Question Number	Scheme	Notes	Marks
6(a)	$y=\sqrt{8}x^{\frac{1}{2}} \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{2}\sqrt{8}x^{-\frac{1}{2}}=\sqrt{2}x^{-\frac{1}{2}}$ $y^2=8x \Rightarrow 2y\frac{\mathrm{d}y}{\mathrm{d}x}=8$ or $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{\mathrm{d}y}{\mathrm{d}t}\frac{\mathrm{d}t}{\mathrm{d}x}=4.\frac{1}{4t}$	Attempts a derivative expression, such as $\frac{\mathrm{d}y}{\mathrm{d}x}=kx^{-\frac{1}{2}}$ or $ky\frac{\mathrm{d}y}{\mathrm{d}x}=c$ or their $\frac{\mathrm{d}y}{\mathrm{d}t}\times\left(\frac{1}{\text{their }\frac{\mathrm{d}x}{\mathrm{d}t}}\right)$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{2}\sqrt{8}x^{-\frac{1}{2}}\left(=\sqrt{2}x^{-\frac{1}{2}}\right)$ or $2y\frac{\mathrm{d}y}{\mathrm{d}x}=8$ or $\frac{\mathrm{d}y}{\mathrm{d}x}=4.\frac{1}{4t}\left(=\frac{1}{t}\right)$	Correct differentiation (need not have substituted for t etc)	A1
	At P, gradient of normal is $m_N=-p$	Correct gradient for the normal.	A1
	$y-4p=-p(x-2p^2)$	$y-4p=(\text{their } m_N)\times(x-2p^2)$ or $y=(\text{their } m_N)x+c$ using $x=2p^2, y=4p$ in an attempt to find c. Their gradient must be a function of p for marks to be awarded. Must use a changed gradient, not tangent gradient.	M1
	$y+px=2p^3+4p$ *	cso	A1
			(5)
6(b)	$y+qx=2q^3+4q$	oe	B1
			(1)
6(c)			
	$y+px=2p^3+4p$ $\underline{y+qx=2q^3+4q}$ $px-qx=2p^3+4p-2q^3-4q$	Attempt to solve simultaneous equations. A correct equation in only one variable	M1 A1
	$(p-q)x=2((p-q)(p^2+pq+q^2)+2(p-q))$	Attempts to simplify the expression to required form. E.g. factorise difference of two cubes, $p^3-q^3=(p-q)(p^2+pq+q^2)$ or equivalent work to enable $p-q$ to cancel.	M1
	$x=2(p^2+pq+q^2+2)$*	cso for reaching the correct x coordinate.	A1
	$y+2p^3+2p^2q+2pq^2+4p=2p^3+4p$ $y=-2pq(p+q)$*	cso for reaching both coordinates correctly.	A1
			(5)
ALT	$qy+pqx=2p^3q+4pq$ $\underline{py+pqx=2pq^3+4pq}$ $py-qy=2pq^3-2p^3q$	Attempt to solve simultaneous equations. A correct equation in only one variable	M1 A1

	$(p-q)y=-2pq(p^2-q^2)$ $(p-q)y=-2pq(p-q)(p+q)$	Attempts to simplify the expression to required form. E.g. Attempt to factorise difference of two squares. $p^2-q^2=(p-q)(p+q)$ or equivalent work to enable $p-q$ to cancel.	M1
	$y=-2pq(p+q)$*	cso for reaching the correct y coordinate.	A1
	$-2p^2q^2-2pq^3+pqx=2p^3q+4pq$ $x=2(p^2+pq+q^2+2)$*	cso for reaching both coordinates correctly.	A1
			(5)
ALT 2	$-2pq(p+q)+2p(p^2+pq+q^2+2)=$ $-2p^2q-2pq^2+2p^3+2p^2q+2pq^2+4p$	Substitutes both coordinates into the equation for normal at P and expands brackets.	M1
	$=2p^3+4p$ so N is on normal at P	Simplifies correctly to $2p^3+4p$ and deduces N is on the normal at P	A1
	$-2pq(p+q)+2q(p^2+pq+q^2+2)=$ $-2p^2q-2pq^2+2p^2q+2pq^2+2q^3+4q$	Substitutes both coordinates into the equation for normal at Q and expands brackets.	M1
	$=2q^3+4q$ so N is on normal at Q	Simplifies correctly to $2q^3+4q$ and deduces N is on the normal at Q but penalise only the first instance for missing the deduction.	A1
	As N is on both normals it is therefore the intersection point of them.	Makes a suitable conclusion	A1
			(5)
6(d)	Grad $PQ=\dfrac{4q-4p}{2q^2-2p^2}\left(=\dfrac{2}{p+q}\right)$	Use of $\dfrac{y_2-y_1}{x_2-x_1}$ and substituting.	M1A1
	Grad $ON=\dfrac{-2pq(p+q)}{2(p^2+pq+q^2+2)}$	Can be unsimplified.	B1
	Grad $PQ\times$ Grad ON $=\dfrac{2}{p+q}\times\dfrac{-2pq(p+q)}{2(p^2+pq+q^2+2)}=-1$	Using product of their gradients $=-1$	M1
	$(p+q)^2-3pq=-2$	-2	A1
			(5)
			Total 16