Name: _____ Date: _____

PHYSICS

Calculating the Properties of Waves

f = frequency: number of waves or cycles per second. Reported in units of Hz.

T = period: the amount of time to complete one cycle or one wave. The time between consecutive waves.

# of cycles = number of waves or back-n-forth motions.

v = wave speed. How fast the wave moves through the medium. Wave speed is reported in units of m/s.

d = distance, how far the wave moved. Distance is reported in units of meters (m).

λ = wavelength: the distance between two identical positions on two side-by-side waves. The length of one wave. Wavelength is reported in units of meters (m)

A = amplitude: the maximum displacement of the wave from its equilibrium position.

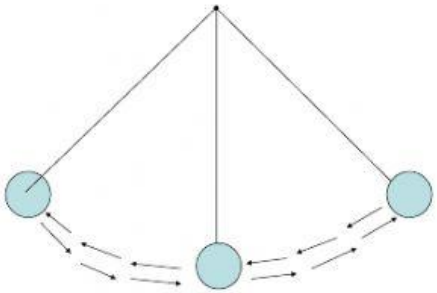
Frequency	$f = \frac{\#cycles}{t}$	Use this equation if you know number of cycles and time.	Hz
Frequency	$f = \frac{1}{T}$	Use this equation if you know the period (T)	Hz
Period	$T = \frac{t}{\#cycles}$	Use this equation if you know number of cycles and time.	s
Period	$T = \frac{1}{f}$	Use this equation if you know the frequency (f)	s
Number of Cycles	$\#cycles = f \cdot t$	Use this equation if you know the frequency and the time.	No units

Wavelength	$\lambda = \frac{v}{f}$	Use this equation if you know wave speed and frequency.	m
Frequency	$f = \frac{v}{\lambda}$	Use this equation if you know wave speed and wavelength.	Hz
Wave speed	$v = f \cdot \lambda$	Use this equation if you know wave length and frequency	m/s
Wave speed	$v = \frac{d}{t}$	Use this equation if you know distance and time	m/s
Distance	$d = v \cdot t$	Use this equation if you know wave speed and time	m

Part 1: Calculating Frequency, Period, and Number of Cycles. Show the calculations in the block and show your answers. (time must be in seconds).

Example: A pendulum swings back and forth 10 times in 35 seconds.

- Calculate frequency (*f*)
- Calculate period (T)

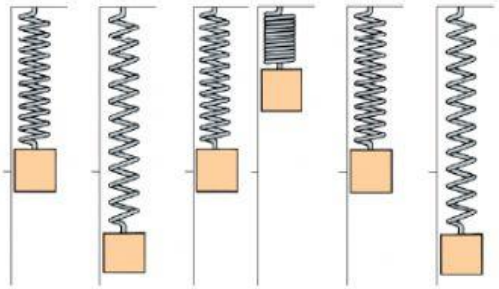


$$f = \frac{\#\,cycles}{t} = \frac{10}{35} = 0.286/_{s} = 0.286\ Hz$$

$$T = \frac{1}{f} = \frac{1}{0.286} = 3.5\,s \quad \text{or} \quad T = \frac{t}{\#\,cycles} = \frac{35s}{10} = 3.5\,s$$

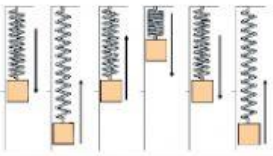
Example: A spring oscillates with a frequency of 2.5 Hz.

- Calculate the period of the spring's oscillation.
- Calculate how many back-and-forth cycles the pendulum will make in 1 minute.



$$T = \frac{1}{f} = \frac{1}{2.5/s} = 0.40\,s$$

$$Cycles = f \cdot t = {}^{2.5}\!/_{s} \cdot 60\,s = 150$$



1. A spring oscillates 45 times in 1 minute.

A) Calculate the frequency of the spring. (*f*)

B) Calculate the period of the spring. (T)

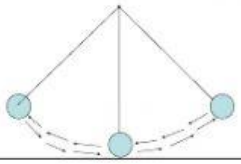
C) How many times will the spring oscillate in 180 seconds? (# of cycles)

2. You play the piano. The piano string vibrates 29,000 times in 1 minute.

A) Calculate the frequency of the piano string. (*f*)

