Trigonometric Application problems

The depth of the water on the shore of a beach varies as the tides moves in and out. The equation 1) $D(t) = 0.75 \cos(\frac{\pi}{6}t) + 1.5$ models the depth of the water, D(t), in feet and t as time in hours.

- What is the amplitude of the equation? a)
- b) What is the period of the equation?
- c) How deep will the water be 2 hours after the high tide?

A grandfather clock has a pendulum that moves from its central position according to the function 2) $P(t) = -3.5 \sin(\frac{\pi}{2})$, where t represents time in seconds. How many seconds does it take the clock to complete one full cycle from the center to the left then the right and then back to the center?

3) The occurrence of sunspots during September can be modeled by the equation $y = 44.2 \sin\left(\frac{\pi}{7.8}x - \frac{2.9}{7.8}\right) + 148$, in which x is the day of the month.

- a) What are the maximum number of sunspots that occurred in September?
- b) What are the minimum number of sunspots that occurred in September?
- c) What is the average value of sunspots that occurred in September?

The average annual snowfall in a certain region is modeled by the function 4)

 $S(t) = 20 + 10 \cos\left(\frac{\pi}{5}t\right)$, where S represents the annual snowfall, in inches, and t represents the number of years since 1970. What is the minimum annual snowfall, in inches, for this region?

Based on years of weather data, the expected low temperature T (in F) in Fairbanks, Alaska can be approximated by $T = 36 \sin\left(\frac{2\pi}{365}t - \frac{202\pi}{365}\right) + 14$, where t is in days and t = 0 corresponds to Jan. What will be the highest temperature in the period of one year?

6) If the equilibrium point is y = 0, then $y = -5\cos(\frac{\pi}{6}t)$, models a buoy bobbing up and down in the water.

- a) Where is the buoy at t = 0 seconds? t = 7 seconds?
- b) What is the maximum height of the buoy? The minimum?
- c) What is the period?

8) In a predator/prey model, the predator population is modeled by the function $y = 900\cos(2x) + 8000$, where x is measured in years.

- a) What is the maximum population?
- b) Find the length of time between successive periods of maximum population.

9) Each time your heart beats, your blood pressure increases, then decreases as the heart rests between beats. A certain person's blood pressure is modeled by the function $p(t) = 25\sin(160\pi t) + 115$, where p(t) is the pressure in mmHG (millimeters of Mercury) at time t, measured in minutes.

- a) Find the amplitude, period.
- b) If a person is exercising, his heart beats faster. How does this affect the period of the function?

10) As you ride a Ferris wheel, your distance from the ground varies sinusoidally with time. You are in the last seat filled and the Ferris wheel starts immediately, modeled by the equation $y = 20 \cos\left(\frac{\pi}{4}t - \frac{3}{4}\right) + 23$ Let *t* be the number of seconds that have elapsed since the Ferris wheel started.

- a) What minimum height above the ground will each gondola reach?
- b) What is the period?

11) A weight attached to the end of a long spring is bouncing up and down. As it bounces, its distance from the floor varies sinusiodally with time. You start a stopwatch. When the stopwatch reads 0.3 seconds, the weight first reaches a high point of 60 cm above the floor. The next low point, 40 cm above the floor occurs and 1.8 seconds. The equation expressing distance from the floor is modeled by $y = 10 \cos\left(\frac{2\pi}{3}t - \frac{.6\pi}{3}\right) + 50$, where t is in of the number of seconds the stopwatch reads.

- a) Predict the distance from the floor when the stopwatch reads 17.2 seconds.
- b) What is the distance from the floor when you started the stopwatch?

12) Tarzan is swinging back and forth on his grapevine. As he swings, he goes back and forth across the river bank, going alternately over land and water. His wife, Jane, decides to mathematically model his motion and starts her stopwatch. The equation $y = -20 \cos(\frac{\pi}{3}t - \frac{2}{3}) - 3$ models his motion, and t is the number of seconds the stopwatch reads and let y be the number of meters Tarzan is from the river bank.

- a) Predict the distance Tarzan's distance from the riverbank when t = 2.8 seconds and t = 15 seconds
- b) Where was Tarzan when Jane started the stopwatch?

13) A rodeo performer spins a lasso in a circle perpendicular to the ground. The height of the knot, in feet, from the ground is modeled by $f(t) = -3\cos\frac{5\pi}{3}t + 3.5$, where t is the time measured in seconds.

- a) What is the highest point reached by the knot?
- b) What is the lowest point reached by the knot?
- c) How long does it take the knot to make one revolution?

14) The jack on an oil well goes up and down, pumping oil out of the ground. As it does so, the distance varies sinusoidally with time. The equation $y = 1.1 \cos\left(\frac{\pi}{3}t - \frac{4\pi}{3}\right) + 2.6$ models this situation. Find the distance when the time is 5.5 seconds.

15) Researchers find a creature from an alien planet. Its body temperature varies sinusoidally with time. The equation $y = 8cos\left(\frac{\pi}{20}t - \frac{35\pi}{20}\right) + 112$, where y is the alien's body temperature, and t is time in minutes

- a) What is the period of the body temperature cycle?
- b) Find the body temperature of the alien when the researchers first started timing.