Name_____ Date_____ Period_____

MODELING PERIODIC PHENOMENA WORKSHEET

Behaviors that can be modeled by a sine or cosine function – moon phases, ocean tides, amount of daylight, Ferris wheel (or anything that moves in circles)

sinusoidal function – a function that can be represented in the form $y = A \sin [b(x - h)] + k$ or
$$y = A \cos [b(x - h)] + k$$
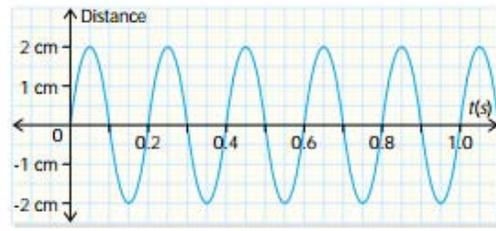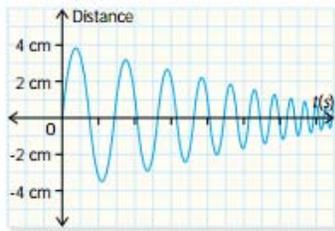
Given a set of data that behaves sinusoidally:
A = Amplitude: ½ (highest value – lowest value)   k = vertical shift: ½ (highest value + lowest value)
$b = 2\pi/\text{period}$ h = phase shift (+ means right while – means left)

1) Determine whether each graph is periodic or not. If it is periodic, find the period and amplitude.
   a) tip of vibrating meter stick   b) movement of a piston in a combustion engine

2) The Bay of Fundy, which is between New Brunswick and Nova Scotia, has the highest tides in the world. There can be no water on the beach at low tide, while at high tide the water covers the beach.

    a) Why can you use periodic functions to model the tides?

    b) What is the change in depth of water from low tide to high tide?

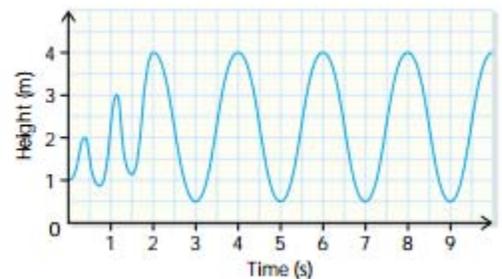   c) What is the amplitude of the curve?

    d) What is the equation of the midline of the curve?
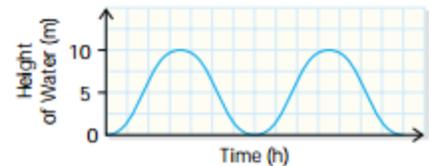
3) Nolan is jumping on a trampoline. The graph shows how high his feet are above the ground.

    a) How long does it take for Nolan's jumping to become periodic? What is happening during these first few seconds?

    b) How long is the period of the curve? Explain the meaning of period in the context of the problem.

c) Write an equation for the midline of the periodic portion of the curve.

d) What is the amplitude of the curve? Explain the meaning of amplitude in the context of the problem.

4) An ecologist studying a species of water beetle estimates the population of a colony over an eight week period. If t is the number of weeks after the initial estimate is made, then the population in thousands can be modelled by $P(t) = 5 + 2\sin(60t)$ where $0 \le t \le 8$.

a) What was the initial population?

b) What were the smallest and largest populations?

c) During what time interval(s) did the population exceed 6000?

5) A ferris wheel has a radius of 10 m. The wheel takes 100 seconds to complete one revolution. Passengers board the Ferris wheel 2 m above the ground at the bottom of its rotation.
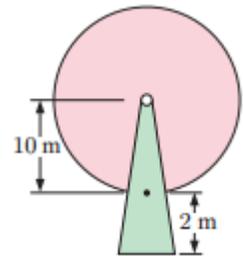
a) Write an equation to represent the position of a passenger at any time, t in seconds.

b) How high is the passenger after 25 seconds?

c) The ride lasts for 200 seconds. When will the passenger be at the maximum height during this ride?

6) The tide in a coastal city peaks every 11.6 hours. The tide ranges from 3.9 meters to 3.3 meters. Suppose that the low tide is at $t = 0$, where t is the time in hours.

a) Write a function that models the height of the tide.

b) Determine the height of the tide at 6.2 hours.

7) A certain person's blood pressure oscillates between 140 and 80. If the heart beats once every second, write a sine function that models the person's blood pressure.