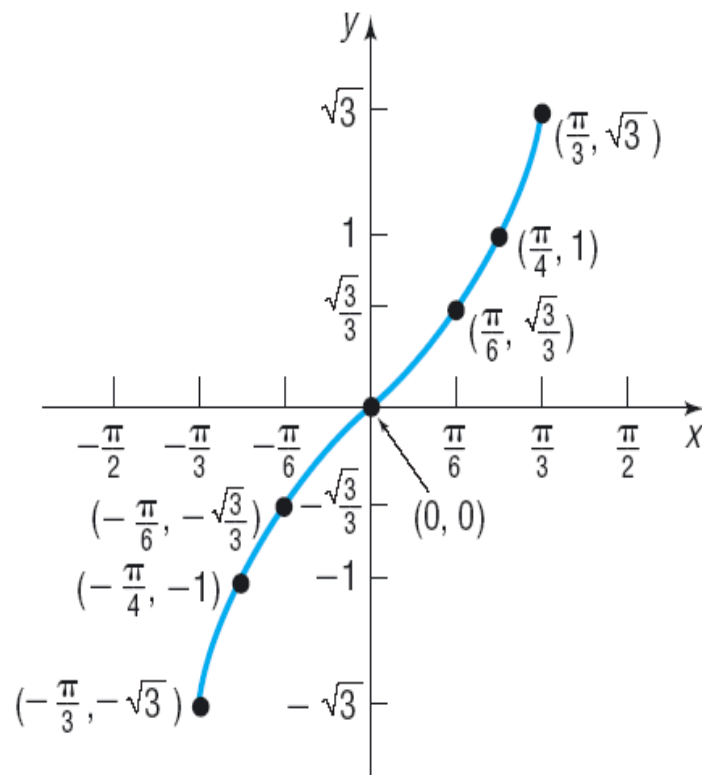


Section 7.7

Graphs of the Tangent, Cotangent, Cosecant, and Secant Functions

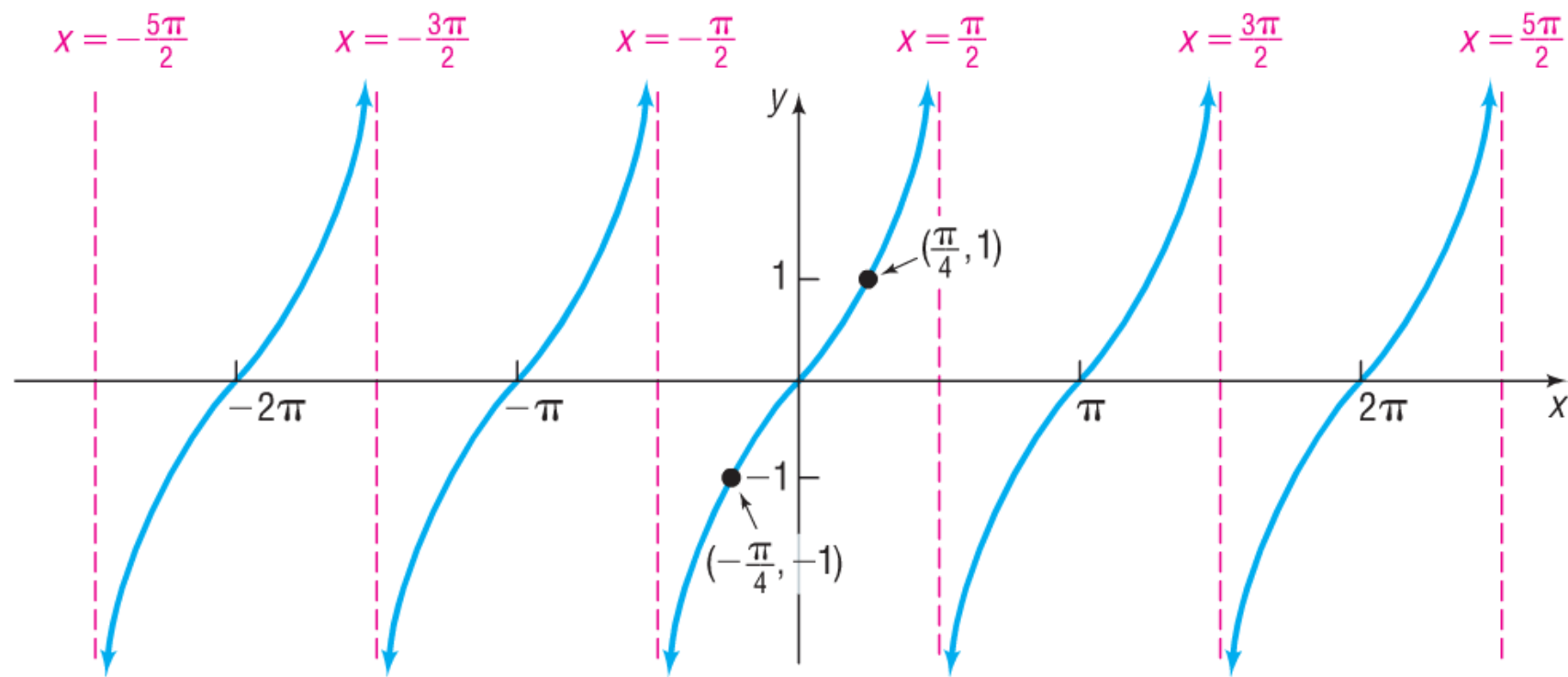
The Graph of the Tangent Function

| x | $y = \tan x$ | (x, y) |
|------------------|-------------------------------------|---|
| $-\frac{\pi}{3}$ | $-\sqrt{3} \approx -1.73$ | $(-\frac{\pi}{3}, -\sqrt{3})$ |
| $-\frac{\pi}{4}$ | -1 | $(-\frac{\pi}{4}, -1)$ |
| $-\frac{\pi}{6}$ | $-\frac{\sqrt{3}}{3} \approx -0.58$ | $(-\frac{\pi}{6}, -\frac{\sqrt{3}}{3})$ |
| 0 | 0 | $(0, 0)$ |
| $\frac{\pi}{6}$ | $\frac{\sqrt{3}}{3} \approx 0.58$ | $(\frac{\pi}{6}, \frac{\sqrt{3}}{3})$ |
| $\frac{\pi}{4}$ | 1 | $(\frac{\pi}{4}, 1)$ |
| $\frac{\pi}{3}$ | $\sqrt{3} \approx 1.73$ | $(\frac{\pi}{3}, \sqrt{3})$ |



$$\tan x = \frac{\sin x}{\cos x}$$

| x | $\sin x$ | $\cos x$ | $y = \tan x$ |
|--------------------------------|----------------------|-----------------------|-------------------------|
| $\frac{\pi}{3} \approx 1.05$ | $\frac{\sqrt{3}}{2}$ | $\frac{1}{2}$ | $\sqrt{3} \approx 1.73$ |
| 1.5 | 0.9975 | 0.0707 | 14.1 |
| 1.57 | 0.9999 | 7.96×10^{-4} | 1255.8 |
| 1.5707 | 0.9999 | 9.6×10^{-5} | 10,381 |
| $\frac{\pi}{2} \approx 1.5708$ | 1 | 0 | Undefined |



$$y = \tan x, -\infty < x < \infty, x \text{ not equal to odd multiples of } \frac{\pi}{2}$$

