# Math 1316: 4-7 Worksheet

April 7, 2022

For this in-class exercise we're going to look at applications of sine and cosine waves. Like with the previous in-class worksheet, the Desmos online graphing calculator is a helpful tool: https://desmos.com/calculator. I strongly encorage you to use this to visualize the functions you are dealing with.

1. When the maximum angle of a pendulum is small, its movement can be closely approximated as a cosine wave.[1] Consider a pendulum whose angle $\theta$, where $\theta = 0$ is pointing straight down, is described by the function
$$\theta(t) = 0.1\cos(1.57t).$$
(Here, $\theta$ is in radians and $t$ is in seconds.) Determine the amplitude and period of the pendulum's oscillation. What is the initial position of the pendulum (that is, what angle is it at when $t = 0$)?

2. For pendulums, the period $T$ of oscillation is given by the following formula:
$$T \approx 2\pi\sqrt{\ell/g},$$
where $\ell$ is the length of the pendulum and $g$ is the acceleration due to gravity. Knowing that $g \approx 32$ ft/sec$^2$, determine the length of the pendulum.

3. Average daily temperature across the year can be modeled with a cosine wave. Suppose the temperature for a region is given by the function
$$T(t) = 34\cos\left(\frac{2\pi}{365}x - \frac{2\pi}{365}\cdot 211\right) + 55$$
where $T(t)$ is the temperature (in degrees Fahrenheit) on the $t$-th day of the year. Determine the lowest and highest daily temperature of the year. What day of the year has the highest temperature?

4. You hold out a slinky and let go of the bottom, so that it begins to bounce back and forth. At its highest the bottom is 5 feet, 4 inches above the ground, and at its lowest is 1 foot, 8 inches above the grond. If it takes 4.3 seconds for the slinky to return to its highest point, write a function
$$y(t) = A\cos(Bt) + C$$
which models the height $y(t)$ in inches of the slinky at time $t$ seconds. (Ignore the effects of friction, and assume it doesn't slow down in its oscillation.) Using this model, calculate the time at which the slinky is first exactly 3 feet above the ground.

[1] If the angle can be large, then its movement is more complicated to describe.