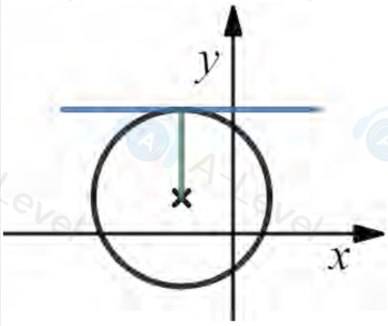
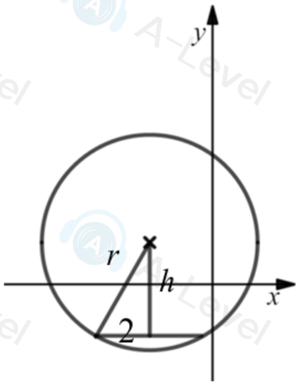
Question Number	Scheme	Marks
7 (i)	States or uses $\tan x = \dfrac{\sin x}{\cos x}$	M1
	$3\sin x \tan x = 11 + \cos x \Rightarrow 3\sin^2 x = 11\cos x + \cos^2 x$	
	$\Rightarrow 3\left(1-\cos^2 x\right) = 11\cos x + \cos^2 x \Rightarrow 4\cos^2 x + 11\cos x - 3 = 0$	dM1, A1
	$\Rightarrow (4\cos x - 1)(\cos x + 3) = 0 \Rightarrow \cos x = \dfrac{1}{4} \Rightarrow x = 1.318, 4.965$	dM1 A1
		(5)
(ii)	$\cos\theta = \dfrac{1}{3} \Rightarrow \sin^2\theta = 1 - \dfrac{1}{3^2} \Rightarrow \tan\theta = \dfrac{\sin\theta}{\cos\theta} = \dfrac{\sqrt{1-\dfrac{1}{3^2}}}{\dfrac{1}{3}}$	M1
	$\Rightarrow \tan\theta = 2\sqrt{2}$	A1
		(2)
		Total 7

Question Number	Scheme	Marks
2.(a)	Attempts $(x \pm 2)^2 + (y \pm 5)^2 ..... = 0$	M1
	(i) Centre $(-2, 5)$	A1
	(ii) Radius $\sqrt{50}$ or $5\sqrt{2}$	B1
		(3)
(b)	Gradient of radius $= \dfrac{(5)-4}{(-2)-5} = -\dfrac{1}{7}$ which needs to be in simplest form	B1ft
	Uses $m_2 = -\dfrac{1}{m_1}$ to find gradient of tangent	M1
	Equation of tangent $y - 4 = "7"(x-5) \Rightarrow y = 7x - 31$	M1 A1
		(4)
		(7 marks)

Question Number	Scheme	Marks
	$x^2+y^2+6x-4y-14=0$	
6.(a)	Attempts $(x\pm3)^2+(y\pm2)^2 .....(=0)$	M1
	(i) Centre $(-3,2)$	A1
	(ii) Radius $\sqrt{27}$ or $3\sqrt{3}$	A1
		(3)
(b)		
	Attempts $y/k=\text{"}2\text{"}\pm\text{"}3\sqrt{3}\text{"}$	M1
	Both $k=2+3\sqrt{3}$ and $k=2-3\sqrt{3}$	A1
		(2)
	Alt:	
	$y=k\Rightarrow x^2+6x+k^2-4k-14=0$	
	$\Rightarrow b^2-4ac=0\Rightarrow 6^2-4\times1\times\left(k^2-4k-14\right)=0$	
	$\Rightarrow 4k^2-16k-92=0\Rightarrow k=...$	M1
	$k=2\pm3\sqrt{3}$ (oe)	A1
		(2)
(c)		
	Attempts Pythagoras to find h $\quad h^2=r^2-2^2$	M1
	Attempts $p=2-h$	dM1
	$p=2-\sqrt{23}$ (oe)	A1
		(3)
	Alt1: chord touches circle when $x=-1$ (or -5) or need $(x+3)=\pm2$	M1
	$\Rightarrow 2^2+(y-2)^2=27\Rightarrow y=...$ or $(-1)^2+y^2+6(-1)-4y-14=0\Rightarrow y=...$	dM1
	$p=2-\sqrt{23}$	A1
		(3)
	Alt2: Sets $y=p$ and applies difference of roots to be 4	
	$\Rightarrow x^2+6x+p^2-4p-14=0\Rightarrow x=\dfrac{-6\pm\sqrt{36-4(p^2-4p-14)}}{2}$	
	$\Rightarrow 2\sqrt{23+4p-p^2}=4$	M1
	$\Rightarrow p^2-4p-19=0\Rightarrow p=...$	dM1
	$p=2-\sqrt{23}$	A1
		(3)
		(8 marks)

