## Sinusoidal Applications

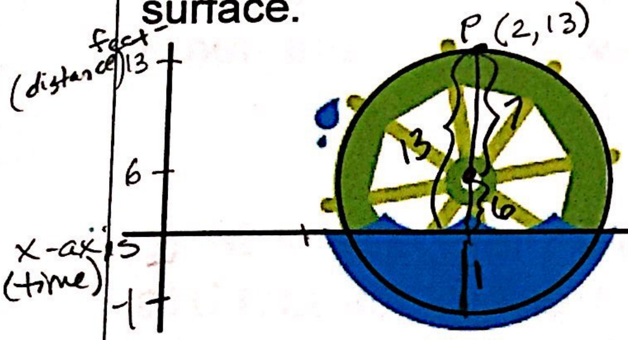
Suppose that a waterwheel rotates at 6 revolutions per minute (rev/min). 2 seconds after you start a stopwatch, point P on the rim of the wheel is at its greatest height, d = 13 feet, above the surface of the water. The center of the waterwheel is 6 ft above the surface.

How much is 1 revolution?

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

1 revolution = 10 seconds

↳ 1 period




a) Sketch the graph of *d* as a function of time *t*, in seconds, since you started the stopwatch.

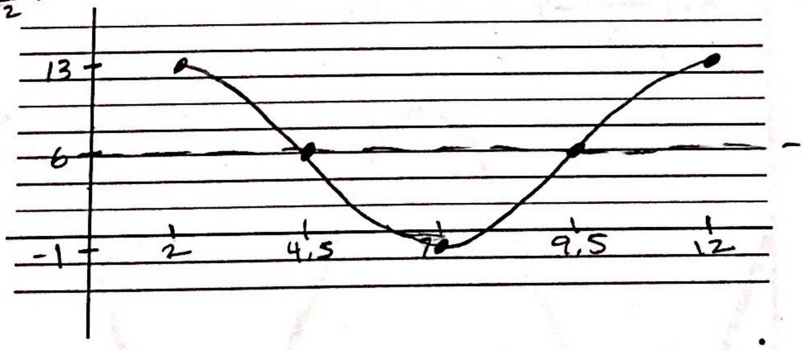
amp: $\frac{max - min}{2} = \frac{13 - -1}{2} = 7$

Period = 10

$b = \frac{2\pi}{10} = \frac{\pi}{5}$

$VS = \frac{max + min}{2}$

$\frac{13 + -1}{2} = 6$




stick marks

$\frac{12+2}{2} = \frac{14}{2} = 7$

$\frac{7+2}{2} = \frac{9}{2} = 4.5$

$\frac{7+12}{2} = \frac{19}{2} = 9.5$

b) Write an equation to model *d* as a sinusodial function of *t*.

Use cosine & radians

$y = a \cos b(x - c) + d$

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

*graphing calc. in radians & check the window

c) How high above or $\boxed{\text{below}}$ the water's surface will point P be at time $t$ = 17.5 seconds? At that time, will it be going up or down? Enter Equation (Correct window if necessary)

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

2nd Calc → value

$X = 17.5$ $\boxed{Y = -.66}$

d) At what positive time $t$ was point P first emerging from the water? Look for zero or root using calculator.

2nd Calc → zero (root)

LB
RB
guess
} Y = 0

$\boxed{x = 7.86 \text{ seconds}}$

e) At what positive time $t$ was point P first at 6 feet above the water?

Given a Y value, find x

Graph y=6 (Horizontal Line) then 2nd Calc → intersect.

Put cursor close to area (Enter, Enter, Enter)

$\boxed{x = 4.5 \text{ seconds}}$