

$$r = 1 + \cos \theta \Rightarrow x = r \cos \theta = \cos \theta (1 + \cos \theta), \quad y = r \sin \theta = \sin \theta (1 + \cos \theta) \Rightarrow$$

$$\frac{dy}{d\theta} = (1 + \cos \theta) \cos \theta - \sin^2 \theta = 2 \cos^2 \theta + \cos \theta - 1$$

$$= (2 \cos \theta - 1)(\cos \theta + 1) = 0 \Rightarrow \cos \theta = \frac{1}{2} \text{ or } -1 \Rightarrow$$

$$\theta = \frac{\pi}{3}, \pi, \text{ or } \frac{5\pi}{3} \Rightarrow \text{horizontal tangent at } \left(\frac{3}{2}, \frac{\pi}{3}\right), (0, \pi), \text{ and } \left(\frac{3}{2}, \frac{5\pi}{3}\right).$$

$$\frac{dx}{d\theta} = -(1 + \cos \theta) \sin \theta - \cos \theta \sin \theta = -\sin \theta (1 + 2 \cos \theta) = 0 \Rightarrow \sin \theta = 0$$

$$\text{or } \cos \theta = -\frac{1}{2} \Rightarrow$$

$$\theta = 0, \pi, \frac{2\pi}{3}, \text{ or } \frac{4\pi}{3} \Rightarrow \text{vertical tangent at } (2, 0), \left(\frac{1}{2}, \frac{2\pi}{3}\right), \text{ and } \left(\frac{1}{2}, \frac{4\pi}{3}\right).$$

Note that the tangent is horizontal, not vertical when $\theta = \pi$, since $\lim_{\theta \rightarrow \pi} \frac{dy/d\theta}{dx/d\theta} =$

0.