Pre-Calculus
Sinusoidal Modeling

1) Jamal rode his bike over a piece of gum. Jamal continued riding his bike at a constant rate. At time t = 1.25 seconds, the gum was at a maximum height above the ground and 1 second later the gum was at a minimum. If the wheel diameter is 68 cm, find a trigonometric equation that will find the height of the gum in cm at any time t.

a) Find the height of the gum when Jamal gets to the corner at t = 15.6 seconds if he maintains a constant speed.

b) Find the first and second time the gum reaches a height of 12 cm while Jamal is riding at a constant rate.

2) Amanda was watching her little brother Mike play on a swing set. She decided that she would like to find his distance above the ground using a sine or cosine curve. She starts timing and finds that at t = 2s, Mike is at his highest point. He reaches his lowest point exactly 1.5 seconds later. Amanda also records that the highest Mike gets is 9 feet while the lowest point occurs at 1 foot. Write an equation that will find Mike's height after t seconds.

a) Find Mike's height at 5.4 seconds.

b) Find the first and second time that Mike reaches a height of 7.2 feet.

3) A pendulum hangs from a ceiling and swings back and forth towards a wall. Harry starts timing and at t = 4 seconds the pendulum is closest to the wall, 25 cm away. Three seconds later the pendulum is farthest from the wall (83 cm). Find an equation for the distance the pendulum is from the wall at any time t.

a) Find out how far the pendulum is away from the wall at t = 8 seconds.

b) Find the first time when the pendulum is 33 cm away from the wall.

4) A reflector on a bicycle wheel is 15 cm from the rim. The diameter of the wheel is 76 cm. At time $t = \frac{1}{2}$ second, the reflector is at is lowest point, $\frac{3}{4}$ second later it returns to the same position. Find an equation which will locate the height of the reflector above the ground at any time t.

a) Find the height of the reflector when t = 5.2 seconds.

b) Find the first time the reflector is at a height of 59 cm above the ground.

5) The temperature during the day can be approximated by a sinusoidal function. At 4 a.m. the temperature was at a low of 65°F. At 4 p.m. the temperature hit a high of 103°F. Write an equation which will find the temperature t hours after midnight.

a) Find the temperature at 11 a.m.

b) Find the first time in the day when the temperature reaches 98°.

6) The amount of air in a person's lungs varies sinusoidally with time under normal breathing. When full, Karen's lungs hold 2.8 liters of air. When "empty," her lungs hold 0.6 liters of air. Her brother starts timing her breathing. At t = 2 seconds she has exhaled completely and at t = 5 seconds she has completely inhaled. Find a function that will find the amount of air in Karen's lungs at anytime.

a) Find the amount of air in Karen's lungs if she starts holding her breath 3.5 seconds into the timing.

b) Find the first time Karen has 2.3 liters of air in her lungs.

7) The height of a piston in a cylinder can be· modeled by a sine or cosine function. A piston is at its lowest point in a cylinder, 8 cm from the bottom, at t = 3.2 seconds. The piston is at its highest position, 39 cm from the bottom, at t = 3.6 seconds. Find an equation for the height of the piston, in cm, at any given time t.

a) Find the height of the piston 15 seconds after the engine has started.

b) Find the first time the piston reaches 13 cm from the bottom.

8) Sean got a new yo-yo and noticed that the height of the yo-yo follows a sine or cosine curve. At time = 3 seconds the yo-yo is at its lowest height of 40 cm above the ground. The string is 62 cm long and one cycle takes 2 seconds. Find an equation that will determine the height of the yo-yo at any time t.

a) Find the height of the yo-yo after 20 seconds.

b) Find the first time the height of the yo-yo reaches 52 cm above the ground.

9) Cooper Toy Company has designed a new toy that uses a spring that follows a sinusoidal curve after you wind it up and start it. At t = 5 seconds, the end of the spring is at its highest point, 18 cm above the ground. Four seconds later, the spring is at its lowest point, which is 6 cm above the ground. Find an equation that will determine the height of the spring at any time t.

a) Find the height of the spring after 26 seconds.

b) Find the first time the height of the spring reaches 16 cm above the ground.