Equation Sheets (Part 1)

Part 1

$\rho_w = 1000\ kg/m^3$ Pressure $= p = \dfrac{\mathbf{F}}{\mathbf{A}}$ $\sigma = \dfrac{\mathbf{F}}{\mathbf{A}}$ $\sigma = \mathbf{Y}\dfrac{\mathbf{L - L_0}}{\mathbf{L}}$ $p_h = \rho g h$;

$F/A = Y (L-L_0)/L_0$ $F/A = S (L-L_0)/L_0$ $\Delta P = -B (V-V_0)/V_0$

1 atm = 1.013×10^5 Pa, $g=9.8\ m/s^2$ $F_B = \rho g V$ $A_1 v_1 = A_2 v_2$ Av -volume flow rate,

Mass flow rate = $Av\rho$

$p_1 + 1/2\rho v_1^2 + \rho g h_1 = p_2 + 1/2\rho v_2^2 + \rho g h_2$ flow in horizontal pipe: $p_1 + 1/2\rho v_1^2 = p_2 + 1/2\rho v_2^2$

$T(^0C) = \frac{5}{9}\ [T(^0F) - 32]$; $T(^0F) = \frac{9}{5}\ T(^0C) + 32$; $T(K) = [T(^0C) + 273]$ $\Delta T_F = 1.8\ \Delta T_C$

$PV = n R T$, $R = 8.31$ J/mol.K or $R = 0.0821$ L·atm/mol·K

$N_{Av} = 6.022 \times 10^{23}$ $N = n N_{Av}$

$L - L_0 = \alpha L_0 (T-T_0)$; $A - A_0 = 2\alpha A_0 (T-T_0)$; $V - V_0 = \beta V_0 (T-T_0)$ $V - V_0 = 3\alpha V_0 (T-T_0)$

$\sigma = Y\alpha (T-T_0)$ $\rho = \frac{m}{V}$; $A_{circle} = \pi r^2$ 1 m = 100 cm $V_{cube} = a^3$ $V_{sphere} = \frac{4}{3}\pi R^3$

$V_{cyl} = \pi r^2 L$ 1m = 100 cm 1 kg = 1000 g

Kinetic Energy of moving object = $\frac{1}{2} m v^2$

Potential Energy near surface of earth = m g h, $g=9.8\ m/s^2$

$\dfrac{Q}{t} = kA\dfrac{T_1 - T_2}{L}$ $\dfrac{Q}{t} = A\dfrac{T_1 - T_2}{\sum R_i}$ **R = L/k** $\dfrac{Q}{t} = \mathbf{e\sigma A(T^4 - T_0^4)}$ $\boldsymbol{\sigma = 5.67 \times 10^{-8}\ W/m^2K^4}$

Equation Sheets (Part 2)

$T(^0C) = \frac{5}{9}[T(^0F) - 32]$; $T(^0F) = \frac{9}{5}T(^0C) + 32$; $T(K) = [T(^0C) + 273]$ $\rho = \frac{m}{V}$; $A_{circle} = \pi r^2$

1 m = 100 cm $V_{cube} = a^3$ $V_{sphere} = \frac{4}{3}\pi R^3$ $V_{cyl} = \pi r^2 L$ 1m = 100 cm 1 kg = 1000 g

Heat: $Q = mc(T - T_0)$, $Q = mL_F$, L - latent heat heat lost = heat gained

$c_{water} = 4186 \frac{J}{kg \cdot {}^0C}$; $L_F = 3.35x10^5 \frac{J}{kg}$; $c_{ice} = 2100 \frac{J}{kg \cdot {}^0C}$

$Q = kA\frac{T_1 - T_2}{L}t$ $Q = kA\frac{T_1 - T_2}{\sum R_i}t$ $R = L/k$ $\frac{Q}{t} = e\sigma A(T^4 - T_0^4)$ $\sigma = 5.67x10^{-8}\ W/m^2K^4$

Thermodynamics: $\Delta U = \Delta Q + W$ $W = P\Delta V$ $Q_h = W + Q_c$ $e = \frac{W}{Q_h}$ $e = 1 - \frac{T_c}{T_h}$

$COP = \frac{Q_c}{W}$ $COP = \frac{T_c}{T_h - T_c}$

Harmonic Motion

$x = A\cos(\omega t)$ $v = -\omega A\sin(\omega t)$ $\omega = 2\pi f$ $\omega = \frac{2\pi}{T}$ $F = -kx$ period: $T_{spring} = 2\pi\sqrt{\frac{m}{k}}$;