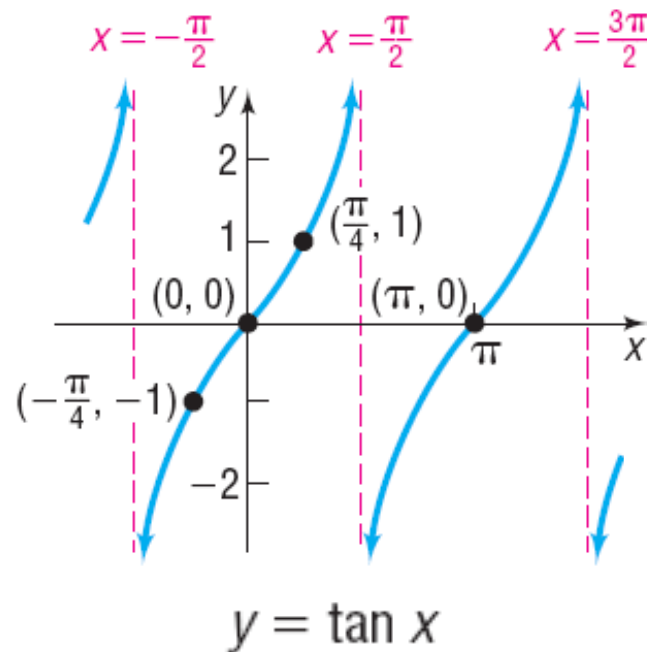
Properties of the Tangent Function

1. The domain is the set of all real numbers, except odd multiples of $\frac{\pi}{2}$.
2. The range is the set of all real numbers.
3. The tangent function is an odd function, as the symmetry of the graph with respect to the origin indicates.
4. The tangent function is periodic, with period π .
5. The x -intercepts are $\dots, -2\pi, -\pi, 0, \pi, 2\pi, 3\pi, \dots$; the y -intercept is 0.
6. Vertical asymptotes occur at $x = \dots, -\frac{3\pi}{2}, -\frac{\pi}{2}, \frac{\pi}{2}, \frac{3\pi}{2}, \dots$

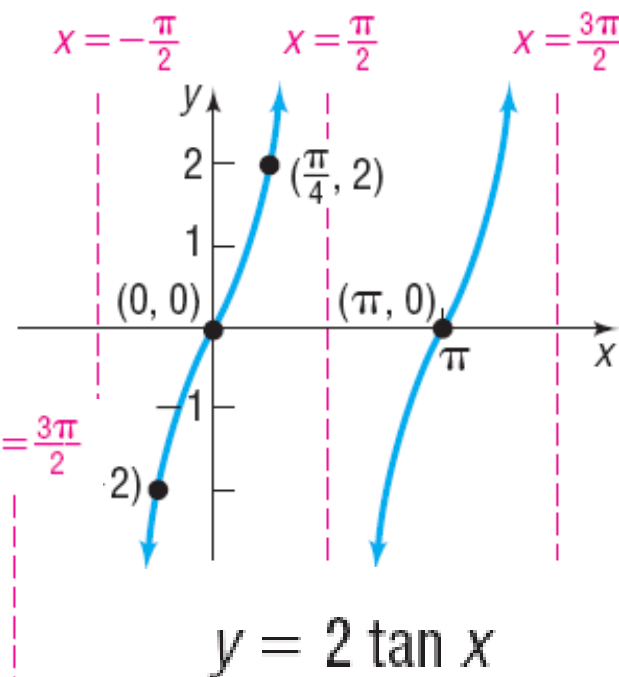
**✓ 1 Graph Functions of the Form $y = A \tan(\omega x) + B$
and $y = A \cot(\omega x) + B$**

