Question Number	Scheme	Notes	Marks
3(a)	$y = 9x^{-1} \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = -9x^{-2} \quad \left\{ = -\dfrac{9}{(3t)^2} \right\}$ or $xy = 9 \Rightarrow x\dfrac{\mathrm{d}y}{\mathrm{d}x} + y = 0 \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = -\dfrac{y}{x} \quad \left\{ = -\dfrac{\frac{3}{t}}{3t} \right\}$ or $x = 3t,\ y = 3t^{-1} \Rightarrow \dfrac{\mathrm{d}x}{\mathrm{d}t} = 3,\ \dfrac{\mathrm{d}y}{\mathrm{d}t} = -3t^{-2} \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{-3t^{-2}}{3}$	Any correct expression for $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ but allow e.g., $\dfrac{\mathrm{d}x}{\mathrm{d}y} = -9y^{-2}$ Calculus must be seen so there is no credit for just a statement e.g., $m_T = -\dfrac{1}{t^2}$	B1
	e.g., $m_N = \dfrac{(3t)^2}{9}$ or $\dfrac{3t}{\frac{3}{t}}$ or $\dfrac{3}{3t^{-2}} \quad \left\{ = t^2 \right\}$	Uses the perpendicular gradient rule to obtain the gradient of the normal in terms of t correct for their m_T Implied by correct use of $-\frac{\mathrm{d}x}{\mathrm{d}y}$	M1
	$y - \dfrac{3}{t} = t^2(x - 3t)$ or $\dfrac{3}{t} = t^2(3t) + c \Rightarrow c = \ldots$ $\left\{ c = \dfrac{3}{t} - 3t^3 \right\}$	Applies straight line method correctly with their normal (changed) gradient in terms of t. If using $y = mx + c$ coordinates must be correctly placed and $c = \ldots$ reached	M1
	$ty - t^3x = 3 - 3t^4$ Intermediate step not required. Allow recovery from a slip.	Correct equation or f(t). Must be seen in (a). Accept equivalents for f(t) e.g., $3(1 - t^4),\ -3(t^4 - 1)$	A1
	Allow work with $xy = c^2$ but the final mark requires use of $c^2 = 9$ No calculus scores a maximum of 0111 if m_T is stated and 0011 if m_N is stated		**(4)**
(b)	$xy = 9,\ 2y - 8x = 3 - 3\times 16$ e.g., $\Rightarrow y = 4x - \dfrac{45}{2}$ or $x = \dfrac{45}{8} + \dfrac{y}{4}$ $\Rightarrow x\left(4x - \dfrac{45}{2}\right) = 9$ or $y\left(\dfrac{45}{8} + \dfrac{y}{4}\right) = 9$	Uses $t = 2$ in their $ty - t^3x = \mathrm{f}(t) \neq 0$ and the equation of H to obtain an unsimplified three term quadratic equation in x or y (no variables in denominators). Only allow $\mathrm{f}(t) = \frac{9}{t}$ if stated first	M1
	$8x^2 - 45x - 18 = 0$ or $2y^2 + 45y - 72 = 0$ $\{\Rightarrow (8x + 3)(x - 6) = 0$ or $(2y - 3)(y + 24) = 0\}$ $\Rightarrow x = \ldots \ \{-\frac{3}{8},\ 6\}$ or $y = \ldots \ \{\frac{3}{2},\ -24\}$	Solves their 3TQ to find a value for x or y – apply usual rules. One root correct if no working. Can award for P provided it has come from quadratic. **Requires previous method mark.**	**d**M1
	$\left(-\dfrac{3}{8}, -24\right)$ or $(-0.375, -24)$	Correct exact coordinates in simplest form from correct work. Allow $x = \ldots$, $y = \ldots$ Ignore $(6,\ \frac{3}{2})$ but A0 for any other point shown or incorrect x or y value.	A1
	Solving in terms of t: M1: $\Rightarrow$ Unsimplified 3TQ e.g., $t^2x^2 + \left(\frac{3}{t} - 3t^3\right)x - 9 = 0$ M1 M1: Solves e.g, $x = \dfrac{-\frac{3}{t} + 3t^3 \pm \sqrt{\left(\frac{3}{t} - 3t^3\right)^2 + 36t^2}}{2t^2} \left\{ \Rightarrow \left(-\frac{3}{t^3},\ -3t^3\right) \right\}$ A1: $t = 2 \Rightarrow \left(-\frac{3}{8},\ -24\right)$		**(3)**
	Correct final answer with no incorrect work is 111 provided f(t) was correct		**Total 7**