$T_{pend} = 2\pi\sqrt{\frac{L}{g}}$ $\omega = \sqrt{\frac{k}{m}}$ $f = \frac{1}{T}$ $v_{max} = A\omega$ $E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$; $Us = \frac{1}{2}kx^2$;

$E = \frac{1}{2}kA^2$; $v = \omega(A^2 - x^2)^{1/2}$

$E = \frac{1}{2}m(v_m)^2$ waves: $v = \lambda \cdot f$ linear mass $\mu = \frac{m}{L}$ $v = \sqrt{\frac{F}{\mu}}$

standing waves on string : n = 1, 2, 3., $f = \frac{v}{2L}n$ $\lambda = \frac{2L}{n}$

Sound:

$v = \left(331\frac{m}{s}\right)\sqrt{\frac{T}{273\,K}}$ $v = \sqrt{\frac{Y}{\rho}}$ $v = \sqrt{\frac{B}{\rho}}$ $\beta = 10\log\left(\frac{I}{I_o}\right)$

Equation Sheets (Part 3)

Waves: $v = \lambda \cdot f$ linear mass: $\mu = \frac{m}{L}$ $v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{Tension}{\mu}}$

sound: $v = 343$ m/s $v = 331 \text{ m/s} \sqrt{\frac{T}{273\,K}}$

$I_0 = 10^{-12}$ W/m^2 $I = \frac{E}{t \cdot A}$ $I = \frac{P}{4\pi R^2}$ $\beta = 10\text{dB} \log \frac{I}{I_0}$ $\beta_2 - \beta_1 = 10\text{dB} \log \frac{I_2}{I_1}$ $f = f_0 \frac{v_{sound} \pm v_d}{v_{sound} \mp v_s}$

standing waves: on string and in open pipe at both ends: $n = 1, 2, 3.,$ $f = \frac{v}{2L} n$ $\lambda = \frac{2L}{n}$

in pipe closed at one end: $n = 1, 3, 5, \ldots$ $f = \frac{v}{4L} n$ $\lambda = \frac{4L}{n}$

interference: constructive: $d_2 - d_1 = n\lambda$ $f = \frac{v}{d_2 - d_1} n$ destructive: $d_2 - d_1 = (n + \frac{1}{2})\lambda$ $f = \frac{v}{d_2 - d_1} (n + \frac{1}{2})$

Electric charge: $q = Ne$ $F = k\frac{q_1 q_2}{r^2}$ $E = k\frac{q}{r^2}$ $F = qE$ $qE = ma$

$k = 8.99 \times 10^9$ Nm^2/C^2 $e = 1.6 \times 10^{-19}$ C $m_e = 9.11 \times 10^{-31}$ kg Circuits: $R = \rho \frac{L}{A}$;

$I = n\, q\, v_d\, A$

$R = R_0[1 + \alpha(T - T_0)]$; $V = I*R$ $I = \frac{\Delta q}{\Delta t} = \frac{Ne}{t}$; $Q = mc\Delta T$ $P = \frac{E}{\Delta t}$ $P = I^2R$

$P = \frac{V^2}{R}$ $P = I*V$; in series : $R_{eq} = R_1 + R_2 + \ldots + R_n$ in parallel: $1/R_{eq} = 1/R_1 + 1/R_2 + \ldots + 1/R_n$

Motion for constant acceleration

$x = v_0 t + \frac{1}{2} at^2$ $x_f = x_i + \frac{v_f^2 - v_i^2}{2a}$ $v = v_0 + at$;

$F = m\, a$

Equation Sheets (Part 4)

Light:

$E=h\,c/\lambda$ $n=\dfrac{c}{v}$ $\lambda=\lambda_0/n$ $c = 3\times10^8$ m/s $n_1\sin\theta_1 = n_2\sin\theta_2$ $n_1\sin\theta_{cr} = n_2\sin90^0$

Thin convex lense and concave mirror

$1/p + 1/q = 1/f$ $M = -q/p$

$A_{circle} = \pi r^2$ $V_{cube} = a^3$ $V = \dfrac{4}{3}\pi r^3$ $V_{cyl} = \pi r^2 L$

1 nm = 10^{-9} m 1 km = 1000 m 1 kg = 1000 g 1 m = 100 cm= 1000 mm 1 ft = 12 in.

1 mi = 1.609 km