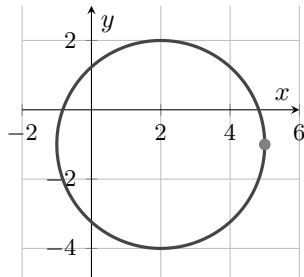
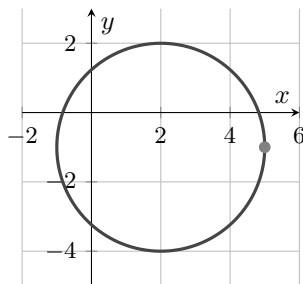


Question 8**Problem**

A moving point satisfies $x = 2 + 3 \cos t$, $y = -1 + 3 \sin t$. Without eliminating t , determine its center, radius, starting point, and initial direction.



Question 8 – Solution



Solution

1. Compare the equations

$$x = 2 + 3 \cos t, \quad y = -1 + 3 \sin t$$

with the standard circle parametrization

$$x = h + R \cos t, \quad y = k + R \sin t.$$

2. It follows immediately that

$$(h, k) = (2, -1) \quad \text{and} \quad R = 3.$$

Thus the curve is a circle centered at $(2, -1)$ with radius 3 .

3. Evaluate the coordinates at $t = 0$:

$$x(0) = 2 + 3 \cos 0 = 5, \quad y(0) = -1 + 3 \sin 0 = -1.$$

Therefore, the starting point is $(5, -1)$.

4. Differentiate to find the velocity:

$$\mathbf{r}'(t) = (-3 \sin t, 3 \cos t).$$

At $t = 0$,

$$\mathbf{r}'(0) = (0, 3),$$

which points straight upward from the rightmost point of the circle.

5. Upward motion from the rightmost point is counterclockwise, so the initial direction is **counterclockwise**.