Name _____ **Date** _____

Guided Practice - Word Problems for Sine and Cosine

Predator and Prey

In the wild, predators such as wolves need prey such as sheep to survive. The population of the wolves and the sheep are cyclic in nature.

If there are more sheep, more wolves can survive. But as more wolves exist, more sheep are eaten, thus the sheep population goes down. This causes the wolf population to also go down. But as few wolves exist, the sheep can start growing again. And thus…a cycle.

d a b

Suppose the population of the wolves W is modeled by $W(m) = 3000 + 1000 \sin(\frac{\pi}{6} \cdot m)$ and population of the sheep S is modeled by $S(m) = 10,000 + 5000 \cos(\frac{\pi}{6} \cdot m)$ where m is the time in months.

$P = \frac{2\pi}{b}$

a. Describe the transformation of the sine function to the Wolf Population *W(m)*.

Amplitude: $|1000| = 1,000$

Vertical Translation: up 3,000

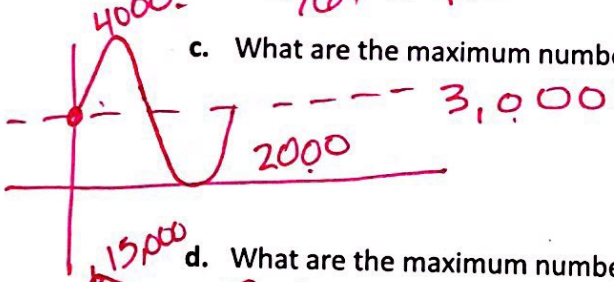
Period: $\frac{2\pi}{\pi/6} = \frac{2\pi}{1} \cdot \frac{6}{\pi} = 12$

b. Describe the transformation of the cosine function to the Sheep Population *S(m)*.

Amplitude: 5000

Vertical Translation: up 10,000

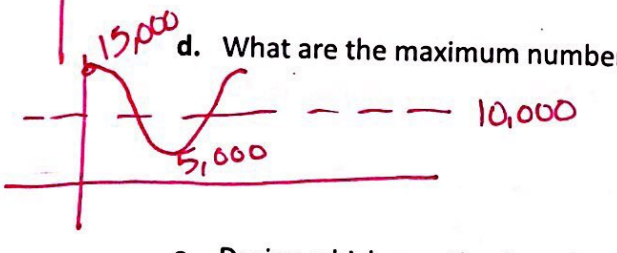
Period: $\frac{2\pi}{\pi/6} = 12$



c. What are the maximum number and minimum number of wolves?

$3000 + 1000 =$ 4000 max

$3000 - 1000 =$ 2000 min



d. What are the maximum number and minimum number of sheep?

$10,000 + 5000 =$ 15,000 max

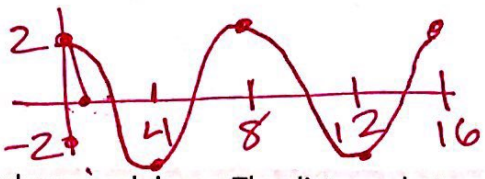
$10,000 - 5000 =$ 5,000 min

e. During which months does the wolf population reach a maximum? The sheep?

wolf → 3, 15, 27, …

sheep → 0, 12, 24, …

Bobbing Buoy



A buoy in the harbor of San Juan, Puerto Rico, bobs up and down. The distance between the highest and lowest point is 4 feet. It moves from its highest point down to its lowest point and back to its highest point every 8 seconds. period Cosine

a) Find the equation of the motion for the buoy assuming that it is at its equilibrium point at x=0 and the buoy is on its way down at that time.

$a=2 \quad 8=\frac{2\pi}{b} \rightarrow b=\frac{\pi}{4} \quad 8b=2\pi \quad y=2\cos\left(\frac{\pi}{4}x\right)$

b) Determine the height of the buoy at 2 seconds.

$y=2\cos\left(\frac{\pi}{4}\cdot 2\right)=$ **0 ft**

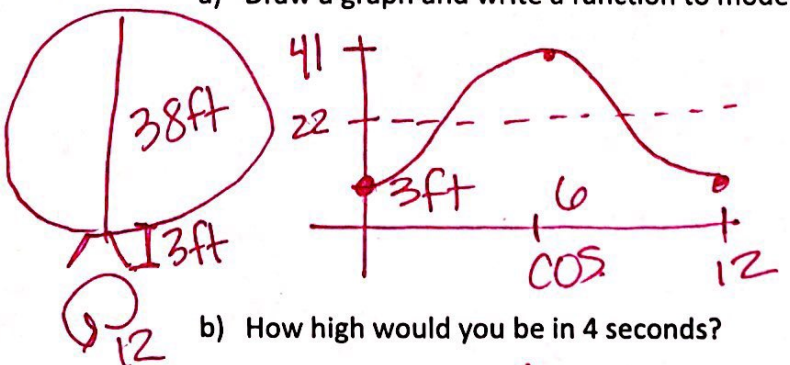
c) Determine the height of the buoy at 12 seconds.

$y=2\cos\left(\frac{\pi}{4}\cdot 12\right)=$ **-2ft**

Ferris Wheel

At the carnival you decide to ride the Ferris Wheel. The wheel is 3ft off of the ground and has a diameter of 38ft. Once loaded, the wheel makes a revolution every 12 seconds.

a) Draw a graph and write a function to model the Ferris Wheel



$\frac{38}{2}=19 \quad 19+3=22$

$y=-19\cos\frac{\pi}{6}x+22$

$12=\frac{2\pi}{b} \quad \frac{12b}{12}=\frac{2\pi}{12} \quad b=\frac{\pi}{6}$

b) How high would you be in 4 seconds?

$y=-19\cos\left(\frac{\pi}{6}\cdot 4\right)+22$

$y=31.5$ ft