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

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)

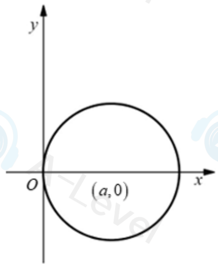
Question Number	Scheme	Marks
3(a)	Attempts $(8-3)^2+(5--7)^2=...$	M1
	Writes $(x-3)^2+(y-5)^2=k$	M1
	$(x-3)^2+(y-5)^2=169$	A1
		(3)
(b)	Attempts $d^2+\left(2\sqrt{22}\right)^2=169\Rightarrow d=...$	M1
	States or uses $(y=)\ 5+d$	dM1
	$y=14$	A1
		(3)
		(6 marks)

Question Number	Scheme	Marks
10(a)	$x^2+y^2+4x-30y+209=0$ $\Rightarrow (x\pm 2)^2+(y\pm 15)^2 \ldots = 0$	M1
(i)	Centre $(-2, 15)$	A1
(ii)	Radius $\sqrt{20}$	A1
		(3)
(b)	$y=mx+1 \Rightarrow (x+2)^2+(mx+1-15)^2=20$ or $y=mx+1 \Rightarrow x^2+(mx+1)^2+4x-30(mx+1)+209=0$	M1
	$x^2+m^2x^2+4x-28mx+180=0$ $b^2-4ac=0 \Rightarrow (4-28m)^2-4(1+m^2)\times 180=0$	**d**M1
	$(4-28m)^2-4(1+m^2)180=0 \Rightarrow 16-224m+784m^2-720-720m^2=0$ $\Rightarrow 2m^2-7m-22=0*$	A1*
		(3)
(c)	$2m^2-7m-22=0 \Rightarrow m=\frac{11}{2}, -2$	M1
	$m=\frac{11}{2} \Rightarrow \frac{125}{4}x^2-150x+180=0 \Rightarrow x=\frac{12}{5} \Rightarrow y=\frac{71}{5}$ or $m=-2 \Rightarrow 5x^2+60x+180=0 \Rightarrow x=-6 \Rightarrow y=13$	M1
	$\left(\frac{12}{5}, \frac{71}{5}\right)$ **or** $(-6, 13)$ oe	A1
	$\left(\frac{12}{5}, \frac{71}{5}\right)$ **and** $(-6, 13)$ oe	A1
		(4)
		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 $P = -\frac{4}{3}$ Perpendicular gradient $=\frac{3}{4}$ $y+3=\frac{3}{4}(x-8)$ $3x-4y-36=0$	B1 M1 M1 A1
		(4)
		(7 marks)

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	Notes	Marks
4(a)(i)	(−7, 9) or e.g. $x = -7$, $y = 9$	$x = -7$ **or** $y = 9$	B1
		$x = -7$ **and** $y = 9$	B1
	Award the marks in (a) once correct answers are seen. **Special case:** If all you see is (9, −7) award B1B0		
(a)(ii)	<u>Examples:</u> $r=\sqrt{\left(-3-(\text{"}-7\text{"})\right)^2+\left(12-\text{"}9\text{"}\right)^2}$ **or** $r=\sqrt{\left(-11-(\text{"}-7\text{"})\right)^2+\left(6-\text{"}9\text{"}\right)^2}$ **or** $r=\dfrac{1}{2}\sqrt{\left(-3+11\right)^2+\left(12-6\right)^2}$	Correct strategy for the radius. Must be a correct method for their centre (if used) **but allow 1 sign slip within one of the brackets**. A correct answer scores both marks. Must see the ½ if finding the length of the diameter.	M1
	$r = 5$	Correct radius	A1
			(4)
(b)	$(x+7)^2+(y-9)^2=5^2$ or e.g. $x^2+y^2+2\times7x-2\times9y+7^2+9^2-5^2=0$ M1: Correct attempt at circle equation using their values. Allow for $\left(x\pm(\mathit{their}-7)\right)^2+\left(y\pm(\mathit{their}\,9)\right)^2=(\mathit{their\ numerical}\ r)^2$ or e.g. $x^2+y^2\pm2\times(\mathit{their}-7)x\pm2\times(\mathit{their}\,9)y+(\mathit{their}-7)^2+(\mathit{their}\,9)^2-(\mathit{their\ numerical}\ r)^2=0$ A1: Correct equation in any form		M1A1
			(2)
(c)	$m_{radius}=\dfrac{12-9}{-3+7}\left(=\dfrac{3}{4}\right)$ **or** $m_{tangent}=-1\div\left(\dfrac{12-9}{-3+7}\right)\left(=-\dfrac{4}{3}\right)$ **or** $m_{tangent}=-\left(\dfrac{-3+7}{12-9}\right)\left(=-\dfrac{4}{3}\right)$	This mark is for an attempt to find the radius gradient **or** the tangent gradient. If the method is not clear allow one sign error in the numerator or denominator.	M1
	Alternative for the first M: $(x+7)^2+(y-9)^2=5^2\Rightarrow2(x+7)+2(y-9)\dfrac{\mathrm{d}y}{\mathrm{d}x}=0$ $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{x+7}{9-y}=\dfrac{-3+7}{9-12}\left(=-\dfrac{4}{3}\right)$ Allow for $(x+7)^2+(y-9)^2=5^2\Rightarrow\alpha(x+7)+\beta(y-9)\dfrac{\mathrm{d}y}{\mathrm{d}x}=0\Rightarrow\dfrac{\mathrm{d}y}{\mathrm{d}x}=\ldots$		
	$y-12=-\dfrac{4}{3}(x+3)$ Uses a correct straight line method for the **tangent** using the point Q. Must be fully correct work here so must be a clear attempt at the tangent not the radius. So if the radius gradient is found previously, must apply negative reciprocal rule to their radius gradient. If using $y = mx + c$ must reach as far as $c = \ldots$		M1
	$4x+3y-24=0$	Allow any integer multiple	A1
			(3)
			Total 9

