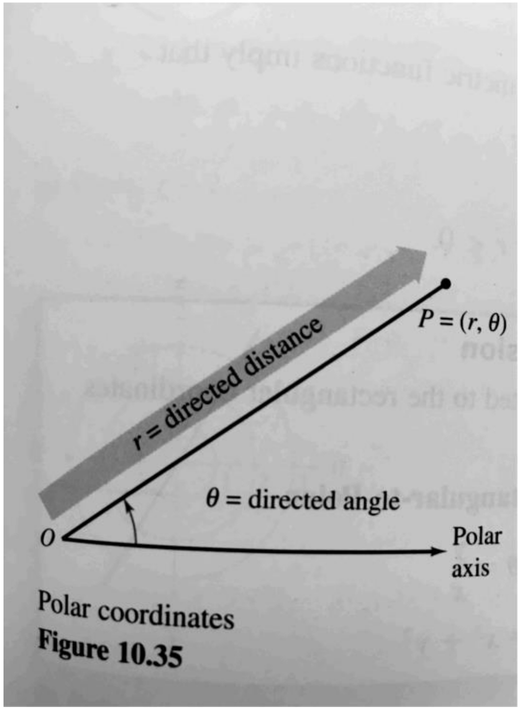
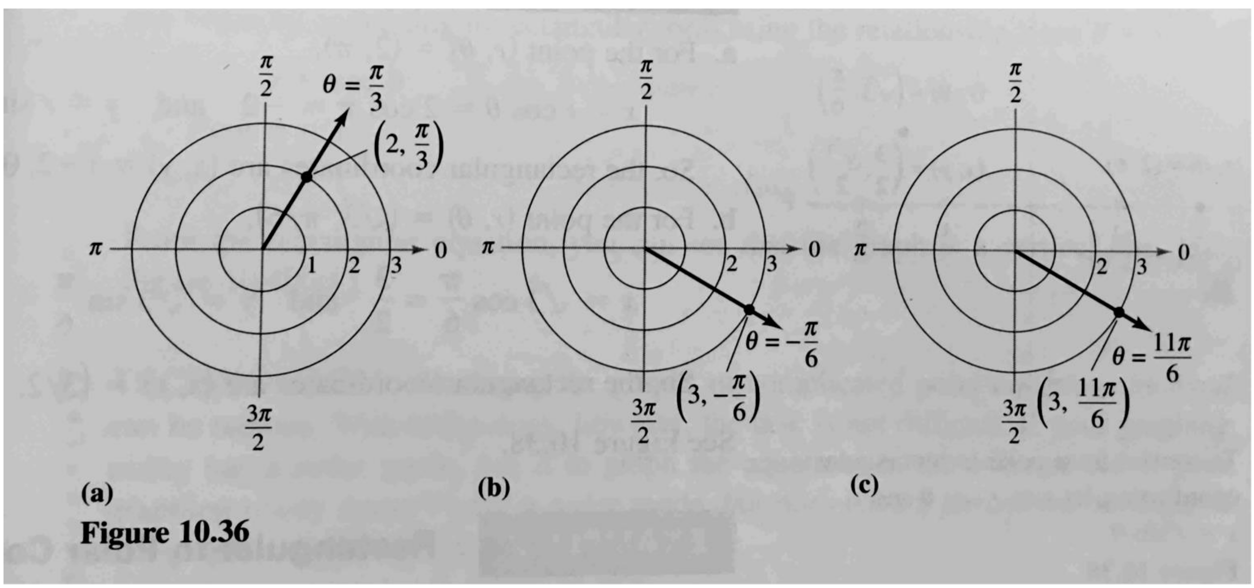


Polar coordinates
Figure 10.35



(a) (b) (c)
Figure 10.36

THEOREM 10.10 Coordinate Conversion

The polar coordinates (r, θ) of a point are related to the rectangular coordinates (x, y) of the point as follows.

Polar-to-Rectangular	**Rectangular-to-Polar**
$x = r\cos\theta$	$\tan\theta = \frac{y}{x}$
$y = r\sin\theta$	$r^2 = x^2 + y^2$

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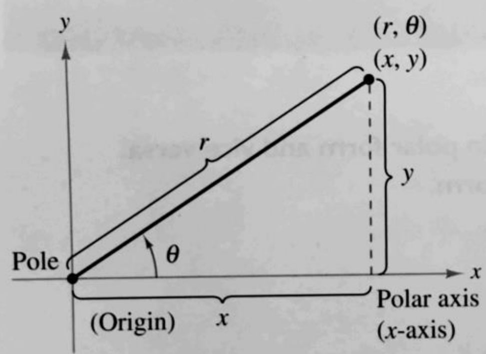
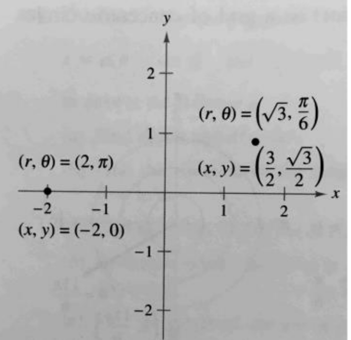


