**5.5 Application of Periodic Functions**

Sinusoidal functions are often used to model periodic data. A motion involving a pattern that is repeated at fixed time intervals is called harmonic motion. Examples: Ferris wheel, pendulum, tides, heartbeat, etc.

1. A Ferris wheel has a radius of 35 m. Its center is 36 m above the ground. It rotates once every 60 s. Suppose you get on the bottom at $t=0$.

a) Sketch two cycles of a graph that represents the height, in meters, of the chair as a function of time t, in seconds.

1. Write an equation the expresses your height as a function of elapsed time.
2. Determine the height the chair is above the ground after 20 seconds.
3. Determine the two times within the first period when the chair is 19 meters above the ground.

2. The rotation of a Ferris wheel is modelled by the equation: $h=26cos2π \frac{(t-25)}{50}+27$, where $h$ is the height above ground, and t is the time in seconds. Suppose you get on at $t=0$ at the bottom of the wheel.

a) How high will you be after 43 s?

b) How many seconds on each rotation is a person, more than 35 meters in the air?

3. A Ferris wheel has a radius of 20 m and rotates twice every 2 minutes. A rider enters the seat at the lowest point of the Ferris wheel, 3m above the ground. Find a cosine function that gives the height $h$, after $t$ seconds of motion for the rider and find at what time the rider first reaches a height of 30 m.

4. The pedals of a bicycle are mounted on a bracket whose centre is 32.0 cm above the ground. Each pedal is 18.5 cm from the centre of the bracket. Assume that the bicycle is pedalled at 15 cycles per minute and that the pedal starts at time $t=0$s at the topmost position. Write an equation which describes this sinusoidal movement.

5. A spring rests 1.8 meters above the ground. The spring is pulled 1.2 meters below its resting position and then released. It takes the spring 0.4 sec to move from the maximum position to its minimum position.

a) Write the equation of the function in two different ways.

b) What height is the spring 2 seconds after it has been released?

6. On a typical day at an ocean port, the water has a maximum depth of 30m at 4:00 am. The minimum depth of 16m occurs 6.1 h later. Assume that the relationship between the depth of water and time is a sinusoidal function. Write an equation for the depth of the water at any time $t$ hours.

7. In a West Kootenay town, the sunrise time for a non-leap year can be found using the formula$ t=-1.77\sin(\frac{2π}{365})\left(d-80\right)+6.1$, where t is the time, in hours, after midnight, and d is the number of days.

a) Use the formula to determine, to the nearest minute, when the sun rose on February 14th.

b) Determine the first date of the year when the sun rose before 6:30 am, and the last day of the year when the sun rose before 6:30 am.