Name _____

Wave Equation Page

As you saw in the simulation, a wave's frequency is inversely proportional to the wavelength. This means that as one gets larger, the other gets smaller. You should have also noticed that the speed of the wave affected both the wavelength and the frequency. That relationship has been expressed in mathematical language as the wave equation:

$$v = \lambda f$$

v = velocity, but we will be substituting speed for this value most of the time. That is acceptable because the only difference between velocity and speed is a notation of the direction of travel.

λ = wavelength

f = frequency

This equation is handy since it allows you to find a missing value if you have the other two. Use this equation to solve the following problems. Be sure to show your work for full credit.

Exercises

1. You have probably heard of UV B waves. Many sunscreens have been formulated to protect skin against these damaging waves, so it is printed on the bottles. UV B light has a wavelength between 280 – 320 nm. Using a wavelength of 300 nm, what is the frequency of this wave?

   Hint: Since it is a light wave it travels at the speed of light or 3.00×10^8m/s. Actually, light only travels at that speed in empty space, not on Earth. However, it is an acceptable approximation for our calculations. Notice the units for the wavelength and speed are different. Wavelength uses nm while speed uses m. So you need to convert to the same unit before finding the frequency.

2. Not all waves travel at the speed of light because not all waves are light. This problem involves sound waves. Have you ever repeatedly tapped your finger on the desk because you were bored or wanted to make a point? Can you believe that tapping creates a

sound wave? If the frequency of the sound is 1200 Hz and the speed of the wave through the wood is 3600 m/s what is the wavelength?

3. The characteristics of a water wave can also be calculated with this formula. Suppose you saw a wave in a local lake with a frequency of 20 Hz and a wavelength of 30 cm. What is the speed of that wave?

4. A clock in a classroom down the hall is exceptionally loud. As you were trying to listen to your teacher you couldn't help but realize that the frequency of the ticking was 426 Hz. The next day you get sent to that classroom on an errand for your teacher. As you wait for the balance you were sent to retrieve, you start snapping your fingers in time with the second hand on the clock. As you walk down the hall to your classroom, you realize that the sound of the second hand is delayed. You do some investigations and find that it takes 1.45 seconds for the sound to travel the 345 meters down the hallway.
    a. What is the speed of the sound wave?

    b. Using your calculated speed and the given frequency, find the wavelength.

5. Let's go back to the lake for a moment. Suppose you were sitting in a park next to the lake waiting on a friend. While waiting, you noticed that the waves traveled past two nearby docks. As a good physics student, you couldn't help but do some measurements as you waited. You noticed that a wave took an average of 3.4 seconds to travel from one dock to the next. You used your handy meter stick and found that the two docks were 15 m. apart. You also noticed that 23 waves passed the first dock in 32 seconds.

a. Use the data above to calculate the speed of the wave.

b. Use the data above to calculate the frequency.

c. Calculate the wavelength for these waves using the speed and frequency you just found.