The Math...Period

The relationship between frequency and period can be easily seen by looking at the math. Make sure to review the definitions for both.

$$Frequency\ (Hz) = \frac{1}{Period\ (T)}\ ;\ Period\ (T) = \frac{1}{Frequency\ (Hz)}$$

Fill in the missing period or frequency using a calculator and the equations above.

Period	Frequency	Example work
2.0 seconds	0.5 Hz	$\frac{1}{2} = 1 \div 2 =$
0.25 s	4 Hertz	$\frac{1}{4} = 1 \div 4 =$
4.0 s	0.25 Hz	
0.33 s	3.03 Hz	$\frac{1}{0.33} =$
0.00136	738 Hz	
.01297 s	77.1 Hz	
73.8 s	.01355 Hz	
.000765 s	1307.2 Hz	

I. A group of students is on a field trip to an art museum. In one of the rooms is a huge pendulum. They decide to collect data on the period. They want to also find out the frequency of the huge pendulum. Here's what they got. Complete the table.

Period (T) Trial 1	Period (T) Trial 2	Period (T) Trial 3	Period (T) Average	Frequency
5.67 s	5.62 s	5.64 s	5.64	0.177

How long would they have to run across the equilibrium point without getting hit with the pendulum? *Of course they would have never tried it!*

Is it possible to write an inequality for this problem?
Remember, we do math *periodically* in science.

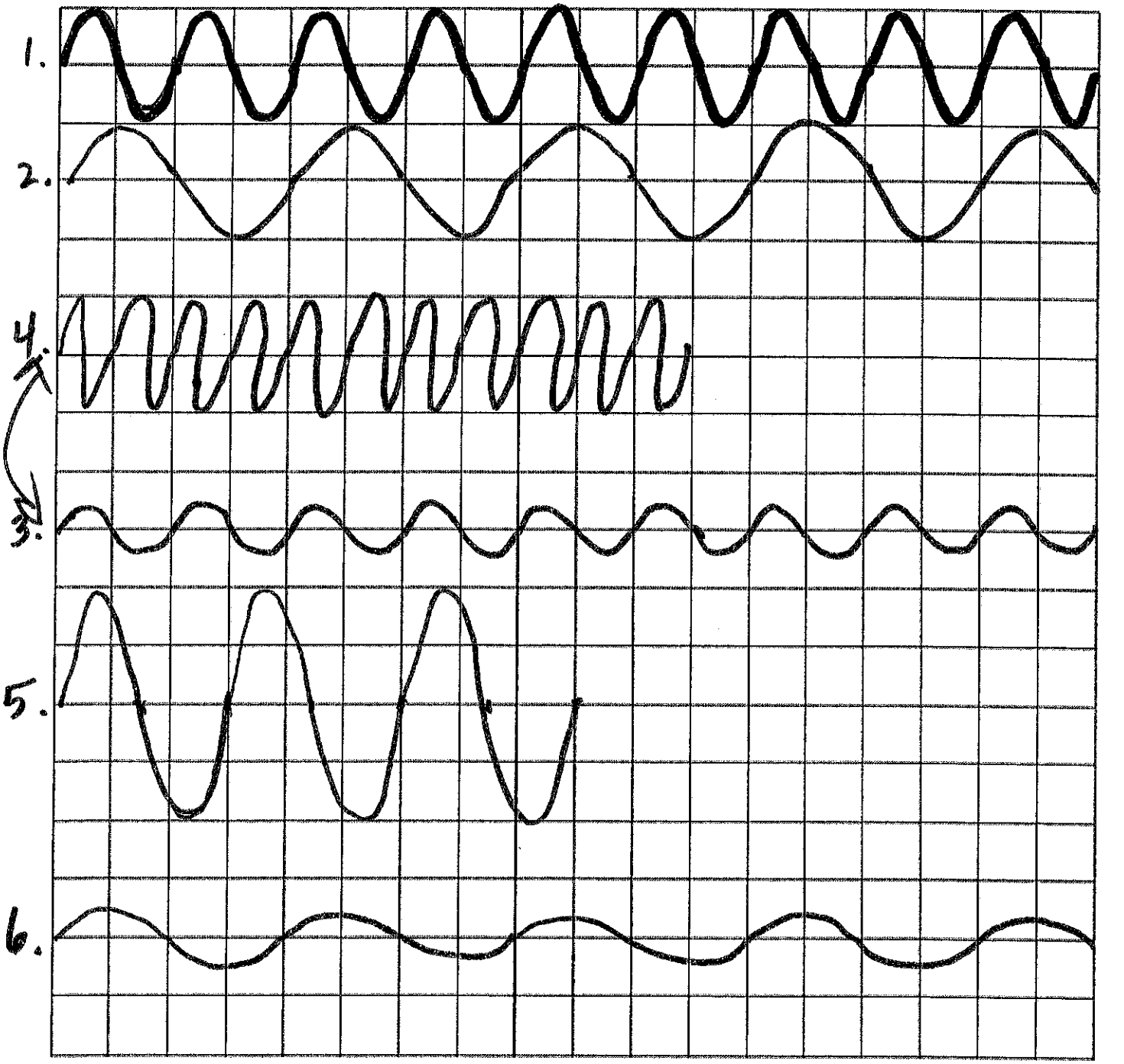
Wave Properties

Use the 1- centimeter grid paper to complete the following. The first wave is the example wave. Number the waves.