Question Number	Scheme	Marks
2(a)	Midpoint of $(-2, 5)$ and $(4, 15)$ is $\left(\frac{-2+4}{2}, \frac{5+15}{2}\right) = (1, 10)$	B1
	Attempts radius ^{2} or diameter ^{2}: e.g. $D^2 = (4--2)^2 + (15-5)^2 = 136$	M1
	Radius^2 = 34	A1
	$(x-1)^2 + (y-10)^2 = 34$	M1, A1
		(5)
(b)	$(1, 10-\sqrt{34})$	B1 , dB1
		(2)
		(7 marks)

Question	Answer	Marks	Guidance
7(a)	Differentiate y^3 to obtain $3y^2 \frac{dy}{dx}$	**B1**	
	Differentiate complete equation to produce at least one term involving $\frac{dy}{dx}$ using implicit differentiation.	**M1**	
	Obtain $2e^{2x} - 18 + 3y^2 \frac{dy}{dx} + \frac{dy}{dx} = 0$	**A1**	
	Substitute $\frac{dy}{dx} = 0$ to obtain either $p = \frac{1}{2}\ln 9$ or $p = \ln 3$	**A1**	
		4	
7(b)	Substitute value of p in original equation and rearrange as far as $y^3 = \ldots$ or $q^3 = \ldots$	**M1**	Allow in terms of $\ln 9$.
	Obtain given result $q = \sqrt[3]{2+18\ln 3 - q}$ **or** $y = \sqrt[3]{2+18\ln 3 - y}$ with sufficient detail	**A1**	AG
		2	
7(c)	Consider sign of $q - \sqrt[3]{2+18\ln 3 - q}$ or equivalent for 2.5 and 3.0	**M1**	
	Obtain $-0.18\ldots$ and $0.34\ldots$ with sufficient detail and justify conclusion	**A1**	OE
		2	

Question Number	Scheme	Marks
6(a)(i)	Centre is $(-4, 2)$	B1
(ii)	$x^2+y^2+8x-4y=0$ $\Rightarrow (x+4)^2+(y-2)^2-16-4=0 \Rightarrow r=...$	M1
	$r=2\sqrt{5}$ oe	A1
		(3)
(b)	$x^2+y^2+8x-4y=0,\ x+2y+10=0$ $\Rightarrow (-2y-10)^2+y^2+8(-2y-10)-4y=0$ or $x^2+\left(\frac{-x-10}{2}\right)^2+8x-4\left(\frac{-x-10}{2}\right)=0$	M1
	$y^2+4y+4=0$ or e.g. $x^2+12x+36=0$	A1
	$(y+2)^2=0 \Rightarrow y=...$ or e.g. $(x+6)^2=0 \Rightarrow x=...$	dM1
	$(-6, -2)$	A1
		(4)
(c)	$x+2y+10=0 \Rightarrow m_T=-\frac{1}{2} \Rightarrow m_N=2$ or $m_N=\frac{"2"-("-2")}{"-4"-("-6")}$	M1
	Usually either $y-2=2(x+4)$ or $y+2=2(x+6)$	dM1
	$y=2x+10$	A1
		(3)
		Total 10

Question Number	Scheme	Marks
3a(i)	$r=\sqrt{(8-2)^2+(-3-5)^2}=10$	M1A1
(ii)	$(x-2)^2+(y-5)^2=100$	A1ft
		(3)
b	Gradient between centre and $P=-\frac{4}{3}$	B1
	Perpendicular gradient $=\frac{3}{4}$	M1
	$y+3=\frac{3}{4}(x-8)$	M1
	$3x-4y-36=0$	A1
		(4)
		(7 marks)

Question	Scheme	Marks
10(a)	Equation of circle is $(x-3)^2+(y-5)^2=r^2$ and line is $y=2x+k$ So intersect when $(x-3)^2+(2x+k-5)^2=r^2$	M1
	$\Rightarrow x^2-6x+9+4x^2+4(k-5)x+(k-5)^2=r^2$ $\Rightarrow 5x^2+(-6+4k-20)x+9+k^2-10k+25-r^2=0$	dM1
	$\Rightarrow 5x^2+(4k-26)x+k^2-10k+34-r^2=0$ *	A1*
		(3)
(b)	Tangent to $C \Rightarrow b^2-4ac=0 \Rightarrow (4k-26)^2-4\times5\times(k^2-10k+34-r^2)=0$	M1
	$\Rightarrow 16k^2-208k+676-20k^2+200k-680+20r^2=0$ $\Rightarrow 5r^2=\ldots$	M1
	$\Rightarrow 5r^2=k^2+2k+1=(k+1)^2$	A1
		(3)
(b) Way 2	Gradient of BX is $-\frac{1}{2}$ so equation of BX is $y-5=-\frac{1}{2}(x-3)$ $y-5=-\frac{1}{2}(x-3), y=2x+k \Rightarrow x=\ldots, y=\ldots\left(\frac{13-2k}{5},\frac{26+k}{5}\right)$	M1
	$\left(\frac{13-2k}{5}-3\right)^2+\left(\frac{26+k}{5}-5\right)^2=r^2$	dM1
	$\Rightarrow 5r^2=k^2+2k+1=(k+1)^2$	A1
		(3)
(c)	Triangle AXB is right angled so $AB^2+r^2=XA^2=(3-0)^2+(5-k)^2$	M1
	$AB^2=4r^2$ so $AB^2+r^2=5r^2$	M1
	$\Rightarrow 5r^2=9+(5-k)^2$	A1
	$\Rightarrow k^2+2k+1=9+25-10k+k^2$	M1
	$\Rightarrow 12k=33 \Rightarrow k=\ldots$	dM1
	$k=\frac{11}{4}$	A1
		(6)
		(12 marks)

