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
	$x^2 + y^2 = (6\sqrt{5}+10)^2$ or $x^2 + y^2 = (6\sqrt{5}-10)^2$ o.e.	A1
	$x^2 + y^2 = (6\sqrt{5}+10)^2$ and $x^2 + y^2 = (6\sqrt{5}-10)^2$ o.e.	A1
		(4)
		(9 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)

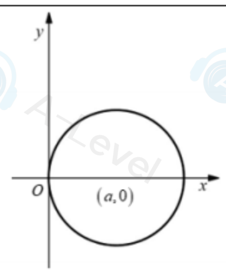
Question	Scheme	Marks
10(a)	Equation of circle is $(x-3)^2+(y-5)^2=r^2$ and line is $y=2x+k$ So intersect when $(x-3)^2+(2x+k-5)^2=r^2$	M1
	$\Rightarrow x^2-6x+9+4x^2+4(k-5)x+(k-5)^2=r^2$ $\Rightarrow 5x^2+(-6+4k-20)x+9+k^2-10k+25-r^2=0$	dM1
	$\Rightarrow 5x^2+(4k-26)x+k^2-10k+34-r^2=0$ *	A1*
		(3)
(b)	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
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 $P=-\dfrac{4}{3}$	B1
	Perpendicular gradient $=\dfrac{3}{4}$	M1
	$y+3=\dfrac{3}{4}(x-8)$	M1
	$3x-4y-36=0$	A1
		(4)
		(7 marks)

Question Number	Scheme	Marks
6(a)	States or uses $M=(5,4)$ **or** grad $AB=\dfrac{1}{3}$ o.e.	B1
	States or uses $M=(5,4)$ **and** grad $AB=\dfrac{1}{3}$ 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)

Question Number	Scheme	Marks
9(a) **(i)**	Centre = $(k, 2k)$	B1
(ii)	Radius = $\sqrt{k+7}$	B1
		(2)
(b)(i)	$(2-k)^2+(3-2k)^2=k+7 \Rightarrow 4-4k+k^2+9-12k+4k^2=k+7$	M1
	$5k^2-17k+6=0$ *	A1*
(ii)	$(k=)\dfrac{2}{5},3$	B1
		(3)
(c)		
	Centre is $\left(\dfrac{2}{5},\dfrac{4}{5}\right)$	B1ft
	Gradient of tangent $\pm\dfrac{2-"\frac{2}{5}"}{3-"\frac{4}{5}"}=\left(-\dfrac{8}{11}\right)$	M1
	$y-3="-\dfrac{8}{11}"(x-2) \Rightarrow$ sets $y=0 \Rightarrow x=...$ Alternatively, $\tan\angle PTO=\dfrac{8}{11} \Rightarrow XT=\dfrac{3}{8/11}=...$ where X is (2,0)	M1
	Area $OPT=\dfrac{1}{2}\times"\dfrac{49}{8}"\times 3=...$ Alternatively, Area $OPT=\dfrac{1}{2}\times 2\times 3+\dfrac{1}{2}\times"\dfrac{33}{8}"\times 3=...$	dM1
	$=\dfrac{147}{16}$ oe	A1
		(5)
		(10 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
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
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)

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)	$\left(1,10-\sqrt{34}\right)$	B1 , dB1
		(2)
		(7 marks)

Question	Answer	Marks	Guidance
7(a)	Differentiate y^3 to obtain $3y^2\frac{\mathrm{d}y}{\mathrm{d}x}$	**B1**	
	Differentiate complete equation to produce at least one term involving $\frac{\mathrm{d}y}{\mathrm{d}x}$ using implicit differentiation.	**M1**	
	Obtain $2\mathrm{e}^{2x}-18+3y^2\frac{\mathrm{d}y}{\mathrm{d}x}+\frac{\mathrm{d}y}{\mathrm{d}x}=0$	**A1**	
	Substitute $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ 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
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)