VECTORS & TRIG

$\sin\theta = \frac{opp}{hyp}$

$\cos\theta = \frac{adj}{hyp}$

$\tan\theta = \frac{opp}{adj}$

$a^2 + b^2 = c^2$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$c^2 = a^2 + b^2 - 2ab\cos C$

MOTION

$\bar{v} = \frac{d}{t}$

$\bar{v} = \frac{v_f + v_i}{2}$

$d = v_i t + \frac{1}{2}at^2$

$v_f = v_i + at$

$v_f^2 = v_i^2 + 2ad$

FORCES

$F_{net} = ma$

$F_w = mg$

$F_N = F_w\cos\theta$

$F_{\parallel} = F_w\sin\theta$

$F_f = \mu F_N$

$F_c = ma_c = \frac{mv^2}{r}$

PROJECTILES

$v_x = v\cos\theta$

$v_y = v\sin\theta$

$t_{total} = \frac{2v_y}{g}$

$d_x = v_x t$

$R = \frac{v^2\sin 2\theta}{g}$

MOMENTUM

$p = mv$

$J = Ft$

$J = Ft = \Delta p = mv_f - mv_i$

$\Sigma p_{before} = \Sigma p_{after}$

CIRCULAR AND ROTATIONAL MOTION

$v = \frac{2\pi r}{T} = r\omega$

$a_c = \frac{v^2}{r} = r\omega^2$

$a_t = r\alpha$

$F_c = ma_c = \frac{mv^2}{r}$

$\tan\theta = \frac{v^2}{rg}(banks)$

$v_{critical} = \sqrt{gr}$

$\bar{\omega} = \frac{\theta}{t}$

$\bar{\omega} = \frac{\omega_i + \omega_f}{2}$

$\omega_f = \omega_i + \alpha t$

$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\theta = \omega_i t + \frac{1}{2}\alpha t^2$