Relating polar and rectangular coordinates
Figure 10.37

EXAMPLE 1 Polar-to-Rectangular Conversion

a. For the point $(r, \theta) = (2, \pi)$,

b. For the point $(r, \theta) = \left(\sqrt{3}, \pi/6\right)$,



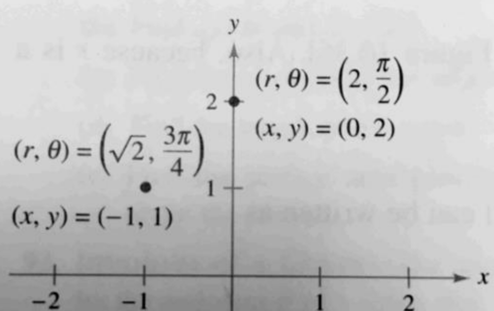
To convert from polar to rectangular coordinates, let $x = r\cos\theta$ and $y = r\sin\theta$.

Figure 10.38

EXAMPLE 2 **Rectangular-to-Polar Conversion**

a. For the second-quadrant point $(x, y) = (-1, 1)$,

Figure 10.38



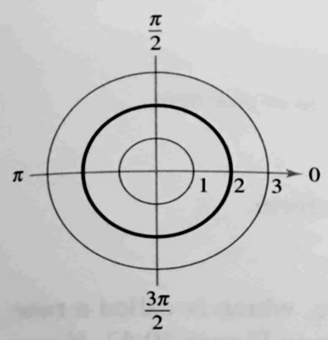
To convert from rectangular to polar coordinates, let $\tan\theta = y/x$ and $r = \sqrt{x^2 + y^2}$.

Figure 10.39

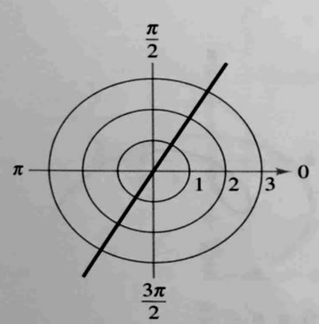
EXAMPLE 3 **Graphing Polar Equations**

Describe the graph of each polar equation. Confirm each description by converting to a rectangular equation.

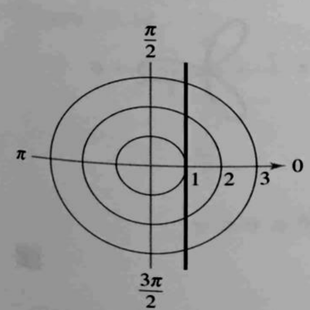
a. $r = 2$ **b.** $\theta = \frac{\pi}{3}$ **c.** $r = \sec\theta$



