Chapter 12 Equations

Sound:

In air, $v \approx (331 + 0.60\ T)$ m/s, T in °C, $v = 343$ m/s at 20°C, $d = vt$.

Sound Intensity, Level:

$I = P/A$, $I = P/4\pi r^2$, $\beta = (10\text{ dB}) \log \frac{I}{I_0}$, $I = I_0\ 10^{\beta/(10\text{ dB})}$, $I_0 = 10^{-12}$ W/m^2.

Chapter 11 Equations

Oscillators, frequency, period, etc.:

$F = -kx = ma$, $f = 1/T$, $\omega = 2\pi f = 2\pi/T$, $\omega = \sqrt{k/m}$, $\omega = \sqrt{g/L}$.

Oscillator energy, speed, etc.:

$E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2 = \frac{1}{2}mv_{\text{max}}^2$, $v_{\text{max}} = \omega A$.

Waves:

$\lambda = vT$, $v = f\lambda$, $v = \sqrt{\frac{F_T}{m/L}}$, $I = P/A$, $I = P/4\pi r^2$.

Standing waves:

node to node distance $= \lambda/2$.

Chapter 10 Equations

Density:

$\rho = m/V$, SG$=\rho/\rho_{\text{H}_2\text{O}}$, $\rho_{\text{H}_2\text{O}} = 1000$ kg/m^3 $= 1.00$ g/cm^3 (at 4°C).

Static Fluids:

$P = F/A$, $P_2 = P_1 + \rho g h$, $\Delta P = \rho g h$, $P = P_{\text{atm.}} + P_G$, $B = \rho g V$ or $F_B = \rho g V$.

Pressure Units:

1 Pa = 1 N/m^2, 1 bar = 10^5 Pa = 100 kPa, 1 mm-Hg = 133.3 Pa.

1.00 atm = 101.3 kPa = 1.013 bar = 760 torr = 760 mm-Hg =14.7 lb/in^2.

Moving Fluids:

$A_1 v_1 = A_2 v_2 =$ a constant, $P + \frac{1}{2}\rho v^2 + \rho g y =$ a constant.

(over)

Energy, Force, Power

Work & Kinetic & Potential Energies:

$W = Fd\cos\theta$, $\quad$ $\text{KE} = \frac{1}{2}mv^2$, $\quad$ $\text{PE}_{\text{gravity}} = mgy$, $F_{\text{gravity}} = -mg$. $\quad$ $\text{PE}_{\text{spring}} = \frac{1}{2}kx^2$, $F_{\text{spring}} = -kx$.

Conservation or Transformation of Energy:

"work-KE theorem" $\Delta\text{KE} = W_{\text{net}}$, **or use conservation law**: $\Delta\text{KE} + \Delta\text{PE} = W_{\text{NC}}$. $\quad$ $E_2 = E_1 + W_{\text{NC}}$.

Power:

$P_{\text{ave}} = \frac{W}{t}$, $\quad$ or use $P_{\text{ave}} = \frac{\text{energy}}{\text{time}}$.

Acceleration Equations

Centripetal Acceleration:

$a_R = \frac{v^2}{r} = \omega^2 r$, towards the center of the circle.

Circular motion:

speed $v = \frac{2\pi r}{T} = 2\pi r f = \omega r$, frequency $f = \frac{1}{T}$, where T is the period of one revolution.

Newton's Second Law:

$\vec{F}_{\text{net}} = m\vec{a}$, which means $\Sigma F_x = ma_x$ and $\Sigma F_y = ma_y$.

Acceleration:

$\bar{v} = \frac{\Delta x}{\Delta t}$, $\quad \Delta x = x - x_0$, $\quad$ slope of $x(t) = v(t)$.

$\bar{a} = \frac{\Delta v}{\Delta t}$, $\quad \Delta v = v - v_0$, $\quad$ slope of $v(t) = a(t)$.

For constant acceleration in one-dimension:

$\bar{v} = \frac{1}{2}(v_0 + v)$, $\quad v = v_0 + at$, $\quad x = x_0 + v_0 t + \frac{1}{2}at^2$, $\quad v^2 = v_0^2 + 2a(x - x_0)$.

Vectors

Written $\vec{V}$ or $\mathbf{V}$, described by magnitude=V, direction=θ or by components (V_x, V_y).

$V_x = V\cos\theta$, $\quad V_y = V\sin\theta$,

$V = \sqrt{V_x^2 + V_y^2}$, $\quad \tan\theta = \frac{V_y}{V_x}$. $\quad$ θ is the angle from $\vec{V}$ to $+x$-axis.

Addition: $\mathbf{A} + \mathbf{B}$, head to tail. $\quad$ Subtraction: $\mathbf{A} - \mathbf{B}$ is $\mathbf{A} + (-\mathbf{B})$, $\quad -\mathbf{B}$ is $\mathbf{B}$ reversed.

Trig summary

$\sin\theta = \frac{(\text{opp})}{(\text{hyp})}$, $\quad \cos\theta = \frac{(\text{adj})}{(\text{hyp})}$, $\quad \tan\theta = \frac{(\text{opp})}{(\text{adj})}$, $\quad (\text{opp})^2 + (\text{adj})^2 = (\text{hyp})^2$.

$\sin\theta = \sin(180^\circ - \theta)$, $\quad \cos\theta = \cos(-\theta)$, $\quad \tan\theta = \tan(180^\circ + \theta)$, $\quad \sin^2\theta + \cos^2\theta = 1$.