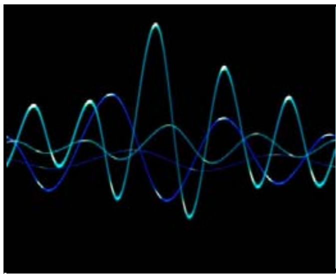


Unit 4: Oscillatory Motion and Mechanical Waves

## 4.4 The Universal Wave Equation

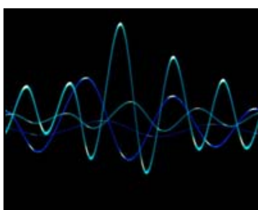
In Physics 20, waves will move in straight lines at constant velocities. This means we can describe the motion of a line with good ol':

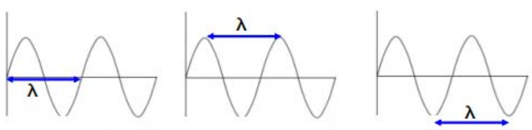
$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$$

But what is displacement and time of a wave?

wavelength frequency

$f = \frac{1}{T}$






**For displacement, we measure the wavelength, λ, of the wave. This is the distance, in m, between any two repeating parts of the wave.**

**For time, we will use period, T, the amount of time it takes for the wave pattern to repeat.**

So...the Universal Wave Equation is:

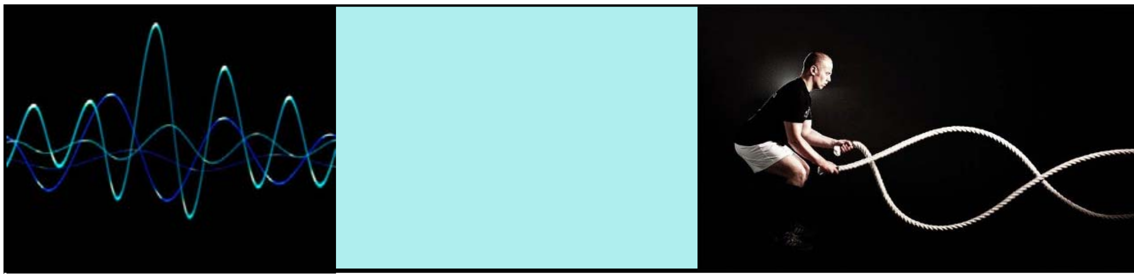
$$v = f\lambda$$

$s^{-1} \cdot m$ $\frac{m}{s}$

v = velocity (m/s)

f = frequency (Hz or $s^{-1}$)

λ = wavelength (m)



Ex.) The speed of sound in air at 0℃ is 331 m/s. The speed of the same sound increases in air at 20℃ to 343 m/s. If the frequency of the sound is 2.50 x $10^3$ Hz, what is the difference in wavelength?

0°C

$\lambda = \frac{331}{2.50 \times 10^3}$

$\lambda = 0.132\text{ m}$

$v = f\lambda$, $\frac{v}{f} = \frac{f\lambda}{f}$

$\lambda = \frac{v}{f}$

20°C

$\lambda = \frac{343}{2.50 \times 10^3}$

$\lambda = 0.137\text{ m}$

Diff: $0.00480 = 4.80 \times 10^{-3}\text{ m}$

$= 4.80\text{ mm}$

Ex.) While floating in a tube on a lake, you notice that you bob up and down 4.0 times every 5.0 minutes. You estimate that the distance between the crests is 4.0 m. What is the estimated speed of the water?

$\frac{4\text{ times}}{300\text{ s}} = \frac{f}{1\text{ s}}$ $\frac{1}{s} = s^{-1}$

$f = 0.013\text{ Hz}$

$v = f\lambda$

$= 0.013 \cdot 4.0$

$= 5.3 \times 10^{-2}\text{ m/s}$

Questions: Pg. 410 # 5-9.