(a) Circle: $r = 2$



(b) Radial line: $\theta = \frac{\pi}{3}$



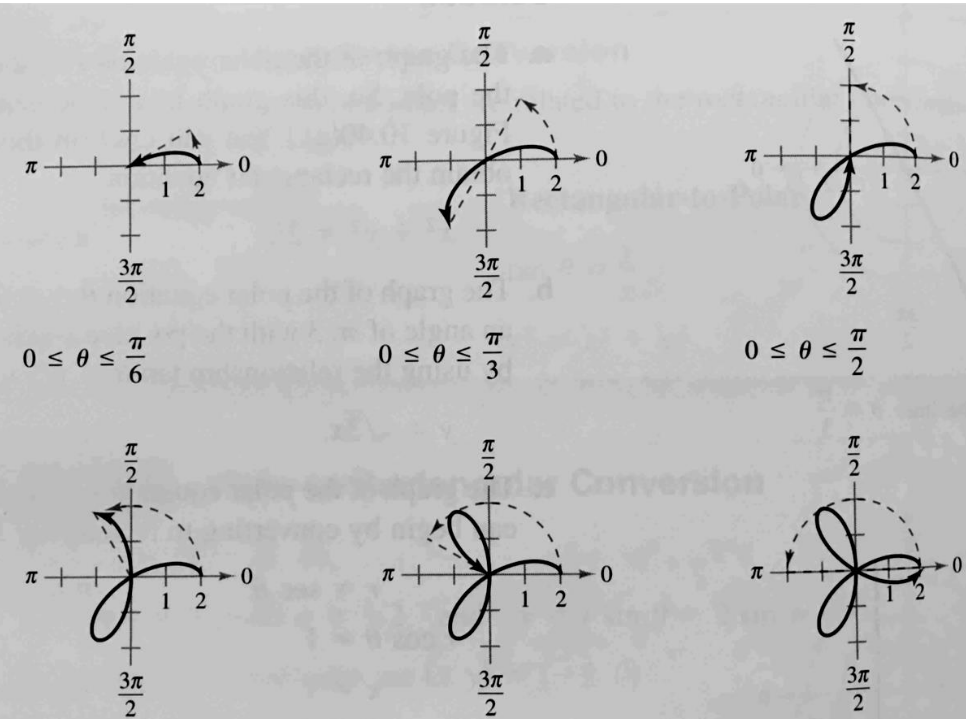
(c) Vertical line: $r = \sec\theta$

Figure 10.40

EXAMPLE 4 **Sketching a Polar Graph**

See LarsonCalculus.com for an interactive version of this type of example.

Sketch the graph of $r = 2\cos 3\theta$.

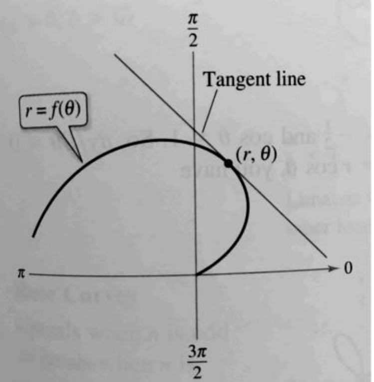


THEOREM 10.11 Slope in Polar Form

If f is a differentiable function of θ, then the *slope* of the tangent line to the graph of $r = f(\theta)$ at the point (r, θ) is

$$\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{f(\theta)\cos\theta + f'(\theta)\sin\theta}{-f(\theta)\sin\theta + f'(\theta)\cos\theta}$$

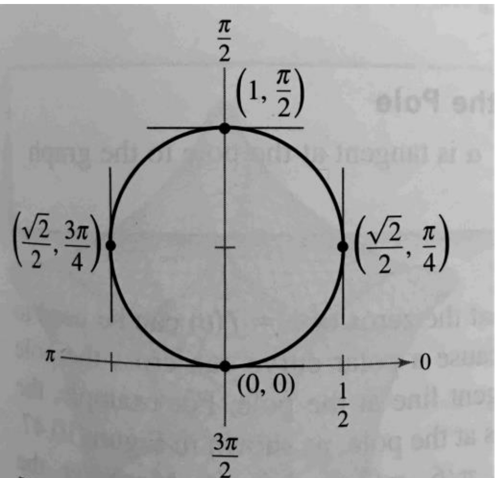
provided that $dx/d\theta \neq 0$ at (r, θ). (See Figure 10.44.)



Tangent line to polar curve
Figure 10.44

EXAMPLE 5 Finding Horizontal and Vertical Tangent Lines

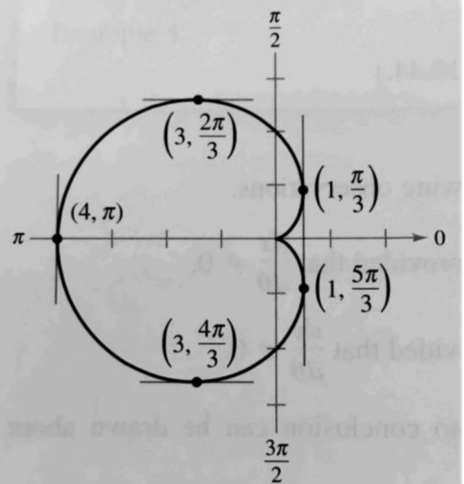
Find the horizontal and vertical tangent lines of $r = \sin\theta$, $0 \le \theta \le \pi$.



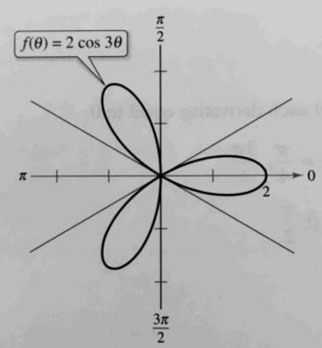
Horizontal and vertical tangent lines of $r = \sin\theta$
Figure 10.45

EXAMPLE 6 **Finding Horizontal and Vertical Tangent Lines**

Find the horizontal and vertical tangents to the graph of $r = 2(1 - \cos\theta)$.



Horizontal and vertical tangent lines of $r = 2(1 - \cos\theta)$
Figure 10.46



This rose curve has three tangent lines ($\theta = \pi/6$, $\theta = \pi/2$, and $\theta = 5\pi/6$) at the pole.

Figure 10.47