral signs		
	$x = 4, f(x) = -8 \Rightarrow$ $-8 = 120 + 24 - 64 + c \Rightarrow c = \ldots$	Substitutes $x = 4, f(x) = -8$ into their f(x) (not $f'(x)$) i.e. a changed $f'(x)$ containing $+c$ and rearranges to obtain a value or numerical expression for c.	M1
	$\Rightarrow (f(x) =) 30x + 12x^{\frac{1}{2}} - 2x^{\frac{5}{2}} - 88$	Cao and cso (Allow $\sqrt{x}$ for $x^{\frac{1}{2}}$ and e.g. $\sqrt{x^5}$ or $x^2\sqrt{x}$ for $x^{\frac{5}{2}}$). Isw here so as soon as you see the correct answer, award this mark. Note that the "f(x) =" is not needed.	A1
			(5)
			(9 marks)

Q8.

Question Number	Scheme	Marks
(a)	$\left(\frac{dy}{dx}=\right)-4+8x^{-2}$ (4 or $8x^{-2}$ for M1… sign can be wrong)	M1A1
	$x=2\Rightarrow$ $m=-4+2=-2$	M1
	$y=9-8-\frac{8}{2}=-3$ The first 4 marks could be earned in part (b)	B1
	Equation of tangent is: $y+3=-2(x-2)\rightarrow$ $y=1-2x$ (*)	M1 A1cso
		(6)
(b)	Gradient of normal = $\frac{1}{2}$	B1ft
	Equation is: $\frac{y+3}{x-2}=\frac{1}{2}$ or better equivalent, e.g. $y=\frac{1}{2}x-4$	M1A1
		(3)
(c)	$(A:)\ \frac{1}{2}$, $(B:)\ 8$	B1, B1
	Area of triangle is: $\frac{1}{2}(x_B\pm x_A)\times y_P$ with values for all of x_B, x_A and y_P	M1
	$\frac{1}{2}\left(8-\frac{1}{2}\right)\times 3=$ $\frac{45}{4}$ or 11.25	A1 (4) [13]
(a)	1st M1 for 4 or $8x^{-2}$ (ignore the signs). 1st A1 for both terms correct (including signs). 2nd M1 for substituting $x=2$ into their $\frac{dy}{dx}$ (must be different from their y) B1 for $y_P=-3$, but not if clearly found from the given equation of the tangent. 3rd M1 for attempt to find the equation of tangent at P, follow through their m and y_P. Apply general principles for straight line equations (see end of scheme). NO DIFFERENTIATION ATTEMPTED: Just assuming $m=-2$ at this stage is M0 2nd A1cso for correct work leading to printed answer (allow equivalents with $2x$, y, and 1 terms… such as $2x+y-1=0$).	
(b)	B1ft for correct use of the perpendicular gradient rule. Follow through their m, but if $m\neq-2$ there must be clear evidence that the m is thought to be the gradient of the tangent. M1 for an attempt to find normal at P using their changed gradient and their y_P. Apply general principles for straight line equations (see end of scheme). A1 for any correct form as specified above (correct answer only).	
(c)	1st B1 for $\frac{1}{2}$ and 2nd B1 for 8. M1 for a full method for the area of triangle ABP. Follow through their x_A, x_B and their y_P, but the mark is to be awarded 'generously', condoning sign errors.. The final answer must be positive for A1, with negatives in the working condoned. Determinant: Area $=\frac{1}{2}\begin{vmatrix}x_1 & y_1 & 1\\ x_2 & y_2 & 1\\ x_3 & y_3 & 1\end{vmatrix}=\frac{1}{2}\begin{vmatrix}2 & -3 & 1\\ 0.5 & 0 & 1\\ 8 & 0 & 1\end{vmatrix}=\ldots$ (Attempt to multiply out required for M1) Alternative: $AP=\sqrt{(2-0.5)^2+(-3)^2}$, $BP=\sqrt{(2-8)^2+(-3)^2}$, Area $=\frac{1}{2}AP\times BP=\ldots$ M1 Intersections with y-axis instead of x-axis: Only the M mark is available B0 B0 M1 A0.	

