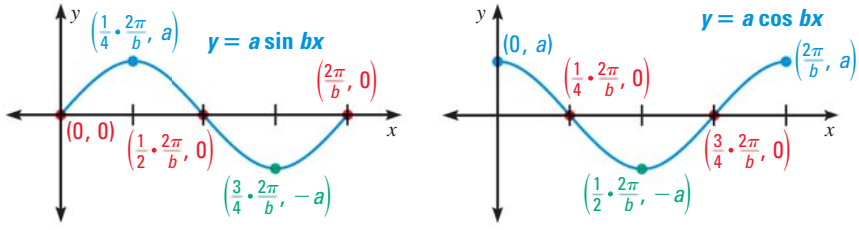
KEY CONCEPT *For Your Notebook*

Amplitude and Period

The amplitude and period of the graphs of $y = a \sin bx$ and $y = a \cos bx$, where a and b are nonzero real numbers, are as follows:

$$\text{Amplitude} = |a| \qquad \text{Period} = \frac{2\pi}{|b|}$$

GRAPHING KEY POINTS Each graph below shows five key x-values on the interval $0 \le x \le \frac{2\pi}{b}$ that you can use to sketch the graphs of $y = a \sin bx$ and $y = a \cos bx$ for $a > 0$ and $b > 0$. These are the x-values where the **maximum** and **minimum** values occur and the ***x*-intercepts**.



EXAMPLE 1 Graph sine and cosine functions

Graph (a) $y = 4 \sin x$ and (b) $y = \cos 4x$.

VARY CONSTANTS
Notice how changes in a and b affect the graphs of $y = a \sin bx$ and $y = a \cos bx$. When the value of a increases, the amplitude increases. When the value of b increases, the period decreases.

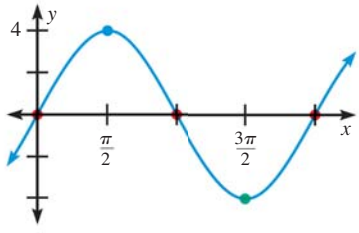
Solution

a. The amplitude is $a = 4$ and the period is $\frac{2\pi}{b} = \frac{2\pi}{1} = 2\pi$.

Intercepts: $(0, 0)$; $\left(\frac{1}{2} \cdot 2\pi, 0\right) = (\pi, 0)$; $(2\pi, 0)$

Maximum: $\left(\frac{1}{4} \cdot 2\pi, 4\right) = \left(\frac{\pi}{2}, 4\right)$

Minimum: $\left(\frac{3}{4} \cdot 2\pi, -4\right) = \left(\frac{3\pi}{2}, -4\right)$

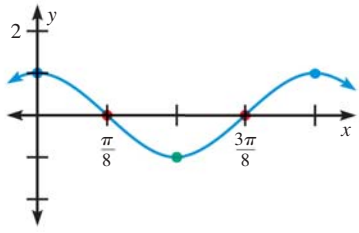


b. The amplitude is $a = 1$ and the period is $\frac{2\pi}{b} = \frac{2\pi}{4} = \frac{\pi}{2}$.

Intercepts: $\left(\frac{1}{4} \cdot \frac{\pi}{2}, 0\right) = \left(\frac{\pi}{8}, 0\right)$; $\left(\frac{3}{4} \cdot \frac{\pi}{2}, 0\right) = \left(\frac{3\pi}{8}, 0\right)$

Maximums: $(0, 1)$; $\left(\frac{\pi}{2}, 1\right)$

Minimum: $\left(\frac{1}{2} \cdot \frac{\pi}{2}, -1\right) = \left(\frac{\pi}{4}, -1\right)$



GUIDED PRACTICE for Example 1

Graph the function.

1. $y = 2 \cos x$ **2.** $y = 5 \sin x$ **3.** $f(x) = \sin \pi x$ **4.** $g(x) = \cos 4\pi x$