Question	Scheme	Marks	AOs
14 (a)	C is $$(x-r)^2 + (y-r)^2 = r^2 \quad \text{or} \quad x^2 + y^2 - 2rx - 2ry + r^2 = 0$$	B1	2.2a
	$$y = 12 - 2x, \ x^2 + y^2 - 2rx - 2ry + r^2 = 0$$ $$\Rightarrow x^2 + (12 - 2x)^2 - 2rx - 2r(12 - 2x) + r^2 = 0$$ or	M1	1.1b

		$y = 12 - 2x, \ (x-r)^2 + (y-r)^2 = r^2$ $\Rightarrow (x-r)^2 + (12-2x-r)^2 = r^2$		
		$x^2 + 144 - 48x + 4x^2 - 2rx - 24r + 4rx + r^2 = 0$ $\Rightarrow 5x^2 + (2r-48)x + \left(r^2 - 24r + 144\right) = 0 \quad *$	A1*	2.1
			(3)	
(b)		$b^2 - 4ac = 0 \Rightarrow (2r-48)^2 - 4 \times 5 \times \left(r^2 - 24r + 144\right) = 0$	M1	3.1a
		$r^2 - 18r + 36 = 0$ or any multiple of this equation	A1	1.1b
		$\Rightarrow (r-9)^2 - 81 + 36 = 0 \Rightarrow r = ...$	dM1	1.1b
		$r = 9 \pm 3\sqrt{5}$	A1	1.1b
			(4)	
				(7 marks)

Notes:

(a)

B1: Deduces the correct equation of the circle

M1: Attempts to form an equation with terms of the form x^2, x, r^2, and xr **only** using $y = 12 \pm 2x$ and their circle
equation which must be of an appropriate form. I.e. includes or implies an x^2, y^2, r^2 such as $x^2 + y^2 = r^2$
If their circle equation starts off as e.g. $(x \pm a)^2 + (y \pm b)^2 = r^2$ then the B mark and the M mark can be awarded
when the "a" and "b" are replaced by r or $-r$ as appropriate for their circle equation.

A1*: Uses correct and accurate algebra leading to the given solution.

(b)

M1: Attempts to use $b^2 - 4ac ... 0$ o.e. with $a = 5, b = 2r - 48, c = r^2 - 24r + 144$ and where ... is "=" or any inequality
Allow minor slips when copying the a, b and c provided it does not make the work easier and allow **their** a, b
and c if they are similar expressions.

FYI $(2r-48)^2 - 4 \times 5 \times \left(r^2 - 24r + 144\right) = 4r^2 - 192r + 2304 - 20r^2 + 480r - 2880 = -16r^2 + 288r - 576$

A1: Correct quadratic **equation** in r (or inequality). Terms need not be all one side but must be collected.

E.g. allow $r^2 - 18r = -36$ and allow any multiple of this equation (or inequality).

dM1: Correct attempt to solve their 3TQ in r. Dependent upon previous M

A1: Careful and accurate work leading to both answers in the required form (must be simplified surds)