$\tau = F_{\perp} r = mr^2\alpha = I\alpha$

$W = \tau\theta$

$P = \frac{W}{t} = \frac{\tau\theta}{t} = \tau\bar{\omega}$

$L = I\omega$

$\sum L_{before} = \sum L_{after}$

$\Sigma\tau_{clockwise} = \Sigma\tau_{counterclockwise}$

$KE_{rotate} = \frac{1}{2}I\omega^2$

$KE_{roll} = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$

ENERGY

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = Fd$

$P = \frac{W}{t} = F\bar{v}$

$AMA = \frac{F_{out}}{F_{in}}$

$IMA = \frac{d_{in}}{d_{out}}$

$Eff = \frac{AMA}{IMA} = \frac{W_{out}}{W_{in}} = \frac{P_{out}}{P_{in}}$

MACHINE IMA'S

$incline = \frac{length}{height}$

$lever = \frac{effort\ arm\ length}{load\ arm\ length}$

$wheel\ \&\ axle = \frac{r_{wheel}}{r_{axle}} = \frac{D_{wheel}}{D_{axle}}$

$pulley = \#\ support\ ropes$

$screw = \frac{2\pi r}{pitch}$

SPRINGS & SHM

$F = kx$

$W_{spring} = PE_e = \frac{1}{2}kx^2$

$T = \frac{1}{f}$

$T_{spring} = 2\pi\sqrt{\frac{m}{k}}$

$T_{pendulum} = 2\pi\sqrt{\frac{L}{g}}$

$\omega = \frac{2\pi}{T} = 2\pi f$

$v_x = -A\omega\sin\omega t$

$v_{max} = A\omega$

$a_x = -A\omega^2\cos\omega t$

$a_{max} = A\omega^2$

$\omega = \sqrt{\frac{k}{m}}$

GRAVITATION

$F = \frac{Gm_1m_2}{d^2}$

$g = \frac{GM}{r^2}$

$v_{escape} = \sqrt{\frac{2GM}{r}} = \sqrt{2gr}$

$v_{orbit} = \sqrt{\frac{GM}{r}}$

$G = 6.67\times10^{-11}\frac{N\cdot m^2}{kg^2}$

$T^2 = Kr^3$

$K = 2.97X10^{-19}\frac{s^2}{m^3}$

WAVES & SOUND

$v = \lambda f$

$v_{sound} = 330\frac{m}{s} + .6\frac{m/s}{^\circ C}$

$v = \sqrt{\frac{F}{m/L}}$

$I = \frac{P}{A} = \frac{P}{4\pi r^2}$

$\beta = (10dB)\log\frac{I}{I_0}$

$\Delta\beta = (10dB)\log\frac{I_2}{I_1}$

$f_l = f_s\frac{v + v_l}{v - v_s}$

$f_n = \frac{nv}{2L}(string, open\ tube) n = 1,2,3, \ldots$

$f_n = \frac{nv}{4L}(tube\ open\ one\ end) n = 1,3,5, \ldots$

$\sin\theta = \frac{\lambda}{D}(square\ opening)$

$\sin\theta = 1.22\frac{\lambda}{D}(round\ opening)$

PROPERTIES OF FLUIDS

$\rho = \frac{m}{V}$

$P = \frac{F}{A}$

$P = \rho gh$

$P_2 = P_1 + \rho gh(absolute)$

$P_2 - P_1 = \rho gh(gauge)$

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$F_B = W_{fluid} = mg = \rho Vg$

$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

$P_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$

THERMODYNAMICS

$\Delta U = Q - W$

$\Delta U = \frac{3}{2}nR\Delta T$

$W = P\Delta V = nR\Delta T\ (isobaric)$

$W = nRT\ln\frac{V_2}{V_1}(isothermal)$

$W = -\frac{3}{2}nR\Delta T(adiabatic)$

$P_1 V_1^\gamma = P_2 V_2^\gamma (adiabatic)$

$Q_V = C_V n\Delta T(C_V = \frac{3}{2}R)$

$Q_P = C_P n\Delta T(C_P = \frac{5}{2}R)$

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

$Eff = \frac{W}{Q_h} = \frac{Q_h - Q_c}{Q_h} = 1 - \frac{Q_c}{Q_h}(real\ engine)$

$Eff = 1 - \frac{T_c}{T_h}(carnot\ engine)$

$\frac{Q_c}{Q_h} = \frac{T_c}{T_h}(carnot\ engine)$

$\Delta S = \frac{Q}{T}$

$COP = \frac{Q_c}{W}(air\ conditioner)$

$COP = \frac{Q_h}{W}(heat\ pump)$

PROPERTIES OF GASES

$PV = nRT = NkT$

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

$k = 1.38X10^{-23}\frac{J}{K}$

$P_1 V_1 = P_2 V_2$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\overline{KE} = \frac{1}{2}mv_{rms}^2 = \frac{3}{2}kT$

PROPERTIES OF SOLIDS

$\rho = \frac{m}{V}$

$P = \frac{F}{A}$

$Y = \frac{FL_0}{A\Delta L}$

$S = \frac{FL_0}{A\Delta X}$

$\Delta P = -B\frac{\Delta V}{V_0}$

$Q = mc\Delta T\ (same\ phase)$

$Q = mL_f(fusion)$

$Q = mL_v(vaporization)$

$\Delta L = \alpha L_0 \Delta T$

$\Delta V = \beta V_0 \Delta T$

$Q = \frac{kA\Delta Tt}{L}$

$Q = \frac{A\Delta Tt}{R}$

$Q = e\sigma AT^4 t$

$\sigma = 5.67X10^{-8}\frac{J}{s\cdot m^2\cdot K^4}$

CONSTANTS

$g = 9.80\frac{m}{s^2}$

$M_{earth} = 5.98\times10^{24}kg$

$r_{earth} = 6.38\times10^{6}m$

$c = 3.00\times10^{8}\frac{m}{s}$

$m_{p^+} = 1.67\times10^{-27}kg$

$m_{e^-} = 9.11\times10^{-31}kg$

$q_{p^+} = 1.602\times10^{-19}C$

$q_{e^-} = -1.602\times10^{-19}C$