EXAMPLE**Graphing Functions of the Form $y = A \tan(\omega x) + B$**

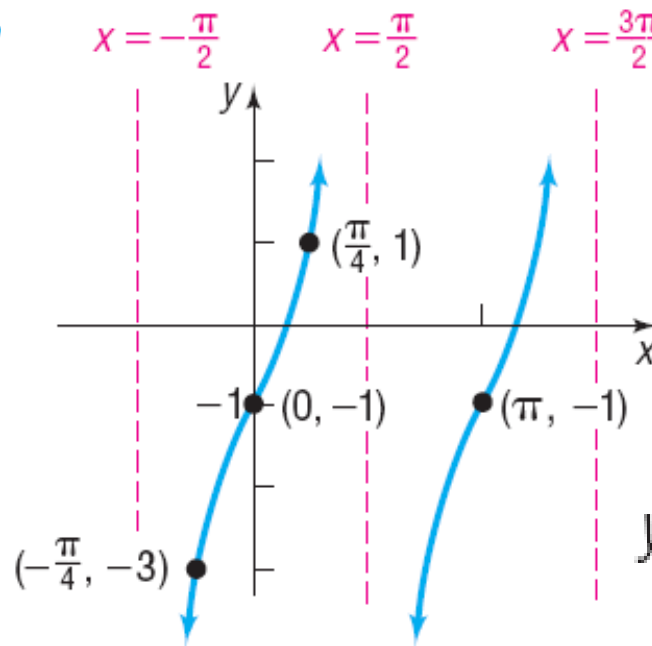
Graph: $y = 2 \tan x - 1$



Multiply by 2;
Vertical stretch
by a factor of 2



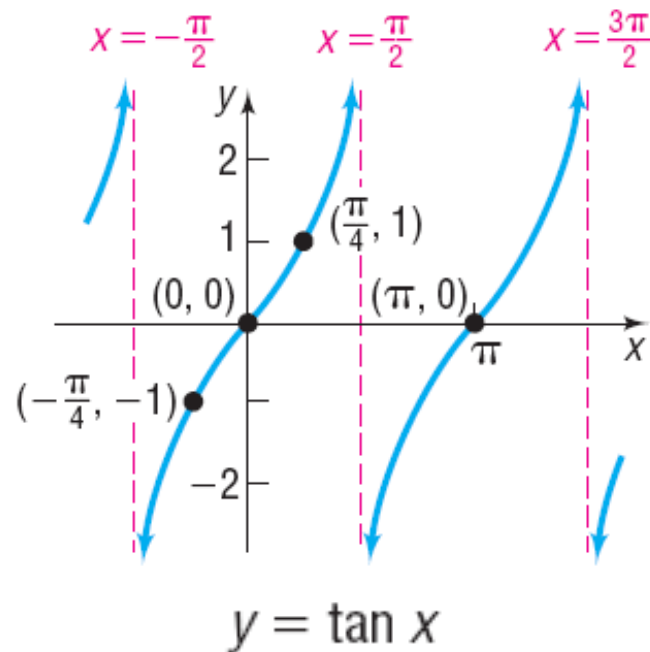
Subtract 1;
vertically shift
down one unit



