Question Number	Scheme	Notes	Marks
6(a)	Examples: $m_{PQ}=\frac{14+30}{23-15},\ m_{QR}=\frac{-30+26}{15+7}\Rightarrow m_{PQ}\times m_{QR}=..$ or $PQ^2=8^2+44^2, QR^2=22^2+4^2,\ PR^2=30^2+40^2$ $PQ^2+QR^2=..$	Correct strategy to show that $\angle PQR=90°$. E.g. attempts gradient of *PQ* and gradient of *QR* and attempts product or finds side lengths and attempts Pythagoras.	M1
	$m_{PQ}\times m_{QR}=\frac{11}{2}\times\left(-\frac{2}{11}\right)=-1\Rightarrow\angle PQR=90°$ Or $PQ^2=2000,\ QR^2=500,\ PR^2=2500$ $2000+500=2500\Rightarrow\angle PQR=90°$	Correct proof and conclusion	A1
			(2)
(b)(i)	Centre is $(8,-6)$	Correct coordinates	B1
(b)(ii)	$r=\sqrt{(23-8)^2+(14+6)^2}$ or e.g. $r=\frac{1}{2}\sqrt{(23+7)^2+(14+26)^2}$	Fully correct method for the radius	M1
	$r = 25$	Cao	A1
			(3)
(c)	S is $(1,18)$ **or** $m_T=\frac{7}{24}$	Correct coordinates for *S* or correct gradient for the tangent.	B1
	$m_N=\frac{18+6}{1-8}\Rightarrow m_T=\frac{8-1}{18+6}\ \Rightarrow y-18=\frac{7}{24}(x-1)$ Uses a correct straight line method for the tangent using their *S* and the negative reciprocal of the radius gradient		M1
	$7x-24y+425=0$	Allow any integer multiple	A1
			(3)
			Total 8

Notes

(a)

M1: For a correct strategy to show that angle *PQR* = 90°. Possible methods are:
Find gradients of *PQ* and *RQ* (in order to check the perpendicularity condition), getting at least as far as both gradients.
Finding the lengths of all three sides and attempting to show $PQ^2+QR^2=PR^2$ attempting substitution into at least $PQ^2+QR^2=..$ When finding lengths, accept at least two correct lengths stated to imply method for finding lengths if no method is shown.
Finding the lengths of all three sides and applying the cosine rule to find the angle, reaching at least substitution into the cosine rule. May find the two acute angles and subtract from 180°.
Finding the midpoint of *PR* and showing it is equidistant from *P*, *Q* and *R* to deduce *PR* is a diameter and applying circle theorem. Must reach at least the calculations of lengths.
Finding the length of all three sides and calculating angle at *P* from both sin and cosine ratios to show both agree. Must reach angle from both ratios.
Other methods are possible, if you see a method you are unsure of then send to review.

A1: For a fully correct proof with all necessary details shown and some kind of concluding statement made (need not be the final statement). Must include the relevant correct calculations (e.g. showing product equals −1 for gradient approach, evaluation of the squares for Pythagoras etc) and deduce the right angle. If details/calculations are missing, then A0. If rounded values (e.g. when finding values) are used, then A0. Conclusion should refer to the angle, not just *PQ* and *QR* being perpendicular.

(b)

(i)

B1: Correct coordinates for the centre, seen anywhere – may be on the diagram. May have been found in part (a).

(ii)

M1: Correct method for the radius. May have been found in part (a). Implied by correct answer if no method is shown. May be seen on the diagram.

A1: $r = 25$ (seen anywhere, e.g. on diagram, as long as it is clearly the radius). Isw after a correct radius is found.

(c)

B1: Either identifies the correct point *S*, or finds the correct gradient for the tangent. Look for the gradient they use in their equation.

M1: For a full method to find the equation of the line. E.g. as in scheme, attempts to find the diametrically opposite point to *Q*, finds radius gradient and takes negative reciprocal (oe, may be using centre and either *S* or *Q*) and uses these to form the equation. They must be using an attempt at *S* and not *Q* (but see alt) but accept any attempt that gives a point above the *x*-axis for *S*.

