Question	Scheme	Marks	AOs
6(a)	$(x+4)^2+(y-3)^2$	M1	1.1b
(i)	Centre $(-4,\ 3)$	A1	1.1b
(ii)	Radius is $\sqrt{32}$	A1	1.1b
		(3)	
(b)	$x^2+(2x+k)^2+8x-6(2x+k)-7=0 \Rightarrow ...x^2 \pm ...x \pm ...=0$	M1	1.1b
	$b^2-4ac=(4k-4)^2-4\times5\times(k^2-6k-7)$	dM1	2.1
	$k^2-22k-39=0 \Rightarrow k=...$	M1	3.1a
	$k=11-4\sqrt{10}$ only	A1	2.2a
		(4)	
			(7 marks)

Notes

(a)

M1: Attempts to complete the square. Score for $(x\pm4)^2...(y\pm3)^2$

A1: $(-4,\ 3)$

A1: $\sqrt{32}$ $\left(\text{or } 4\sqrt{2}\right)$

(b)

M1: Substitutes $y=2x+k$ into the equation of the circle and proceeds to a three-term quadratic (3TQ) in x where the coefficients of "b" and "c" are both in terms of k

dM1: Attempts to find b^2-4ac for a 3TQ where the coefficients of "b" and "c" are both in terms of k. It is dependent on the first method mark.

M1: A complete method to find a value for k. They must have substituted $y=2x+k$ into the equation of the circle, attempted to find the discriminant and attempted to solve the resulting quadratic, in terms of k, set equal to zero.

A1: $k=11-4\sqrt{10}$ or equivalent only. They must have rejected the positive solution.

There may be other geometrical methods to solving (b) e.g.

M1: As the tangent line $y=2x+k$ has gradient 2 , the gradient between the centre of the circle and the point where the line $y=2x+k$ touches C is $-\frac{1}{2}$.

$\Rightarrow (2t)^2+t^2=32$ for a parameter t and attempts to solve $(2t)^2+t^2=32$ leading to a value for t $\left(=\frac{4\sqrt{10}}{5}\right)$

dM1:	Substitutes their value of t to find the coordinates of the point where the tangent touches the circle. $\left(-4+2"t", 3-"t"\right)$
M1:	A complete method to find a value of k using $k = y - 2x$
A1:	$k = 11 - 4\sqrt{10}$