Formula Sheet - Phys. 32

$v^2 = v_0^2 + 2a\Delta x$

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

$g = 9.8\ m/s^2$

$G = 6.67 \times 10^{-11}\ \frac{N \cdot m^2}{kg^2}$

$R = 8.31\ \frac{J}{mol \cdot K}$

$k = 1.38 \times 10^{-23}\ J/K$

$\vec{F} = \frac{GmM}{r^2}\hat{r}$ $\quad PE = -\frac{GmM}{r}$

$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$

$P = F/A$

$Av = \text{constant}$

$x(t) = A e^{-bt/2m}\cos\left[\sqrt{\left(\frac{k}{m} - \frac{b^2}{4m^2}\right)}t + \phi\right]$

$\omega = \sqrt{\frac{k}{m}}$; $\omega = \sqrt{\frac{g}{l}}$; $\omega = \sqrt{\frac{mgH}{I}}$

$\omega = \frac{2\pi}{T}$ $\quad T = \frac{2\pi}{\omega}$ $\quad \vec{\tau} = I\vec{\alpha}$ $\quad \vec{\tau} = \vec{r} \times \vec{F}$

$v = \lambda f$ $\quad k = \frac{2\pi}{\lambda}$ $\quad \omega = 2\pi f$

$KE = \frac{1}{2}mv^2$ $\quad PE = \frac{1}{2}kx^2$

$KE = \frac{1}{2}I\omega^2$ $\quad PE = mgh$

SHM: $x(t) = x_{max}\cos(\omega t + \phi)$ $\quad$ Standing Wave: $y(x,t) = 2y_{max}(\sin kx)(\cos \omega t)$

$v = \frac{dx}{dt}$

$a = \frac{d^2x}{dt^2}$ $\quad a = \frac{v^2}{r}$

Traveling wave: $y(x,t) = y_{max}\sin(kx - \omega t + \phi)$

$\Delta E = \Delta Q \pm \Delta W$

$C_p = C_v + nR$

$\Delta Q = mc\Delta T$ $\quad \Delta Q = mL$

$\frac{dQ}{dt} = KA\left(\frac{dT}{dx}\right)$

* Thermal expansion: $\Delta L = L_0 \alpha \Delta T$ $\quad \Delta V = V_0 \beta \Delta T$

$PV = nRT$ $\quad PV^{\gamma} = \text{const.}$ $\quad TV^{\gamma-1} = \text{const}$

$\left(P + \frac{a}{(V/n)^2}\right)\left(\frac{V}{n} - b\right) = RT$

Specific heat / latent heat of water:

$c_{water} = 4186\ J/kg \cdot K$

$c_{ice} = 2100\ \frac{J}{kg \cdot K}$

$c_{steam} = 2000\ \frac{J}{kg \cdot K}$

$L_f = 333{,}000\ J/kg$

$L_v = 2.26 \times 10^6\ J/kg$

$c_{Aluminum} = 900\ \frac{J}{kg \cdot K}$

$c_{copper} = 385\ \frac{J}{kg \cdot K}$

$c_{iron} = 450\ \frac{J}{kg \cdot K}$

$\rho_{water} = 1000\ kg/m^3$

$\rho_{air} = 1.2\ kg/m^3$

$\rho_{Al} = 2700\ kg/m^3$

$\rho_{copper} = 8960\ kg/m^3$

$\rho_{Fe} = 7870\ kg/m^3$

$v = \sqrt{\frac{B}{\rho}}$ $\quad v = \sqrt{\frac{T}{\mu}}$

$f' = f_0\left(\frac{v_{sound} \pm v_{obs}}{v_{sound} \mp v_{source}}\right)$

$f(v) = 4\pi N\left(\frac{m}{2\pi kT}\right)^{3/2} v^2 e^{-\frac{mv^2}{2kT}}$

$l_{mfp} = \frac{1}{4\pi\sqrt{2}\, r^2\left(\frac{N}{V}\right)}$ $\quad \frac{N_a}{22.4 \times 10^{-3}\ m^3}$

$\bar{v} = \sqrt{\frac{8kT}{\pi m}}$ $\quad v_p = \sqrt{\frac{2kT}{m}}$ $\quad v_{RMS} = \sqrt{\frac{3kT}{m}}$

$I = 2\pi^2 v \rho f^2 A^2$

$\beta = 10\log\left(\frac{I}{I_0}\right)$ $\quad I_0 = 10^{-12}\ \frac{W}{m^2}$

$\gamma = \frac{C_p}{C_v}$ $\quad e = \frac{\Delta W_{net}}{Q_{in}}$ $\quad e_{Carnot} = \frac{T_H - T_C}{T_H}$

$\Delta S = \int \frac{dQ}{T}$ $\quad \Delta W = \int P\,dV$

$\frac{dQ}{dt} = \sigma \varepsilon A(T^4 - T_0^4)$

$v_{sound\ in\ air} \simeq 343\ m/sec$