

EXAMPLE 2 Graph a horizontal translation

Graph $y = 5 \cos 2(x - 3\pi)$.

Solution

STEP 1 Identify the amplitude, period, horizontal shift, and vertical shift.

Amplitude: $a = 5$ Horizontal shift: $h = 3\pi$

Period: $\frac{2\pi}{b} = \frac{2\pi}{2} = \pi$ Vertical shift: $k = 0$

STEP 2 Draw the midline of the graph. Because $k = 0$, the midline is the x -axis.

STEP 3 Find the five key points.

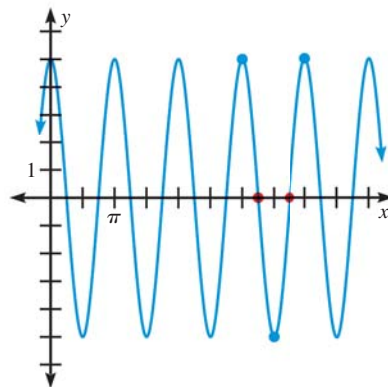
On $y = k$: $(\frac{\pi}{4} + 3\pi, 0) = (\frac{13\pi}{4}, 0)$;

$(\frac{3\pi}{4} + 3\pi, 0) = (\frac{15\pi}{4}, 0)$

Maximums: $(0 + 3\pi, 5) = (3\pi, 5)$;
 $(\pi + 3\pi, 5) = (4\pi, 5)$

Minimum: $(\frac{\pi}{2} + 3\pi, -5) = (\frac{7\pi}{2}, -5)$

STEP 4 Draw the graph through the key points.



FIND KEY POINTS

Because the graph is shifted to the right 3π units, the x -coordinates of the five key points will be increased by 3π .

EXAMPLE 3 Graph a model for circular motion

FERRIS WHEEL Suppose you are riding a Ferris wheel that turns for 180 seconds. Your height h (in feet) above the ground at any time t (in seconds) can be modeled by the equation $h = 85 \sin \frac{\pi}{20}(t - 10) + 90$.

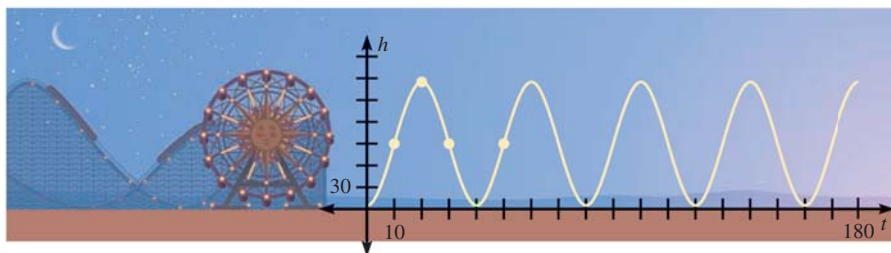
- Graph your height above the ground as a function of time.
- What are your maximum and minimum heights?

Solution

a. The amplitude is 85 and the period is $\frac{2\pi}{\frac{\pi}{20}} = 40$. The wheel turns

$\frac{180}{40} = 4.5$ times in 180 seconds, so the graph below shows 4.5 cycles.

The five key points are $(10, 90)$, $(20, 175)$, $(30, 90)$, $(40, 5)$, and $(50, 90)$.



- Your maximum height is $90 + 85 = 175$ feet and your minimum height is $90 - 85 = 5$ feet.