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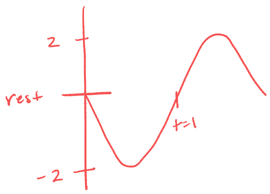
Algebra II Advanced 2022 - 2023

Carrier: ______
Contreras/Fogler/Gao/Gaston/Sakach/Trujillo

Extra Trig Modeling Practice

1. A mass suspended from a spring is pulled down a distance of 2 feet from its rest position. The mass is released at time $t = 0$ and allowed to oscillate. If the mass returns to this position after 1 second, find an equation that describes its motion then find the first time the mass is at a height of 1 foot above its rest position.



period = 2
$b=\pi$

$\boxed{y = -2\sin(\pi t)}$

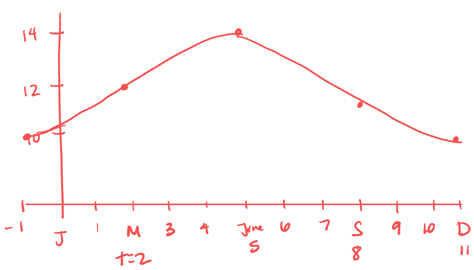
$1 = -2\sin(\pi t)$

$-\frac{1}{2} = \sin(\pi t)$

$\frac{7\pi}{6} = \pi t$

$\boxed{t = 7/6 \text{ sec}}$

2. A city averages 14 hours of daylight in June, 10 in December, and 12 in both March and September. Assume that the number of hours of daylight varies sinusoidally over a period of one year. Write an equation $n(t)$ representing the number of hours of daylight, as a cosine function of t. Let t be in months and $t = 0$ correspond to the month of January. What is the average amount of daylight hours in August?



per = 12
$b = \pi/6$

$\boxed{n(t) = 2\sin(\pi/6(t-2))+12}$

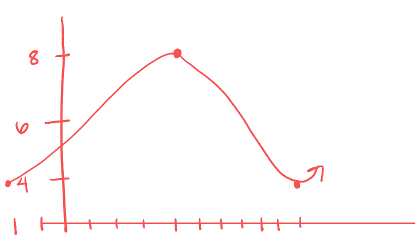
August: t=7

$n(7) = 2\sin(\pi/6(7-2))+12$

$= 2\sin(5\pi/6)+12$

$= \boxed{13 \text{ hours}}$

3. The average depth of water at the end of a dock is 6 feet. This varies 2 feet in both directions with the tide. Suppose there is a high tide at 4 AM. If the tide goes from low to high every 6 hours, write a sine function $d(t)$ describing the depth of the water as a function of time with $t = 4$ corresponding to 4 AM. At what time of day is the depth of water 4 feet for the first time?



per = 12
$b = \pi/6$

$\boxed{d(t) = -2\cos(\pi/6(t+2))+6}$

$4 = -2\cos(\pi/6(t+2))+6$

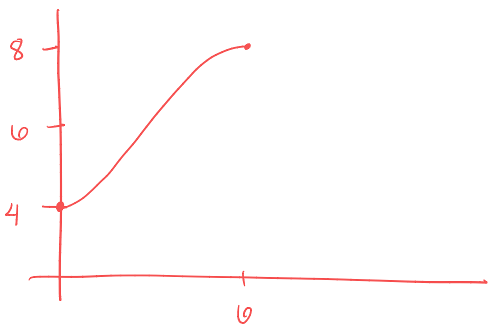
$1 = \cos(\pi/6(t+2))$

$0 = \pi/6(t+2)$

$t=-2 \longrightarrow \underset{\text{period}}{+12} \longrightarrow t=10$

$\boxed{10 \text{ am}}$

4. A cart is attached to a spring that is connected to a wall. The spring is compressed so that the cart is placed 4 feet away from the wall. The cart is then released, so that it rolls back and forth away from and towards the wall as the spring stretches and contracts. The distance from the cart to the wall varies sinusoidally with time. Suppose the distance between the cart and the wall varies between 4 feet and 8 feet, and that it takes 6 seconds for the cart to go from the point closest to the wall to the point that is farthest from the wall. Write an equation for a function that describes how far the cart is from the wall t seconds after it is released, then find how many seconds pass before the cart is exactly 7 feet from the wall for the first time.



per = 12
$b = \pi/6$

$$\boxed{y = -2\cos\left(\tfrac{\pi}{6}t\right) + 6}$$

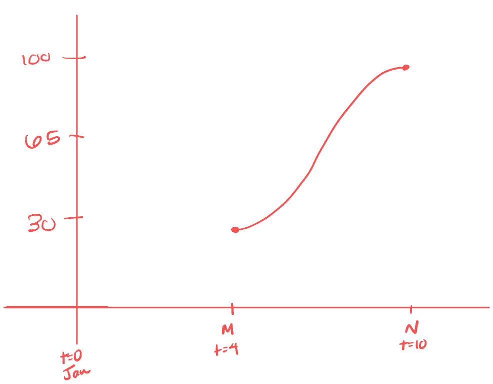
$$7 = -2\cos\left(\tfrac{\pi}{6}t\right) + 6$$

$$\frac{-1}{2} = \cos\left(\tfrac{\pi}{6}t\right)$$

$$\frac{2\pi}{3} = \frac{\pi}{6}t$$

$$\boxed{4 = t}$$

5. The monthly sales of a particular company varies sinusoidally with time over the year. The sales reach a peak in November, when the company sells 100,000 units of their product. The sales reach a low point in May, when the company only sells 30,000 units of their product. Write an equation for the number of units sold (in thousands) in terms of time (in months). Let $t = 0$ correspond to January. Then use your equation to determine the number of units sold in July.



per = 12
$b = \pi/6$

$$\boxed{y = -35\cos\left(\tfrac{\pi}{6}(t-4)\right) + 65}$$

$$y = -35\cos\left(\tfrac{\pi}{6}(6-4)\right) + 65$$

$$= -35\cos\left(\tfrac{\pi}{3}\right) + 65$$

$$= \frac{-35}{2} + 65$$

$$= 47.5$$

$\boxed{\text{47,500 units sold in July}}$