Q9.

Question Number	Scheme	Marks
(a)	Substitutes $x=2$ into $y=20-4\times2-\frac{18}{2}$ and gets 3	B1
	$\frac{dy}{dx}=-4+\frac{18}{x^2}$	M1 A1
	Substitute $x=2\Rightarrow\frac{dy}{dx}=\left(\frac{1}{2}\right)$ then finds negative reciprocal (-2)	dM1
	Method 1: States or uses $y-3=-2(x-2)$ or $y=-2x+c$ with their (2, 3) **Method 2:** Or: Check that (2, 3) lies on the line $y=-2x+7$	dM1
	Method 1: to deduce that $y=-2x+7$ * **Method 2:** Deduce equation of normal as it has the **same gradient** and passes through **a common point**	A1*
		(6)
(b)	Put $20-4x-\frac{18}{x}=-2x+7$ and simplify to give $2x^2-13x+18=0$	M1 A1
	Or put $y=20-4\left(\frac{7-y}{2}\right)-\frac{18}{\left(\frac{7-y}{2}\right)}$ to give $y^2-y-6=0$	
	$(2x-9)(x-2)=0$ so $x=$ or $(y-3)(y+2)=0$ so $y=$	dM1
	$x=\frac{9}{2},y=-2$	A1, A1
		(5)
		(11 marks)

PTO for notes on this question.

Q10.

Question Number	Scheme		Marks
(a)	$\left(-\frac{3}{4}, 0\right)$. Accept $x = -\frac{3}{4}$		B1
			(1)
(b)	$y = 4$	B1: One correct asymptote	B1B1
	$x = 0$ or 'y-axis'	B1: Both correct asymptotes and no extra ones.	
	Special case $x \neq 0$ **and** $y \neq 4$ scores B1B0		
			(2)
(c)	$\frac{dy}{dx} = -3x^{-2}$	$\frac{dy}{dx} = kx^{-2}$ (Allow $\frac{dy}{dx} = kx^{-2} + 4$)	M1
	At $x = -3$, gradient of curve $= -\frac{1}{3}$	Cao (may be un-simplified but must be a fraction with no powers) e.g. $-3(-3)^{-2}$ scores A0 unless evaluated as e.g. $\frac{-3}{9}$ or is implied by their normal gradient.	A1
	Gradient of normal = -1/m	Correct perpendicular gradient rule applied to a numerical gradient that must have come from substituting x = -3 into their derivative. **Dependent on the previous M1.**	dM1
	Normal at P is $(y-3) = 3(x+3)$	M1: Correct straight line method using (-3, 3) and a "changed" gradient. A wrong equation with no formula quoted is M0. **Also dependent on the first M1.** A1: Any correct equation	dM1A1
			(5)
(d)	(-4, 0) and (0, 12).	Both correct (May be seen on a sketch)	B1
	So AB has length $\sqrt{160}$ or AB^2 has length 160	M1: Correct use of Pythagoras for their A and B one of which lies on the x-axis and the other on the y-axis, obtained from their equation in (c). A correct method for AB^2 or AB. A1: $\sqrt{160}$ or better e.g. $4\sqrt{10}$ **with no errors seen**	M1 A1cso
			(3)
			[11]

Q11.

Question Number	Scheme		Marks
(a)	$\frac{dy}{dx}=\frac{1}{2}-\frac{27}{x^2}$	M1: $\frac{1}{2}$ or $-\frac{27}{x^2}$ A1: $\frac{dy}{dx}=\frac{1}{2}-\frac{27}{x^2}$ oe e.g. $\frac{1}{2}x^0-27x^{-2}$	M1A1
	$x=3\Rightarrow\frac{dy}{dx}=\frac{1}{2}-\frac{27}{9}=\left(-\frac{5}{2}\right)$	Substitutes $x=3$ into their $\frac{dy}{dx}$ to obtain a numerical gradient	M1
	$m_T=-\frac{5}{2}\Rightarrow m_N=-1\div-\frac{5}{2}$ $\Rightarrow y-\left(-\frac{3}{2}\right)=\frac{2}{5}(x-3)$	The correct method to find the equation of a normal. Uses $-\frac{1}{m_T}$ with $\left(3,-\frac{3}{2}\right)$ where m_T has come from calculus. If using $y=mx+c$ must reach as far as $c=$ …	M1
	$10y=4x-27$*	Cso (correct equation must be seen in (a))	A1*
			(5)

