Study Guide for Test 4

Fluid Dynamics

You should understand the concept of flow rate of a fluid, and know the formulas

$$\text{flow rate} = \frac{\text{volume}}{\text{time}} = (\text{area}) \cdot (\text{speed}).$$

You should understand the "squirt gun principle" for an incompressible fluid, which says that the flow rate is the same at all points along a closed passageway. You should understand and be able to apply Bernoulli's equation,

$$P = \tfrac{1}{2}\rho v^2 + \rho g h = \text{constant},$$

but you need not memorize the euqation itself. You should have a qualitative understanding of the concept of viscosity, and how it affects the flow rate of real fluids in real pipes.

Oscillations

You should understand the terms *frequency* and *period*, and how they relate to each other ($f = 1/T$). You should know that "Hz" (hertz) is another name for the unit of frequency, s^{-1} (or oscillations per second).

I'll give you the formulas for the period of a mass on a spring and a simple pendulum:

$$T = 2\pi\sqrt{\frac{m}{k_s}}; \qquad T = 2\pi\sqrt{\frac{L}{g}}.$$

You should be able to apply these formulas correctly to answer both qualitative and quantitative questions.

Waves

You should understand the following terms as applied to waves: transverse; longitudinal; amplitude; frequency; period; wavelength; speed; superposition; interference; standing wave; fundamental frequency; overtone; intensity. You should understand what sound waves are, in terms of density, pressure, and displacement.

You should memorize, or be able to figure out, the relation between speed, period, and wavelength:

$$v = \frac{\Delta x}{\Delta t} = \frac{\lambda}{T} = \lambda f.$$

You should memorize the approximate value of the speed of sound in air at room temperature. I'll give you the more general formulas for the speed of transverse waves on a string and sound waves:

$$v = \sqrt{\frac{|\vec{F}_T|}{(m/L)}}; \qquad v = \sqrt{\frac{B}{\rho}}.$$

You should be able to apply these equations both quantitatively and qualitatively.

You should be able to draw and interpret standing-wave patterns and determine the various standing-wave wavelengths and frequencies for a string (or rope or cord) that is fixed at both ends, and for a pipe or tube with one or two open ends.

You should understand and be able to explain the Doppler effect. When the motion of source and/or detector is slow compared to the speed of the wave, the observed frequency is shifted by a percentage equal to their relative velocity as a percentage of the wave speed.