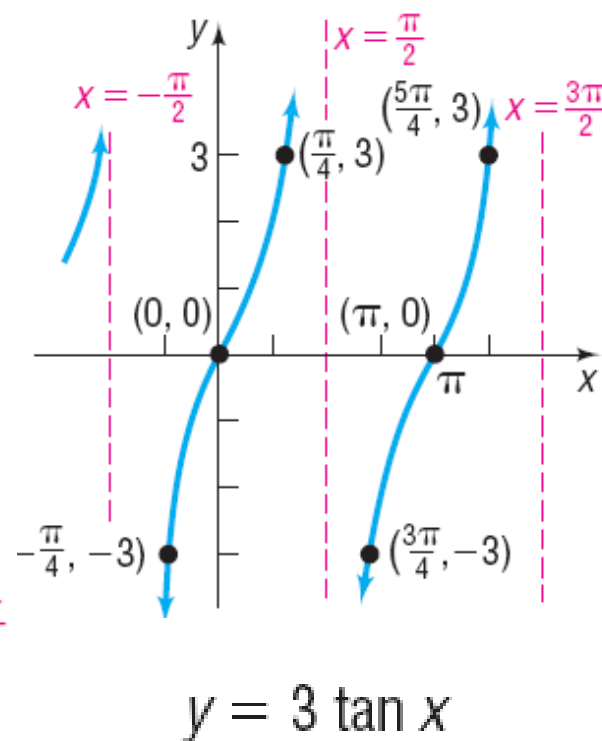
$$y = 2 \tan x - 1$$

EXAMPLE**Graphing Functions of the Form $y = A \tan(\omega x) + B$**

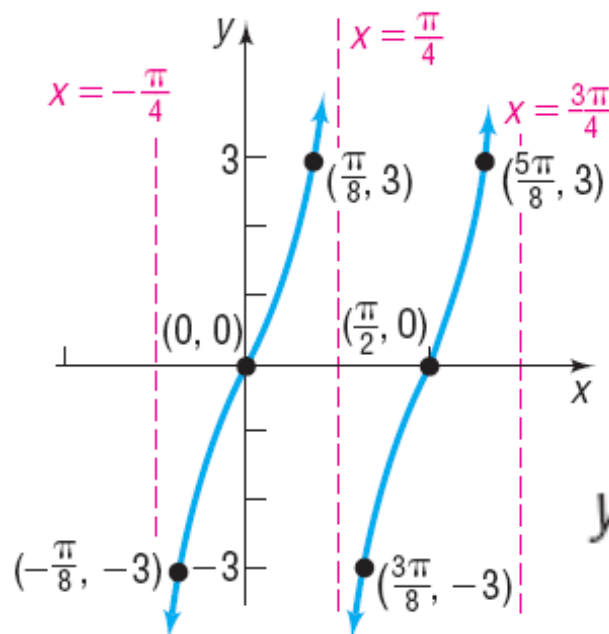
Graph: $y = 3 \tan(2x)$



Multiply by 3;
Vertical stretch by
a factor of 3



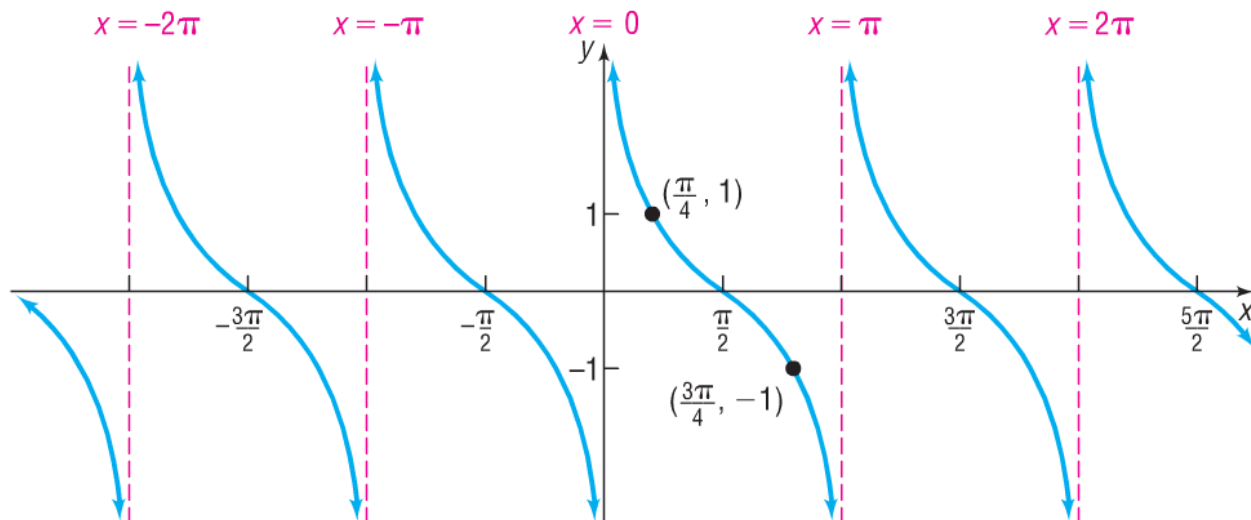
Replace x by $2x$;
Horizontal compression
by a factor of $\frac{1}{2}$



