

DIMENSIONS OF THE SINE WAVE

- dimensions of sine waves
 - ◆ Amplitude
 - ◆ Phase
 - ◆ Frequency/Period: $f = 1 / T$ or $T = 1 / f$

Note: when a sine wave represents something in space, wavelength is used instead of period.

Ch2-1

Amplitude

- rms = $A / \sqrt{2} = A (0.707)$
- mean square = rms²
- Full-Wave Rectified Average (FW_{avg})
 - ◆ FW_{avg} = $2A / \pi = A (.636)$
- Half-Wave Rectified Average (HW_{avg})
 - ◆ HW_{avg} = $A / \pi = A (.318)$

Ch2-2

DIMENSIONS OF THE SINE WAVE

- FREQUENCY (f)
 - ◆ The rate, in Hz, at which a sinusoid repeats itself
- PERIOD (T)
 - ◆ The time required to complete one cycle

• T of X = .001 s: f = ? f = 1000 Hz

• T of Y = .0005 s: f = ? f = 2000 Hz

Ch2-3

Determinants of Frequency

- Frequency depends on properties of the source of sound
- Spring-mass system: mass (m) and stiffness (s) of system
- **Natural Frequency** is the frequency with which a system oscillates freely (f_{nat})
- f_{nat} = $\sqrt{s / m}$
- Remember: $f = 1 / T$; $T = 1 / f$

Ch2-4

Comments on the Radian

- 1 radian = 57.3°
 - ◆ $360^\circ / 57.3^\circ = 2\pi$ Or $360^\circ = 2\pi r$
- Snip a circle: unroll it. So for circles of all size, length = 2π (6.2832) times radius of circle ($2\pi r$)
- One cycle = 360°
 - ◆ $360^\circ = 2\pi$ radians

Ch2-5

Angular Velocity (ω)

- Alternative ways to express frequency
 - ◆ degrees / s; circle divided into 360 equal parts
 - >> 1 Hz = 360° / s; 10 Hz = 3600° / s
- The measure of choice
 - ◆ 2π radians / s; circle divided into 2π (6.2832) equal parts
 - >> 1 Hz = 2π radians / s

Ch2-6

DIMENSIONS OF THE SINE WAVE

- **PHASE**
Four reference points: A, B, C, & D
- ◆ At moment rotation begins, what is displacement in degrees for each of four points?
 - ☑ A = 0
 - ☑ B = 90
 - ☑ C = 180
 - ☑ D = 270

Ch2-7

Starting Phase

- That defines the starting phase; the angle, in degrees, at the moment rotation begins
- Starting phase relations
 - B leads A by? ☑ 90°
 - C leads B by? ☑ 90°
 - C leads A by? ☑ 180°
 - D leads B by? ☑ 180°
 - B lags C by? ☑ 90°

Ch2-8

Phase Angles in Radians

- Radians replace degrees on abscissa
- $360^\circ = 2\pi$ radians
- $0^\circ = ?$
 - ☑ 0 radians
- $90^\circ = ?$
 - ☑ $\pi/2$ radians
- $180^\circ = ?$
 - ☑ π radians
- $270^\circ = ?$
 - ☑ $3\pi/2$ radians

Ch2-9

Simple Harmonic Motion and Sound Waves

- At 0° , balloon is partially inflated
- At 90° , balloon maximally inflated
- At 270° , balloon minimally inflated
- Compressions and rarefactions are propagated through medium
- The result is a sound wave

Ch2-10

Amplitude

- Particle velocity leads particle displacement by 90° : Why?
 - ☑ c is maximal at equilibrium where x is 0; c is 0 at x_{max} where motion is momentarily halted
- Instantaneous sound pressure "mirrors" particle velocity and leads particle displacement by 90°

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Amplitude

- Particle acceleration leads particle displacement by 180° : Why?
 - ◆ $F_i = ma$ (2nd Law)
 - ◆ $F_r = -kx$ (Hooke's)
 - ◆ $F_i = F_r$ (3rd Law)
 - ◆ $ma = -kx$
- where: m and -k are constants and a and x are variables, so a and x must be opposites

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