Question Number	Scheme	Notes	Marks
5(a)	$3(1)^3+A(1)^2+B(1)-10=k$ **or** $3(-1)^3+A(-1)^2+B(-1)-10=-10k$	Attempts $f(\pm1)=k$ **or** $f(\pm1)=-10k$	M1
	$A+B-7=k,\ A-B-13=-10k$ $\Rightarrow -10A-10B+70=A-B-13$	Uses $f(\pm1)=k$ **and** $f(\mp1)=-10k$ to eliminate *k* and obtains an equation in *A* and *B* only	M1
	$\Rightarrow 11A+9B=83$*	Correct proof with no errors	A1*
			(3)
(b)	$3\left(\frac{2}{3}\right)^3+A\left(\frac{2}{3}\right)^2+B\left(\frac{2}{3}\right)-10=0$	Attempts $f\left(\frac{2}{3}\right)=0$	M1
	$11A+9B=83,\ 12A+18B=246$ $\Rightarrow A=...,B=...$	Solves $11A+9B=83$ simultaneously with *their* equation in *A* and *B*	M1
	$A=-8,\ B=19$	Correct values	A1
			(3)
(c)	$f(x)=(3x-2)(x^2+...x+...)$	Uses any appropriate method e.g. long division/inspection to obtain x^2+px+q where *p* and *q* are non-zero.	M1
	$g(x)=x^2-2x+5$	Correct expression	A1
			(2)
			Total 8

Notes

(a)

M1: Attempts to apply the remainder theorem for either term – so substitutes ±1 into f and equates to *k* or $-10k$. The powers of ±1 need not be seen. For attempts via long division look for reaching a quotient $3x^2+(A\pm3)x+...$ and remainder $\pm A\pm B-\alpha$ before setting equal to the remainder.

M1: Must have attempted remainder theorem on both terms with opposite sign (ie both f(1) and f(−1) attempted, but may be set to the wrong remainders). Uses their two equations to eliminate the *k* and form an equation in *A* and *B* only. Note: finding a value for *k* (incorrectly) and substituting is M0.

A1*: Correct equation reached from fully correct work.

(b)

M1: Applies the factor theorem with $f\left(\frac{2}{3}\right)=0$. Must be correct sign here, but no need to evaluate powers for the method mark. Allow if all that is wrong is a slip in one term. The "=0" may be implied by working. For attempts via long division look for quotient $x^2+\frac{1}{3}(A\pm2)x+...$ and then their remainder (in *A* and *B*) set to zero.

M1: Solves their equation and the one from (a) simultaneously. Not dependent so may be scored from an attempt at $f\left(-\frac{2}{3}\right)=0$. Must have produced a second equation in *A* and *B.* Look for an attempt to match coefficients and add/subtract, or an attempt to substitute for a variable, reaching values for *A* and *B*. If no method is shown, values reached must match their equations.

A1: Correct values found.

(c)

M1: Attempts inspection, factorisation or long division to try and find the factor. Must produce a three-term quadratic. Implied by the correct answer if no incorrect method seen. For inspection look

for an attempt to set up and solve at least one equation using coefficients, for factorisation look for correct first and last term, for long division look for correct *x* term for their *A* and a constant (do not be concerned about a remainder for this mark).

A1: Correct g(*x*). May be stated separately or accept if seen in a factorised cubic form $f(x)=(3x-2)(x^2-2x+5)$ or the correct factor from long division – as long as there is no remainder.

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.