

Section 2: Circles

Solutions to Exercise level 1

1. (i) $(x-0)^2 + (y-0)^2 = 6^2$
 $x^2 + y^2 = 36$

- (ii) $(x-3)^2 + (y-1)^2 = 5^2$
 $x^2 - 6x + 9 + y^2 - 2y + 1 = 25$
 $x^2 + y^2 - 6x - 2y = 15$

- (iii) $(x+2)^2 + (y-5)^2 = 1^2$
 $x^2 + 4x + 4 + y^2 - 10y + 25 = 1$
 $x^2 + y^2 + 4x - 10y = -28$

- (iv) $(x-0)^2 + (y+4)^2 = 3^2$
 $x^2 + y^2 + 8y + 16 = 9$
 $x^2 + y^2 + 8y = -7$

2. (i) $x^2 + y^2 = 100 = 10^2$
Centre = $(0, 0)$, radius = 10.

- (ii) $(x-2)^2 + (y-7)^2 = 16 = 4^2$
Centre = $(2, 7)$, radius = 4

- (iii) $(x+3)^2 + (y-4)^2 = 4 = 2^2$
Centre = $(-3, 4)$, radius = 2

- (iv) $(x+4)^2 + (y+5)^2 = 20$
Centre = $(-4, -5)$, radius = $\sqrt{20}$

3. (i) $x^2 + y^2 + 4x - 5 = 0$
 $x^2 + 4x + y^2 - 5 = 0$
 $(x+2)^2 - 4 + y^2 - 5 = 0$
 $(x+2)^2 + y^2 = 9$
Centre = $(-2, 0)$, radius = 3.

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$$\begin{aligned} \text{(ii)} \quad x^2 + y^2 - 6x + 10y + 20 &= 0 \\ x^2 - 6x + y^2 + 10y + 20 &= 0 \\ (x-3)^2 - 9 + (y+5)^2 - 25 + 20 &= 0 \\ (x-3)^2 + (y+5)^2 &= 14 \\ \text{Centre is } (3, -5) \text{ and radius} &= \sqrt{14} \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad x^2 + y^2 - 2x - 3y + 3 &= 0 \\ x^2 - 2x + y^2 - 3y + 3 &= 0 \\ (x-1)^2 - 1 + (y-\frac{3}{2})^2 - \frac{9}{4} + 3 &= 0 \\ (x-1)^2 + (y-\frac{3}{2})^2 &= 1 + \frac{9}{4} - 3 \\ (x-1)^2 + (y-\frac{3}{2})^2 &= \frac{1}{4} \\ \text{Centre is } (1, \frac{3}{2}) \text{ and radius} &= \frac{1}{2}. \end{aligned}$$

$$\begin{aligned} 4. \text{ Radius of circle} &= \sqrt{(6-4)^2 + (3-(-2))^2} = \sqrt{4+25} = \sqrt{29} \\ \text{Equation of circle is } (x-4)^2 + (y+2)^2 &= 29 \\ x^2 - 8x + 16 + y^2 + 4y + 4 &= 29 \\ x^2 + y^2 - 8x + 4y &= 9 \end{aligned}$$

5. Centre of circle C is the midpoint of AB.

$$C = \left(\frac{2+6}{2}, \frac{0+4}{2} \right) = (4, 2)$$

$$\begin{aligned} \text{Radius of circle is distance AC} &= \sqrt{(2-4)^2 + (0-2)^2} = \sqrt{4+4} = \sqrt{8} \\ \text{Equation of circle is } (x-4)^2 + (y-2)^2 &= 8 \\ x^2 - 8x + 16 + y^2 - 4y + 4 &= 8 \\ x^2 + y^2 - 8x - 4y + 12 &= 0 \end{aligned}$$

$$\begin{aligned} 6. \text{ (i)} \quad x^2 + y^2 - 4x + 6y &= 51 \\ \Rightarrow (x-2)^2 + (y+3)^2 &= 64 \\ \Rightarrow \text{centre is } (2, -3), \text{ radius} &= 8 \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad x^2 + 2y^2 - 3x &= 11 \\ \text{The coefficients of } x^2 \text{ and } y^2 \text{ are different, so this is not a circle.} \end{aligned}$$

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$$(iii) \quad 4x^2 + 4y^2 = 65$$

$$\Rightarrow x^2 + y^2 = \frac{65}{4}$$

$$\Rightarrow \text{centre is } (0, 0), \text{ radius} = \frac{\sqrt{5} \cdot \sqrt{13}}{2}$$

$$(iv) \quad 8x^2 + 8y^2 - 48x - 16y = -104$$

$$\Rightarrow x^2 + y^2 - 6x - 2y = -13$$

$$\Rightarrow (x-3)^2 + (y-1)^2 = -3$$

so not a circle, as no (real) radius.

(There are no real values (x, y) which satisfy the equation)