AP PHYSICS 1 BIG IDEAS – Waves

Waves Parts and Definitions

Transverse Wave: Medium moves perpendicular to wave motion. (crests/troughs)
Examples: Light waves, shaking a rope, earth quake s-waves.

Longitudinal Wave: Medium moves parallel to the wave motion. (compressions/rarefactions)
Examples: Sound waves, earthquake p-waves.

Wavelength, λ: Distance between corresponding parts of a wave. (Crest to crest, etc.)

Frequency, f: Number of waves that pass each second. (Hertz, Hz)

Period, T: Time for one wave to pass. (Seconds, s)

Amplitude, A: Transverse – Distance from equilibrium to crest or to trough, or half the distance from crest to trough. Longitudinal – Change in pressure above and below normal pressure.

Interference: Two waves at the same place at the same time combine the energy of each wave which is just combining the amplitudes.

Velocity = frequency x wavelength. Since all waves travel at the same velocity on a particular medium, frequency is inversely proportional to wavelength.

Increasing the tension on a string will increase the velocity of the waves.
Increasing the linear density of a string will decrease the velocity of waves.

Standing Waves

Waves undergo a phase change when bouncing off of a fixed (or closed) end.

Waves undergo no phase change when bouncing off a free (or open) end.

If the wavelength is correct, advancing waves will arrive in step with returning waves. The two waves passing by each other and create a standing wave.

The largest wave that fits on a given length medium is called the Fundamental Frequency or the 1st Harmonic. The next largest is called the 1st Overtone, or the 2nd Harmonic, etc.

Doppler Effect

The Doppler Effect is the apparent shift in frequency of a wave due to the relative motion of the source of the wave and the observer. Wavelengths get "comprunched" (higher frequency) in front of the moving source, and "de-comprunched" (lower frequency) behind the moving source. If the source is stationary, a moving observer will "intercept" more waves/sec if moving toward the source, and less if moving away.

Resonance Interference and Beats

Resonance is when an object is forced to vibrate at its natural frequency (frequencies that produce standing waves).

Light can interfere destructively if crest of one wave meets the trough of another.

Sound can interfere destructively if the compression of one wave meets the rarefaction of another.

Beats occur when two notes of different frequencies are played together. The frequency of the beats is the difference in the frequencies of the two notes. 512 Hz with 515 Hz would have a beat frequency of 3 Hz. If a beat of 5 Hz is hear with one note of 300 Hz, you can only know that the other note must be either 295 Hz or 305 Hz. You can't narrow it down without more information.