Question Number	Scheme	Marks
9(a)		B1
		(1)
(b)	$(x \pm a)^2 + y^2 = \ldots$	M1
	$(x \pm a)^2 + y^2 = a^2$	A1
	Uses $(5, 6)$ in $(x \pm a)^2 + y^2 = a^2$ to form and solve an equation in a	dM1
	E.g. $(5-a)^2 + 36 = a^2 \Rightarrow 10a = 61 \Rightarrow a = 6.1$	
	$(x-6.1)^2 + y^2 = 6.1^2$	A1
		(4)
		(5 marks)

Question Number	Scheme	Marks
3(a)	Attempts to complete the square for both variables $(x+4)^2, (y-7)^2$	M1
	Centre $(-4, 7)$	A1
	Radius = 12	A1
		(3)
(b)	Attempts $"\pm\left(12" - \sqrt{"4"^2 + "7"^2}\right)$	M1
	$12 - \sqrt{65}$	A1 ft
		(2)
		Total 5

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 Number	Scheme	Marks
6 (a)	Centre of circle is midpoint of $(-2, 18)$ and $(14, 6)$ = $(6, 12)$	B1
	Attempts radius² or diameter². E.g. $D^2 = (14 - -2)^2 + (6-18)^2 = 400$	M1
	Radius² = 100	A1
	$(x-6)^2 + (y-12)^2 = 100$	M1, A1
		(5)
(b)	Recognises equation of C_2 is $x^2 + y^2 = k^2$	B1
	Attempts to find one value of k or k^2 Look for $\sqrt{"6"^2 + "12"^2} \pm \sqrt{"100"}$	M1
	$x^2 + y^2 = \left(6\sqrt{5}+10\right)^2$ or $x^2 + y^2 = \left(6\sqrt{5}-10\right)^2$ o.e.	A1
	$x^2 + y^2 = \left(6\sqrt{5}+10\right)^2$ and $x^2 + y^2 = \left(6\sqrt{5}-10\right)^2$ o.e.	A1
		(4)
		(9 marks)

Question Number	Scheme	Marks
6(a)	Attempts line with gradient -2 and point $(4, -1)$	
	$y + 1 = -2(x-4)$	M1
	$y = -2x + 7$	A1
		(2)
(b)	$y = \frac{1}{2}x$ meets $y = -2x + 7$ when $\frac{1}{2}x = -2x + 7 \Rightarrow x = \frac{14}{5}, y = \frac{7}{5}$ oe	M1 A1
	Attempts $r^2 = \left(4 - "\frac{14}{5}"\right)^2 + \left(-1 - "\frac{7}{5}"\right)^2 = \frac{36}{5}$ oe	dM1 A1
	$(x-4)^2 + (y+1)^2 = \frac{36}{5}$ oe	A1
		(5)
		(7 marks)