Question Number	Scheme	Marks
3(a)	Attempts $(8-3)^2+(5--7)^2=...$	M1
	Writes $(x-3)^2+(y-5)^2=k$	M1
	$(x-3)^2+(y-5)^2=169$	A1
		(3)
(b)	Attempts $d^2+(2\sqrt{22})^2=169 \Rightarrow d=...$	M1
	States or uses $(y=)\ 5+d$	dM1
	$y=14$	A1
		(3)
		(6 marks)

Question Number	Scheme	Notes	Marks
6(a)	Examples: $m_{PQ}=\dfrac{14+30}{23-15},\ m_{QR}=\dfrac{-30+26}{15+7} \Rightarrow m_{PQ}\times m_{QR}=..$ 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
	$m_{PQ}\times m_{QR}=\dfrac{11}{2}\times\left(-\dfrac{2}{11}\right)=-1 \Rightarrow \angle PQR=90°$ 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. $r=\dfrac{1}{2}\sqrt{(23+7)^2+(14+26)^2}$	Fully correct method for the radius	M1
	$r=25$	Cao	A1
			(3)
(c)	S is $(1, 18)$ **or** $m_T=\dfrac{7}{24}$	Correct coordinates for *S* or correct gradient for the tangent.	B1
	$m_N=\dfrac{18+6}{1-8} \Rightarrow m_T=\dfrac{8-1}{18+6} \Rightarrow y-18=\dfrac{7}{24}(x-1)$ 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

Question Number	Scheme	Marks
6 (i)	$x^2+y^2+10x-12y=k$	
(a)	Attempts $(x\pm5)^2+(y\pm6)^2 .....=0$	M1
	Centre $(-5,6)$	A1
		(2)
(b)	Sets $k+(\pm5)^2+(\pm6)^2>0$	M1
	$k>-61$	A1
		(2)
(ii)	Centre $\left(\frac{-2+8}{2},\frac{10+(-14)}{2}\right)=...$; radius $\frac{1}{2}\sqrt{(-2-8)^2+(10-(-14))^2}=...$	M1
	Centre is $(3,-2)$; radius is 13	A1
	$\Rightarrow C_2:(x-3)^2+(y+2)^2=13^2\Rightarrow(p-3)^2+4=169\Rightarrow p=...$ Or $PX=r\Rightarrow(p-3)^2+(0-(-2))^2=169\Rightarrow p=...$	M1
	$p=3+\sqrt{165}$ only	A1
		(4)
		(8 marks)

Question	Scheme	Marks
6(a)	Way 1: Eqn is $(x-3)^2+(y+4)^2-9-16+k=0$	**M1**
	So radius must be 4 $\Rightarrow 25-k=16$	**M1**
	$\Rightarrow k=9$	**A1**
		(3)
	Way 2: $y=0\Rightarrow x^2-6x+k=0$ has one solution	**M1**
	$\Rightarrow 6^2-4\times1\times k=0$	**M1**
	$\Rightarrow k=9$	**A1**
		(3)
(b)	C intersects x axis at (3,0)	**B1**
	Intersects y axis when $y^2+8y+9=0\Rightarrow y=...$ or $y=\text{"}-4\text{"}\pm\sqrt{\text{"}16\text{"}-\text{"}9\text{"}}$ Or uses base of triangle is $2\sqrt{\text{"}16\text{"}-\text{"}9\text{"}}$	**M1**
	Area $RST=\frac{1}{2}\times2\sqrt{7}\times3$	**M1**
	$=3\sqrt{7}$	**A1**
		(4)
		(7 marks)

Question Number	Scheme	Marks
6(a)	States or uses $M=(5,4)$ **or** grad $AB = \frac{1}{3}$ o.e.	B1
	States or uses $M=(5,4)$ **and** grad $AB = \frac{1}{3}$ o.e.	B1
	Equation of l is $y-4=-3(x-5)$	M1
	$y=-3x+19$	A1
		(4)
(b)	$k=-2$	B1 ft
		(1)
(c)	Attempts radius or radius ^{2} E.g. $(11-7)^2+(6--2)^2$	M1
	States $(x-7)^2+(y+'2')^2=(11-7)^2+(6--2)^2$	dM1
	$(x-7)^2+(y+2)^2=80$	A1
		(3)
		(8 marks)