$$y = 3 \tan(2x)$$

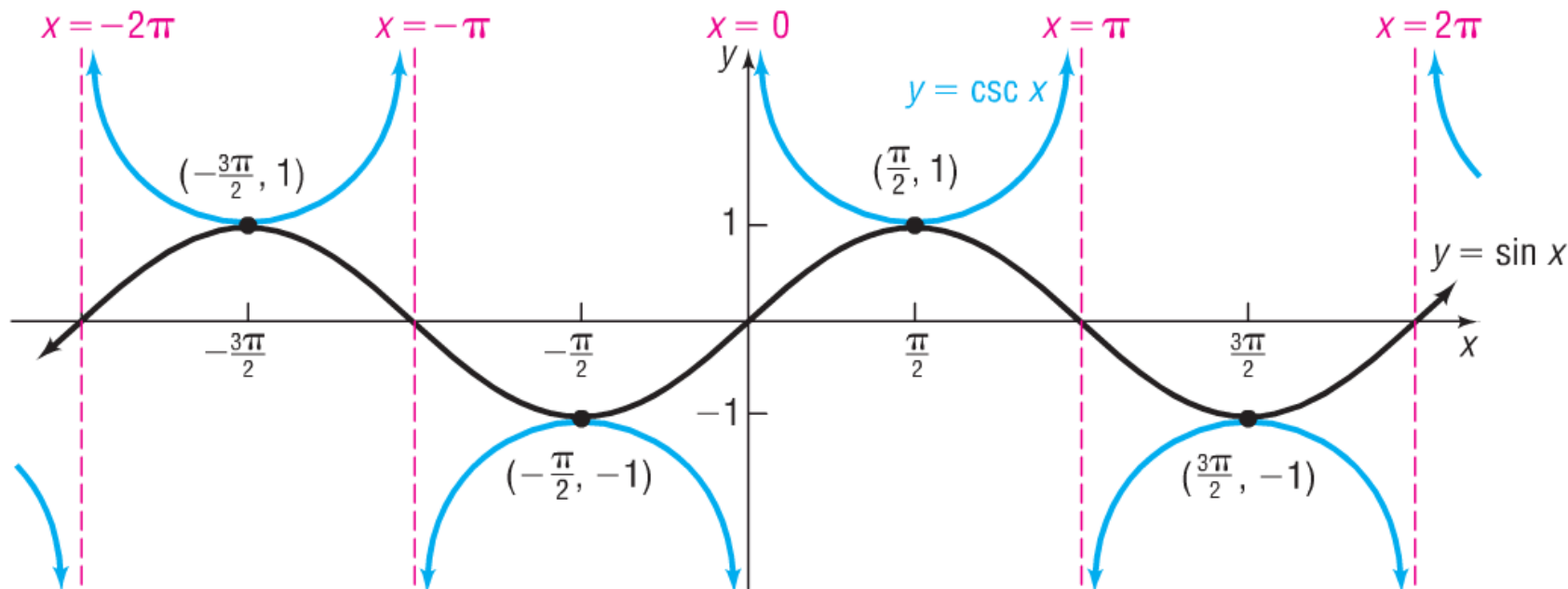
The Graph of the Cotangent Function

| x | $y = \cot x$ | (x, y) |
|------------------|-----------------------|---|
| $\frac{\pi}{6}$ | $\sqrt{3}$ | $(\frac{\pi}{6}, \sqrt{3})$ |
| $\frac{\pi}{4}$ | 1 | $(\frac{\pi}{4}, 1)$ |
| $\frac{\pi}{3}$ | $\frac{\sqrt{3}}{3}$ | $(\frac{\pi}{3}, \frac{\sqrt{3}}{3})$ |
| $\frac{\pi}{2}$ | 0 | $(\frac{\pi}{2}, 0)$ |
| $\frac{2\pi}{3}$ | $-\frac{\sqrt{3}}{3}$ | $(\frac{2\pi}{3}, -\frac{\sqrt{3}}{3})$ |
| $\frac{3\pi}{4}$ | -1 | $(\frac{3\pi}{4}, -1)$ |
| $\frac{5\pi}{6}$ | $-\sqrt{3}$ | $(\frac{5\pi}{6}, -\sqrt{3})$ |



