

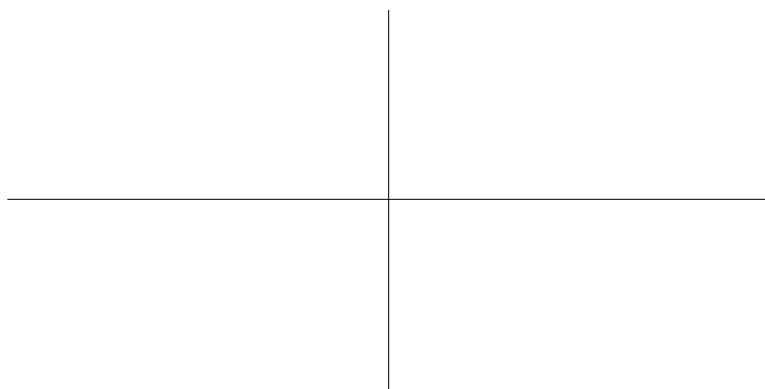
## 5.3b More Graphing Sine and Cosine Functions

**Objectives:** (1) Use transformations to shift sinusoidal functions horizontally and vertically, (2) find sinusoidal functions to model real world applications.

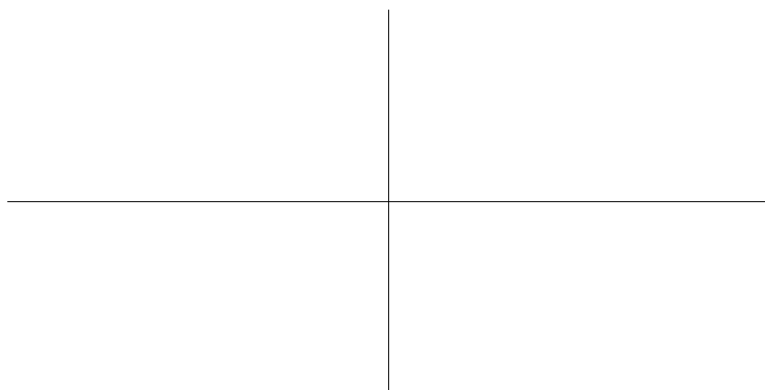
💡 Recall from previous chapters the two transformations: (1) horizontal shifts:  $y = f(x - c)$ , and (2) vertical shifts  $y = f(x) + d$ . We can apply these to the trigonometric functions.

**Example 1** Find the amplitude, phase shift, and period for the sinusoidal function  $f(x) = 15 \sin(0.2x - 1) + 20$ , and graph.

**Example 2** Make an accurate sketch of the  $f(x) = 20 \cos\left(\frac{\pi}{12}x - \frac{\pi}{4}\right) + 15$ . (Also, can you shift this to make it an equivalent sine function?)



**Example 3** Graph the function  $y = -3 \cos\left(-2x + \frac{\pi}{2}\right)$ . Find the amplitude, period, and phase shift. Be sure to label key points.



**Example 4** A Ferris wheel has a diameter of 120 feet and its lowest point is 8 feet off the ground. If each revolution takes 140 seconds, and a person enters the Ferris wheel at the point  $(0, 8)$ , (a) find a sinusoidal function for any time  $t$ , (b) find the location of the person after 4 minutes, and (c) is the person going up or going down?

**Example 5** Use your calculator to graph the functions  $f(x) = \frac{x^2}{8} \sin(x)$ ,  $g(x) = \frac{x^2}{8}$ , and  $h(x) = \frac{-x^2}{8}$ .

**Example 6** Make a sketch of the function  $f(x) = 3 e^{0.2x} \cos(2x)$ .

**Example 7** Find the maximum and minimum values on the interval  $[0, 2\pi)$  for  $f(x) = x - 2x \cos(x)$