Alternatively, may find the gradient of tangent using centre and *Q* and attempt a translation of the line. Look for

$y = \frac{7}{24}\left(x - 15\right) - 30 \rightarrow y = \frac{7}{24}\left(\left(x \pm 2\times"7"\right) - 15\right) - 30 \pm 2\times"24"$ (or may find the vertical translation first via trig or Pythagoras).

For attempts at the gradient look for an attempt at the radius followed by negative reciprocal, or an attempt at change in *x* over change in *y* directly. Allow if there are sign slips if the intent is clear. Some may attempt differentiation, look for evidence of implicit differentiation giving a $y\frac{\mathrm{d}y}{\mathrm{d}x}$ term before attempting to substitute *x* and *y* values.

A1: $7x - 24y + 425 = 0$ or any (non-zero) integer multiple of this. Accept terms in any order, but have the "=0".

Question Number	Scheme	Notes	Marks
7(i)	$3\sin(2x-15°)=\cos(2x-15°)$ $\Rightarrow \tan(2x-15°)=\frac{1}{3}$	Uses $\tan\theta\equiv\frac{\sin\theta}{\cos\theta}$ and reaches $\tan(2x-15°)=...$	M1
	$\Rightarrow x=\frac{\tan^{-1}\left(\frac{1}{3}\right)\pm 15°}{2}$	Correct strategy for finding *x*	M1
	$x=16.7°,\ -73.3°$	One of awrt 16.7 **or** –73.3	A1
		Awrt 16.7 **and** awrt –73.3 and no extras in range	A1
			(4)
(ii)	$4\sin^2\theta+8\cos\theta=3$ $\Rightarrow 4(1-\cos^2\theta)+8\cos\theta=3$ $\Rightarrow 4\cos^2\theta-8\cos\theta-1=0$	Applies $\sin^2\theta=1-\cos^2\theta$ and collects terms to obtain a 3TQ in cos θ	M1
	$\cos\theta=\frac{8\pm\sqrt{64+4\times4}}{2\times4}\Rightarrow\theta=\cos^{-1}\left(1-\frac{\sqrt{5}}{2}\right)=...$	Solves their 3TQ and takes inverse cos to obtain at least one value for θ	M1
	$\theta=1.69,\ 4.59$	Awrt 1.69 **or** 4.59	A1
		Awrt 1.69 **and** awrt 4.59 and no extras in range	A1
			(4)
			Total 8

Notes (i)

M1: Evidence of correct identity $\tan\theta=\frac{\sin\theta}{\cos\theta}$ seen, with attempt made to reach an equation $\tan(2x-15°)=k$. Note $\tan(2x-15°)=3$ with no correct identity stated is M0, but if correct identity stated first allow M1 as a slip. Allow recovery for all relevant marks for $3\tan(2x-15°)=0\rightarrow\tan(2x-15°)=\frac{1}{3}$ but allow only the first M if $\tan(2x-15°)=0$ follows.

Allow with e.g. $\tan y=...$ as long as *y* has been clearly defined as 2*x* − 15°.

Alternatively, may square both sides (including the 3) and apply $\sin^2\theta+\cos^2\theta=1$ to reach an equation in sin or cos. They should get $\sin(2x-15°)=\pm\frac{1}{\sqrt{10}}$ or $\cos(2x-15°)=\pm\frac{3}{\sqrt{10}}$ if correct but allow the method if slips in rearranging are made.

M1: Correct order of operations from $\tan(2x-15°)=k$ (any non-zero *k*) to produce a value of *x,* so applies arctan, then attempts to move the 15° across before dividing by 2. Must be working in degrees OR entirely in radians (if the 15° is converted first).

A1: One of awrt 16.7 **or** –73.3. Must have come from a correct equation – answer from calculators score A0 (they will not have score the M).

A1: Both of awrt 16.7 **and** –73.3 and no other solutions in the range. Must have come from a correct equation – answer from calculators score A0 (they will not have scored the M).

(ii)

M1: Applies $\sin^2\theta=1-\cos^2\theta$ and collects terms to obtain a 3TQ in cos θ or rearranges suitably to be able to solve via completing the square (oe method). Allow the method marks if there are notation errors (e.g. missing θ.