

# Trig Modelling Practice

The following problems are snippets from the textbook with the core function erased. Determine the general equation for them, use the equation to predict a value, and use the equation to solve a problem.

1.

- a. A point on saw blade experiences motion around a circle with radius  $r$ . It makes  $n$  rotations per second. The blade sits so that the center is  $d$  units below the top of the table. Determine an equation for the height of the point at time  $t$ .

- b. If the radius is 10 cm and it sits 8 cm below the top of the table, what percentage of one rotation will the point be above the table?

2.

- a. A satellite follows a sinusoidal path over the Earth in orbit. It takes the satellite  $m$  minutes to orbit the Earth. On one side of the Earth, it reaches a maximum height of  $h_1$  (km) and on the opposite side it reaches a min height of  $h_0$  (km). At  $t_0$  minutes after noon, the satellite is at the min height. Determine an equation for the height of the satellite at time  $t$ .
- b. If  $m = 200$  minutes,  $h_1 = 300$  km and  $h_0 = 220$  km, and at 12:47 pm the satellite is at the min height, determine the height of the satellite at 5:10 pm.
- c. Determine the intervals of time from midnight to 6:00 am of that day that the satellite was more than 280 km above the Earth.

3.

a. The population of foxes in a region cycles from a minimum  $P_0$  to maximum  $P_1$  during a  $m$  month period (that is from  $P_0$  to  $P_1$  in  $m$  months). The population starts at  $P_1$  on the first of month  $m_0$ . Determine an equation for the population of foxes at time  $t$  in months.

b. If  $P_0 = 600$  and  $P_1 = 1600$ ,  $m = 12$  months, and  $m_0$  is March 2020, determine the population of foxes on June 28<sup>th</sup>, 2021.

c. Determine the approximate dates between Jan 1, 2020 to December 31, 2024, the population of foxes is greater than 1000.

4.

a. The altitude of the Sun follows a sinusoidal path. The maximum altitude it reaches is  $\theta_1$  degrees above the horizon at time  $t_1$  (hours). The lowest it reaches is  $\theta_2$  degrees below the horizon at time  $t_2$  (hours). Determine an equation for the height of the Sun as a function of time  $t$ .

b. If  $\theta_1 = 38^\circ$  at 1:20 pm on March 14, 2021 and  $\theta_2 = -42^\circ$  at 1:20 am on March 15, 2021. Then what was the height of the Sun at 10 am on March 15?

c. Determine the time of sunrise and sunset on March 15, 2021.

5.

a. Daily temperature follows a sinusoidal curve. In Vancouver, it reaches a minimal temperature of  $T_0$  degrees Celsius at time  $t_0$  and a maximal temperature of  $T_1$  at time  $t_1$ . Determine an equation for the temperature as a function of the time  $t$ .

b. If  $T_0 = -1^\circ\text{C}$  at 6:00 am and  $T_1 = 9^\circ\text{C}$  at 7:00 pm. Then what was the temperature at 10:30 am and 10:30 pm?

c. Determine the interval of times in the day when the temperature is above  $5^\circ\text{C}$ .

Generalize the scenarios in the textbook page 278-280 # 17-23