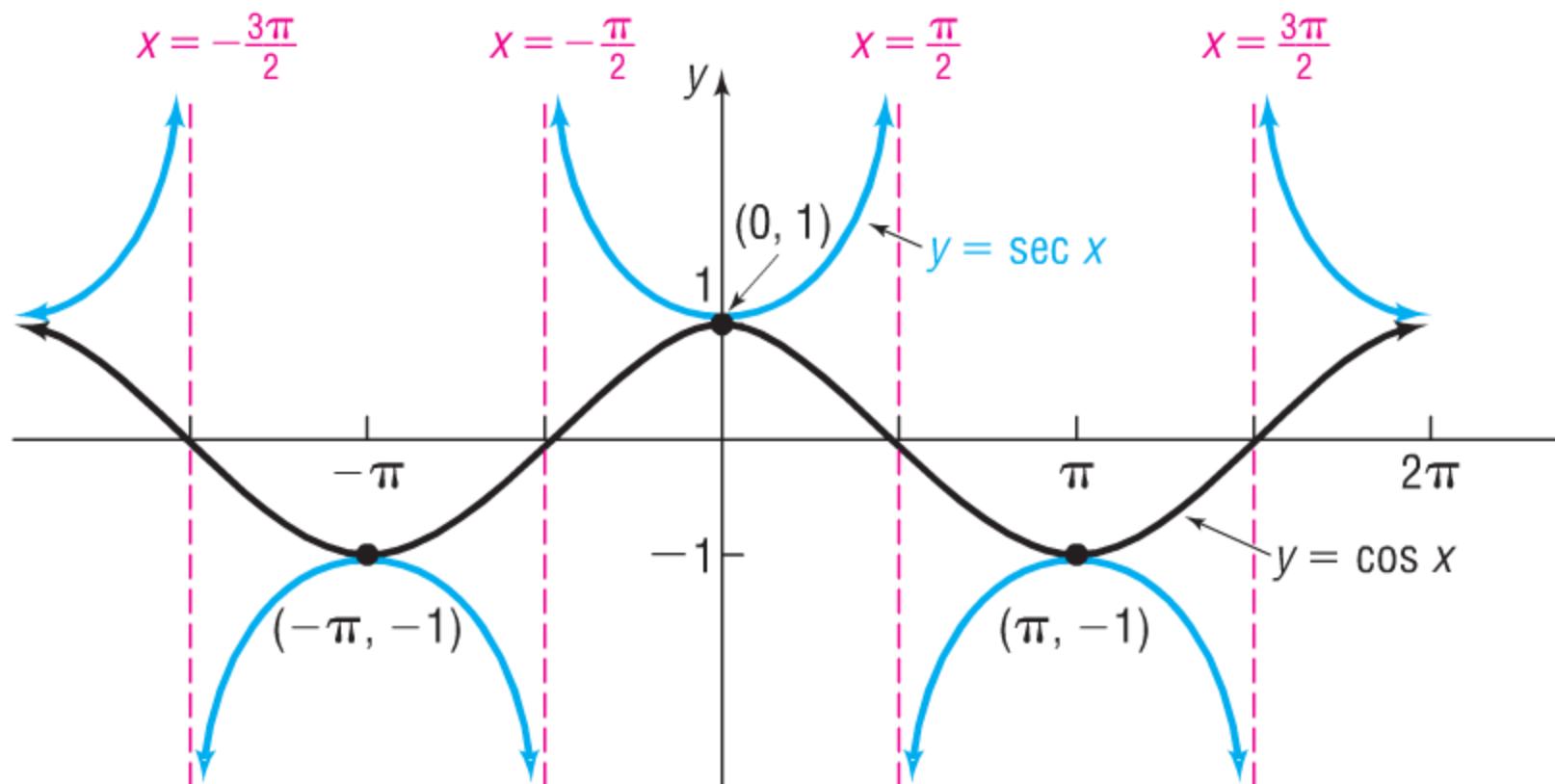
$y = \cot x, -\infty < x < \infty, x$ not equal
to integer multiples of π ,
 $-\infty < y < \infty$

The Graph of the Cosecant Function



$y = \csc x, -\infty < x < \infty, x$ not equal to integer multiples of $\pi, |y| \geq 1$

The Graph of the Secant Function



$$y = \sec x, -\infty < x < \infty, x \text{ not equal}$$

$$\text{to odd multiples of } \frac{\pi}{2}, |y| \geq 1$$

✓ 2 Graph Functions of the Form $y = A \csc(\omega x) + B$ and $y = A \sec(\omega x) + B$

EXAMPLE

Graphing Functions of the Form $y = A \csc(\omega x) + B$

Graph: $y = 2 \csc x - 1$

