1) A bicycle rider covers a distance of 3 km in 20 minutes. What is the speed of the rider? Give your answer in km/hour and m/s.

\[ 20 \text{ min } = \frac{1}{3} \text{ hour } \rightarrow v = \frac{3}{(1/3)} = 9 \text{ km/hour} = \frac{(9 \times 1000 \text{ m})}{(3600 \text{ s})} = 2.5 \text{ m/s} \]

2) The speed of sound in air is about 300 m/s. About how long does it take for Ugo’s voice to reach the far end of the lecture room? (Make a guess of the length of the lecture room.)

Lecture room length \(L=45 \text{ m}\). \(v = \frac{x}{t} \rightarrow t = \frac{x}{v} = \frac{45}{300} = 0.15 \text{ s} = 0.00015 \text{ ms}\)

3) The highest frequency that my dog Ruby can hear is 40 kHz. What is the period of this oscillation?

\( T = \frac{1}{f} \rightarrow T = \frac{1}{40,000} = 0.000025 \text{ s} = 0.025 \text{ ms}\)

4) Consider the graph showing the displacement of a pendulum shown below, the vertical axis is labeled in centimeters, the horizontal axis is labeled in milliseconds. What is the period? What is the frequency?

\( T = 2 \text{ ms}; \ f = \frac{1}{T} = \frac{1}{0.002} = 500 \text{ Hz}\)

5) When does the pendulum move fastest? When is it stopped?

The pendulum is fastest when the slope of the graph is greatest, at times \(t = 0.5 \text{ ms}, 1.5 \text{ ms}, 2.5 \text{ ms}, \text{ etc.}\)

The pendulum is stopped at times \(t = 0, t = 1 \text{ ms}, 2 \text{ ms}, \text{ etc.}\)

6) FOR HONOR STUDENTS — Estimate the velocity of the pendulum at times \(T/4\) and \(T/8\).

Method: draw a tangent to the graph at the point \(t = T/4 = 1 \text{ ms}\) as shown above. Use the points shown above: \(x = 20 \text{ cm for } t \sim 0.2 \text{ ms}, \text{ and } x = -20 \text{ cm for } t \sim 0.8 \text{ ms}. \) Calculate the velocity in \(\text{cm/ms and m/s}\).