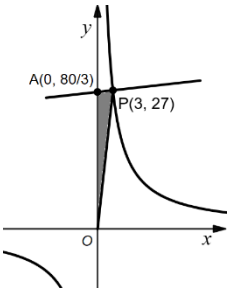
Question Number	Scheme	Notes	Marks
4(a)	For the first two marks if any **ambiguous** fractions within fractions are seen e.g., $\frac{\frac{-9}{t^2}}{9}$ then marks must be confirmed by appropriate later processing.		
	$xy=81,\ \ P\left(9t,\frac{9}{t}\right)\Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=-\frac{81}{x^2}$ or $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{\frac{-9}{t^2}}{9}$ or $x\frac{\mathrm{d}y}{\mathrm{d}x}+y=0\left\{\Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=-\frac{y}{x}\right\}$ Any correct equation involving $\frac{\mathrm{d}y}{\mathrm{d}x}\left(\text{ or } \frac{\mathrm{d}x}{\mathrm{d}y}\right)$. Accept just $\frac{\mathrm{d}y}{\mathrm{d}x}$ or $m_T=-\frac{1}{t^2}$. May see e.g. $x=\frac{81}{y}\Rightarrow \frac{\mathrm{d}x}{\mathrm{d}y}=-\frac{81}{y^2}$ or $-\frac{\mathrm{d}x}{\mathrm{d}y}=\frac{81}{y^2}$		B1
	e.g., $-\frac{81}{x^2}\to\frac{x^2}{81},\ -\frac{81}{(9t)^2}\to\frac{(9t)^2}{81},\ \frac{-\frac{9}{t^2}}{9}\to\frac{9}{\frac{9}{t^2}},\ -\frac{y}{x}\to\frac{x}{y},\ -\frac{1}{t^2}\to-\frac{1}{-\frac{1}{t^2}}\ \ \{\Rightarrow t^2\}$ Applies correct perpendicular gradient rule to obtain a gradient for the normal. Allow in terms of *t*, *x*, *y*, or *x* and *y*. $\frac{\mathrm{d}y}{\mathrm{d}x}$ may be incorrect - just look for clear use of $-\frac{1}{m_T}$. Could just change the sign of $\frac{\mathrm{d}x}{\mathrm{d}y}$. If starts with just $m_N=t^2$ then 0110 max		M1
	$y-\frac{9}{t}=t^2(x-9t)$ or $\frac{9}{t}=t^2\times 9t+c\Rightarrow c=...\ \left\{\frac{9}{t}-9t^3\right\}$	Correct straight line method with any **changed** gradient **in terms of *t***. "Changed" gradient may just be the negative or reciprocal instead of negative reciprocal. Condone (for all marks) late substitution if gradient not initially in terms of *t* (but no "*x*"s or "*y*"s can be combined before this substitution)	M1
	$\Rightarrow ty-9=t^3x-9t^4$ or $y=t^2x+\frac{9}{t}-9t^3$ $\Rightarrow ty=t^3x+9(1-t^4)*$	Correct equation reached with an intermediate step and no errors seen. Allow recovery of poor bracketing provided it is before the final answer. Allow e.g., $yt=9(1-t^4)+xt^3$ (*yt* must be on its own on one side, +9 must have been factorised out)	A1*
			(4)
(b)	$\{x=0\Rightarrow\}\ ty=9(1-t^4)\Rightarrow y=...$	Sets *x* = 0 in **given** equation of normal and obtains an expression in *t* for *y* (which may be incorrect)	M1
	$A\left(0,\frac{9}{t}\times(1-t^4)\right)$ or oe e.g., $\left(0,\frac{9}{t}-9t^3\right),\left(0,\frac{9-9t^4}{t}\right),\left(0,9\left(\frac{1}{t}-t^3\right)\right)$	Correct answer - coordinates or *x* = 0, *y* = … stated separately. Brackets may be missing. The *x* = 0 must be seen at some point in this part. Isw once a correct *y* is seen.	A1
			(2)

Question Number	Scheme	Notes	Marks
4(c)	 $A:\left(0,\ \frac{9}{\frac{1}{3}}\left(1-\frac{1}{3^4}\right)\right)$ or $\left(0,\ \frac{80}{3}\right)$ $\Rightarrow \{\text{Area } OPA =\}$ $\frac{1}{2}\times 9\times\frac{1}{3}\times"\frac{9}{\frac{1}{3}}\left(1-\frac{1}{3^4}\right)"$ or $\frac{1}{2}\times 9\times\frac{1}{3}\times"\frac{80}{3}"$ or $\frac{1}{2}\times 3\times"\frac{80}{3}"$ May see alternatives e.g., $27\times 3-\frac{1}{2}\times\left(27-"\frac{80}{3}"\right)-\frac{1}{2}\times 3\times 27$	Uses $t=\frac{1}{3}$ to obtain a positive value/expression for the y coordinate of A using their result from (b) provided it is a function of t **and** obtains a consistent exact numerical expression or value for the area of OPA. If there is no work calculating y_A then the value must be correct and exact. Note that subsequent work could recover an exact expression. The coordinate/coordinates of P that are used must be correct. Do not allow if any length is negative. May use "shoelace" algorithm - award once multiplications are set up e.g., $\frac{1}{2}\left\lvert 3\times"\frac{80}{3}"-0\right\rvert$. If modulus is missing and expression within is negative, it must be corrected to positive. M0 if the x-axis intercept (-240) of the normal is used. Allow if correct method for area in terms of t followed by substitution to obtain a numerical expression or value e.g., $\left[\frac{1}{2}\times 9t\times"\frac{9}{t}(1-t^4)"\right]_{t=\frac{1}{3}}\Rightarrow ...$	M1
	= 40	40 only. No equivalents. Allow if e.g., the y-coordinate of P is incorrect but not used	A1
	If other alternatives for finding the area of the triangle are used work must be exact (or lead to exactly 40 - exactness can be recovered) to score any marks		
			(2)
			Total 8