B) Calculate the period of the piano string. (T)

C) How many times will the piano string vibrate in 20 seconds? (# of cycles)



3. A pendulum swings back-and-forth with a frequency of 3.0 Hz.

A) Calculate the period of the pendulum. (T)

B) How many times does the pendulum swing in 30 seconds? (#cycles)

4. You drop a rock into a pond. The rock makes 100 small waves in 30 seconds.

A) Calculate the frequency of the waves (*f*)

B) Calculate the period of the waves. (T)

C) How many small waves will be made in 2 minutes? (#cycles)

Part 2: Calculations. **Calculate the frequency, period, wavelength, wave speed, or the distance that waves travel.** Show the calculations in the block and show your answers. (time must be in seconds).

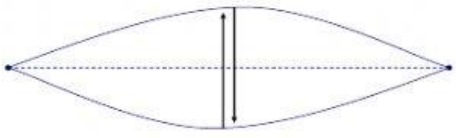
Example: A guitar string vibrates at a rate of 60000 oscillations per minute. The speed of sound in air at 20°C is 343 m/s.

- Calculate the frequency (*f*) of the guitar string in Hz.
- Calculate the period (T) of the vibration. (s)
- Calculate the wavelength (λ) of the vibration. (m)

$$f = \frac{cycles}{t} = \frac{60{,}000}{60\ \text{s}} = 1000/_s = 1000\ Hz$$

$$T = \frac{1}{f} = \frac{1}{1000} = 0.001\ s \text{ or}$$

$$T = \frac{60\text{s}}{60{,}000} = 0.001s$$



$$\lambda = \frac{v}{f} = \frac{343\ ^m/_s}{1000/_s} = 0.343\ m$$

Example: A horn emits a sound with a frequency of 6500 Hz. The speed of sound in air at 20°C is 343 m/s.

- Calculate the period (T) of the sound waves emitted from the horn. (s)
- Calculate the wavelength (λ) of the sound waves. (m)
- Calculate how far the sound traveled in 30 seconds? (d)

$$T = \frac{1}{f} = \frac{1}{6500/s} = 0.000154\ s$$

$$\lambda = \frac{v}{f} = \frac{343\ ^{m}/_{s}}{6500/_{s}} = 0.0.528m$$

$$d = v \cdot t = 343\frac{m}{s} \cdot 30s = 10{,}290\ m$$

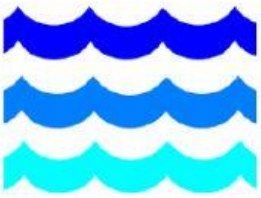
Example: A whale's song has a frequency of 400 Hz. The speed of sound passing through seawater at 10°C is 1530 m/s.

- Calculate the period of the sound waves of the whale's song.
- Calculate the wavelength of the sound waves of the whale's song.
- Calculate how far the whale's song traveled in 1 minute.

$$T = \frac{1}{f} = \frac{1}{400/s} = 0.0025\ s$$

$$\lambda = \frac{v}{f} = \frac{1530\ ^{m}/_{s}}{400/_{s}} = 3.83\ m$$

$$d = v \cdot t = 1530\frac{m}{s} \cdot 60s = 91{,}800\ m$$



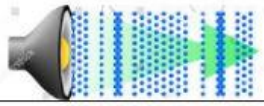
5. Waves move on the surface of the ocean. They move with a wave speed of 25 m/s. The frequency of the wave is 0.50 Hz.

A) Calculate the period of the wave. (T)

B) Calculate the wavelength of the wave. (λ)

C) Calculate the number of waves produced in 1 min. (#cycles)

6. Sound waves travel 4000 m in 12.5 seconds. The frequency of the wave is 530.5 Hz.



A) Calculate the period of the wave. (T)

B) Calculate the wave speed. (v)

C) Calculate the wavelength of the wave. (λ)

7. The ripples on the surface of a pond have wavelengths of 0.25 meters and a frequency of 32 Hz.

A) Calculate the speed of the ripples. (v)

B) How many waves are generated in 1 min? (#cycles)

C) Calculate how far the waves move in 30 seconds. (d)

8. You count 240 ripples on a pond's surface in 1 minute time. You measure 1 meter length, there are 42 of the ripples inside that 1 meter length.