Question Number	Scheme		Marks
(b)	$\frac{1}{2}x+\frac{27}{x}-12=\frac{4x-27}{10}$ or $y=\frac{10y+27}{8}+\frac{108}{10y+27}-12$	Equate equations to produce an equation just in x or just in y. Do not allow e.g. $\frac{1}{2}x^2+27-12x=\frac{4x-27}{10}$ Unless $\frac{1}{2}x+\frac{27}{x}-12=\frac{4x-27}{10}$ was seen previously. **Allow sign slips only.**	M1
	$x^2-93x+270=0$ or $20y^2-636y-999=0$	Correct 3 term quadratic equation (or any multiple of). Allow terms on both sides e.g. $x^2-93x=-270$ (The "$=0$" may be implied by their attempt to solve)	A1
	$(x-90)(x-3)=0\Rightarrow x=...$ or $x=\frac{93\pm\sqrt{93^2-4\times270}}{2}$ or $(10y-333)(2y+3)=0\Rightarrow y=...$ or $y=\frac{636\pm\sqrt{636^2-4\times20\times(-999)}}{2\times20}$	Attempt to solve a 3TQ (see general guidance) leading to at least one for x or y. **Dependent on the first method mark.**	dM1
	$x=90$ **or** $y=33.3$ oe	Cso. The x must be 90 and the y an equivalent number such as e.g. $\frac{333}{10}$	A1
	$x=90$ **and** $y=33.3$ oe	Cso. The x must be 90 and the y an equivalent number such as e.g. $\frac{333}{10}$	A1
			(5)
			(10 marks)

Q12.

Question Number	Scheme	Notes	Marks
(a)	$y=\frac{12}{x}+5 \Rightarrow \frac{dy}{dx}=-\frac{12}{x^2}$	$\frac{12}{x} \to \frac{k}{x^2}\left(\text{or } kx^{-2}\right)$	M1
	At $x=-2$ $\frac{dy}{dx}=-\frac{12}{4}$ or -3	Correct value (may be implied by later work)	A1
	Gradient of normal is $-1 \div -\frac{12}{4}\left(=\frac{1}{3}\right)$	Correct application of the perpendicular gradient rule. May be implied by use of $-\frac{1}{12}$ as the normal gradient for those candidates who think the gradient is 12.	M1
	$y+1=\text{"}\frac{1}{3}\text{"}(x+2)$ **or** $y=\text{"}\frac{1}{3}\text{"}x+c$ **and** $-1=\text{"}\frac{1}{3}\text{"}(-2)+c \Rightarrow c=...$	A correct straight line method using their changed gradient and the point (–2, –1). This must follow use of calculus to find the gradient.	M1
	$3y-x+1=0$	Correct equation in the required form. (Allow any integer multiple)	A1
			[5]
(b)	Gradient of given line is $\frac{3}{4}$	May be implied by use of $-\frac{4}{3}$	B1
	$\frac{x^2}{12}=\frac{3}{4} \Rightarrow x=...$	Sets up a correct equation using what they think is the gradient of the given line and attempts to solve.	M1
	$x=\pm 3$	Both correct values required	A1
	$x=... \Rightarrow \frac{12}{x}+5=...$	Uses at least one x to find a value for y using $y=\frac{12}{x}+5$. **Dependent on the first method mark.**	dM1
	(3 , 9) and (–3, 1) or e.g. $x=3, y=9$ $x=-3, y=1$	Correct coordinates correctly paired	A1
			[5]
			10 marks