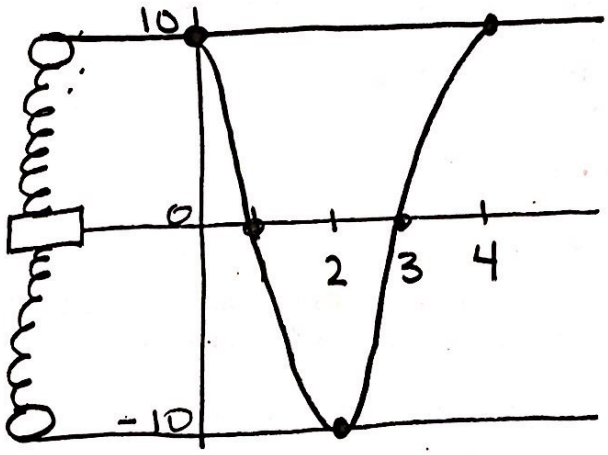
Example 1 Consider a ball that is bobbing up and down on the end of a spring. Suppose that 10 cm is the maximum distance that the ball moves vertically upward or downward from its equilibrium (at rest) position. Suppose further that the time it takes for the ball to move from its maximum displacement above zero to its maximum displacement below zero and back again is $t = 4$ seconds.

1. Find the period of the spring/ball's motion.
2. Determine the amplitude.
3. Find the frequency (cycles per second)
4. Write an equation for the height of the ball above/below the "at-rest" position of $y=0$.

$y = a\sin b(x-h)+k$
$y = a\cos b(x-h)+k$



① Period: 4 sec

② Amp: 10

③ Freq: $\frac{1 \text{ cyc}}{4 \text{ sec}}$

④ $y = 10\cos\frac{\pi}{2}(x)$

$b = \frac{2\pi}{\text{Period}} = \frac{2\pi}{4} = \frac{\pi}{2}$

Example 2 Suppose that the waterwheel in the figure rotates at 6 revolutions per minute (rpm). Two seconds after you start a stopwatch, point P on the rim of the wheel is at its greatest height, $d = 13$ ft, above the surface of the water. The center of the waterwheel is 6 ft above the surface.

1. Sketch a graph based on the information given
   ~~a. Determine the first maximum, minimum, or zero~~
   b. Determine the period of the function
   ~~c. Determine the final max/min/zero of the period~~
   d. Use the "pattern" to sketch the graph

$\frac{6 \text{ rev}}{1 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}} = \frac{6 \text{ rev}}{60 \text{ sec}} = \frac{1 \text{ rev}}{10 \text{ sec}}$

b. Period: 10 sec

2. Write the equation of the function
   a. Find amplitude (and reflection, if any)
   b. Find b using the period
   c. Find h using the initial max/min/zero
   d. Find the vertical shift using the max and min

2a) Amp: $13-6=7$

2b) $b = \frac{2\pi}{\text{per}} = \frac{2\pi}{10} = \frac{\pi}{5}$

2c) Right 2

2d) up 6

$y = 7\cos\frac{\pi}{5}(x-2)+6$