A) Calculate the frequency of the ripples on the pond. (f)

B) Calculate wavelength of each ripple. (λ)

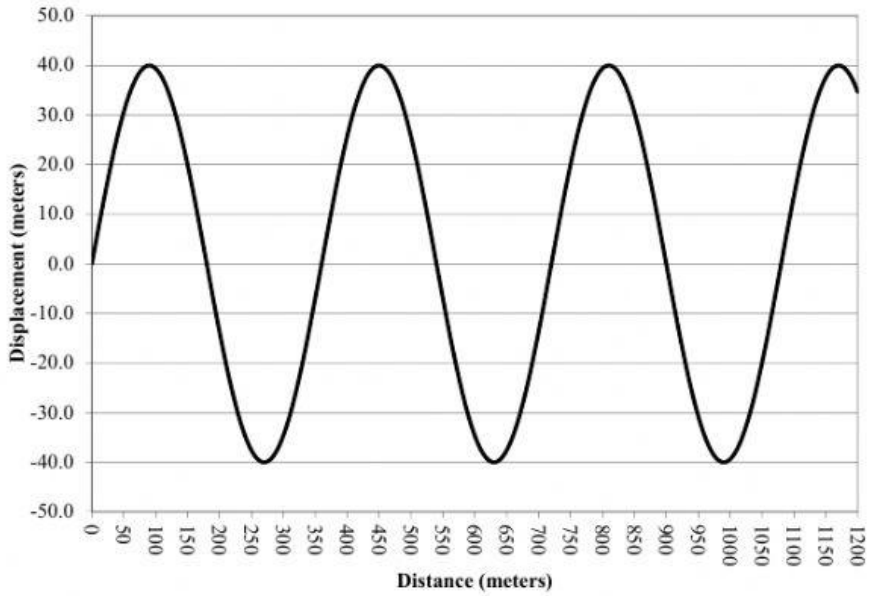
C) Calculate the period of the ripples (T)

D) Calculate the speed of the ripples. (v)

E) How far do the ripples travel in 20 seconds? (d)

Part 3: Identification and Calculation. Identify or calculate the wavelength, frequency, period, and amplitude of the waves. You are given the values of the wave speed (v)

Wave #1: v = 800 m/s



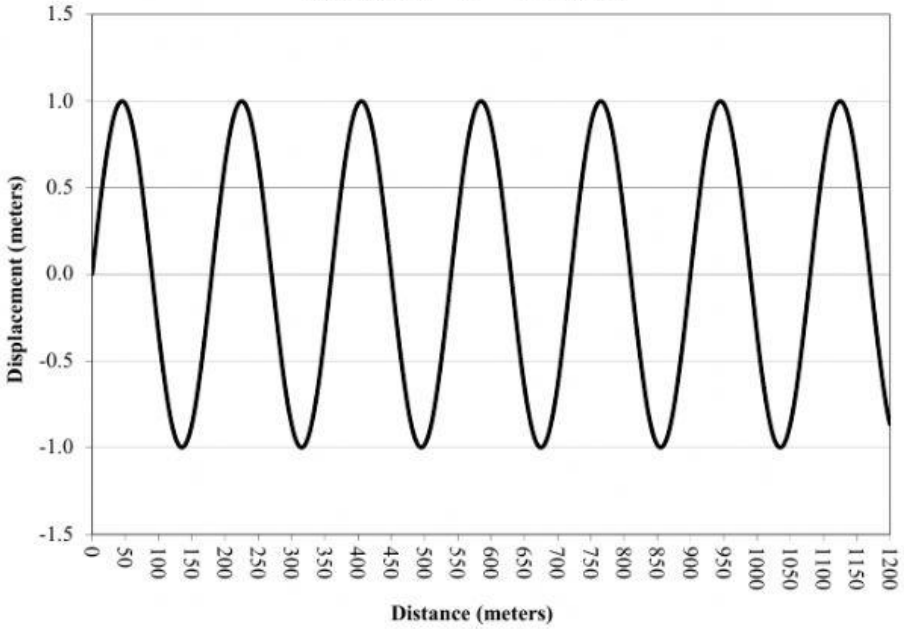
Wavelength =

Frequency =

Period =

Amplitude =

Wave #2: v = 720 m/s



Wavelength =

Frequency =

Period =

Amplitude =