1. Example wave: wavelength 2 cm Amplitude 1 cm Frequency 36 Hz
2. Double the wavelength of the example wave
3. Draw a wave with 1/2 of the amplitude of the example wave.
4. Double the frequency of the example wave. *
5. Draw a wave with wavelength 3 and amplitude 2
6. Draw a wave with wavelength 4 and amplitude 0.5

* you only have to do half of the line of waves

]---------- **0.25 seconds** ----------[

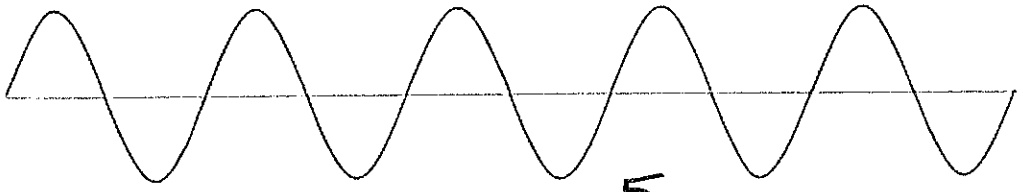


The time from the beginning to the end of the wave train in each situation is 1 second.

Wave 1

$v = f \times \lambda$

$v = 5.0 \times 2.5\text{cm}$

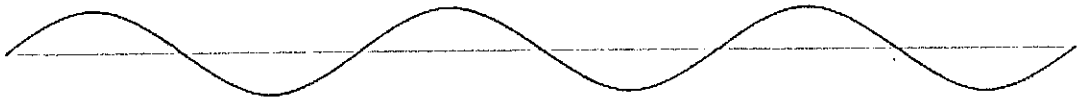


a) How many waves are there in this wave train? 5

b) Wavelength 2.5 cm c) Amplitude -1 cm d) frequency 5.0 Hz e) speed 12.5 cm/s

.125 m/s

Wave 2



a) How many waves are there in this wave train? 3

b) Wavelength 4.5 cm c) Amplitude .5 cm d) frequency 3.0 Hz e.) speed 13.5 cm/s

.135 m/s

Problems:

1. What is the wavelength of a sound wave with a frequency of 50 Hz? The speed of sound is 342 m/s.

$\lambda = \frac{v}{f}$ $\lambda = \frac{342\text{ m/s}}{50\text{ Hz}} = 6.84\text{ m}$

2. A sound wave in a steel rail has a frequency of 620 Hz and a wavelength of 10.5 m. What is the speed of sound in steel?

$v = f \times \lambda = 620\text{Hz} \times 10.5\text{m} = 6510\text{m/s}$

Wave Speed Calculation

1. Use the formula *frequency* × *wavelength* = *wave speed* to complete the table.

	Frequency (Hz or $\frac{1}{s}$)	Wavelength (m)	Wave speed (m/s)
A	500	3.0 m	1500
B	2400 Hz	0.5	1200
C	1,000	0.34	340
D	10,000,000,000	0.03	300,000,000
E	150,000,000	2.0 m	300,000,000
F	20,000	0.15	3,000 m/s

Cut out and tape/glue into your notebook

2. Water waves on a lake pass by a boat that is anchored.
   - A wave crest passes by the boat every 4.0 seconds. Calculate the frequency of the waves in hertz. $\frac{1}{4.0} = .25\text{ Hz}$
   - The distance from one wave crest to the next wave trough is 5.0m.
     - Calculate the wavelength of the waves. 10.0 m
     - Calculate the wave speed. 2.5 m/s

Problems for you to try: Complete the following practice problems. You MUST show ALL the work outlined in the steps in the example problems.

1. A wave with a frequency of 14 Hz has a wavelength of 3 meters. At what speed will this wave travel?

$v = \text{frequency} \times \text{wavelength}$

$42\,m/s = 14 \times 3$

2. The speed of a wave is 65 m/sec. If the wavelength of the wave is 0.8 meters, what is the frequency of the wave?

$f = \frac{65\,m/s}{0.8\,m} = 81.25\ Hz$

3. A wave has a frequency of 46 Hz and a wavelength of 1.7 meters. What is the speed of this wave?

$v = 46\ Hz \times 1.7\,m = 78.2\,m/s$

4. A wave traveling at 230 m/sec has a wavelength of 2.1 meters. What is the frequency of this wave?

$f = \frac{230\,m/s}{2.1} = 109.5\ Hz$

5. A wave with a frequency of 500 Hz is traveling at a speed of 200 m/s. What is the wavelength?

$\lambda = \frac{200\,m/s}{500\ Hz} = 0.4\,m$