

$$12. \vec{r}(t) = 3 \cos t \vec{i} + 3 \sin t \vec{j} \quad t_0 = \frac{\pi}{2}$$

$$\vec{r}'(t) = -3 \sin t \vec{i} + 3 \cos t \vec{j}$$

$$\begin{aligned} \vec{r}'\left(\frac{\pi}{2}\right) &= -3 \sin \frac{\pi}{2} \vec{i} + 3 \cos \frac{\pi}{2} \vec{j} \\ &= -3 \vec{i} \end{aligned}$$

$$\|\vec{r}'\left(\frac{\pi}{2}\right)\| = \sqrt{(-3)^2} = \sqrt{9} = 3$$

$$\text{so } \vec{T}\left(\frac{\pi}{2}\right) = \frac{\vec{r}'\left(\frac{\pi}{2}\right)}{\|\vec{r}'\left(\frac{\pi}{2}\right)\|} = \frac{-3 \vec{i}}{3} = \begin{pmatrix} -1 \\ 0 \\ 0 \end{pmatrix}$$

$$\vec{N}\left(\frac{\pi}{2}\right) = \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix}$$

$$x = 3 \cos t \quad y = 3 \sin t$$

$$\frac{x}{3} = \cos t \quad \frac{y}{3} = \sin t$$

$$\frac{x^2}{9} = \cos^2 t \quad \frac{y^2}{9} = \sin^2 t$$

$$\frac{x^2}{9} + \frac{y^2}{9} = \cos^2 t + \sin^2 t$$

$$\frac{x^2}{9} + \frac{y^2}{9} = 1$$

$$x^2 + y^2 = 9$$

