PHY 171 Formula Sheet

Fundamental SI Units

Length	meter (m)
Mass	kilogram (kg)
Time	second (s)
Electric Current	ampere (A)

Some Derived SI Units

Force	$N = kg\ m/s^2$
Energy	$J = kg\ m^2/s^2$
Power	$W = J/s$
Pressure	$Pa = N/m^2$

Some Important Constants

$G = 6.674 \times 10^{-11}\ N \cdot m^2/kg^2$
$c = 3.00 \times 10^8\ m/s$
$N_A = 6.02 \times 10^{23}$ particles/mole
$k = 1.38 \times 10^{-23}\ J/K$
$g = 9.80\ m/s^2$
$R = 8.31\ J/mol \cdot K$

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

Kinematics

Displacement $\Delta x = x_f - x_0$

Velocity $v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_0}{t_f - t_0}$

Acceleration $a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_0}{t_f - t_0}$

constant a
$x = x_0 + vt$
$v = v_0 + at$
$x = x_0 + v_0 t + \frac{1}{2}at^2$
$v^2 = v_0^2 + 2a(x - x_0)$

freefall $a = -g$
$v = v_0 - gt$
$y = y_0 + v_0 t - \frac{1}{2}gt^2$
$v^2 = v_0^2 - 2g(y - y_0)$

Projectile motion

horizontal motion $a_x = 0$
$x = x_0 + v_x t$
$v_x = v_{0x} = v_x$
vertical motion
$y = y_0 + v_0 t - \frac{1}{2}gt^2$
$v_y = v_{0y} - gt$
$v_y^2 = v_{0y}^2 - 2g(y - y_0)$

$s = \sqrt{x^2 + y^2}$
$\theta = \tan^{-1}(y/x)$
$v = \sqrt{v_x^2 + v_y^2}$
$\theta_v = \tan^{-1}(v_y/v_x)$
Maximum height and range
$h = \frac{v_{0y}^2}{2g}$
$R = \frac{v_0^2 \sin 2\theta_0}{g}$

Dynamics

$a = \frac{F}{m}$
$F = ma$
$w = mg$

friction

$f_s \leq \mu_s N$
$f_k = \mu_k N$

Uniform Circular Motion

$\Delta\theta = \frac{\Delta s}{r}$
2π rad $= 360° = 1$ revolution
$\omega = \frac{\Delta\theta}{\Delta t}$
$v = r\omega$ or $\omega = \frac{v}{r}$
Centripetal Acceleration
$a_c = \frac{v^2}{r}$; $a_c = r\omega^2$
Centripetal Force
$F_c = ma_c$
$F_c = m\frac{v^2}{r}$
$F_c = mr\omega^2$
$\Delta L = \frac{F}{k}$

Newton's Univeral Law of Gravitation

$F = G\frac{mM}{r^2}$

Work and Energy

$W = Fd\cos\theta$
$KE = \frac{1}{2}mv^2$
$\Delta PE_g = mgh$
$W = \Delta KE + \Delta PE$
$PE_{spring} = \frac{1}{2}kx^2$
$P = \frac{W}{t}$

Linear Momentum

$p = mv$
$F = \frac{\Delta p}{\Delta t}$
$p_{tot} =$ constant
$PE_{spring} = \frac{1}{2}kx^2$

Statics and Torque

$\tau = rF\sin\theta$
$\tau = r_\perp F$
$F_{net} = 0 \quad$ net $\tau = 0$

Rotational Motion and Angular Momentum

$\omega = \frac{\Delta\theta}{\Delta t} \quad \alpha = \frac{\Delta\omega}{\Delta t}$
$a_t = r\frac{\Delta\omega}{\Delta t} \quad a_t = r\alpha$
$x = r\theta \quad v = r\omega$
$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$
$\omega = \omega_0 + \alpha t$
$\omega^2 = \omega_0^2 + 2\alpha\theta$
net$\tau = I\alpha$
$KE_{rot} = \frac{1}{2}I\omega^2$

Fluid Statics

$\rho = \frac{m}{V}$
$P = \frac{F}{A}$
$P = h\rho g$
$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

Temperature, Kinetic Theory, & the Gas Laws

$\Delta L = \alpha L \Delta T$
$PV = nRT \quad PV = NkT$
$\bar{KE} = \frac{1}{2}m\bar{v^2} = \frac{3}{2}kT$

Heat and Heat Transfer

$Q = mc\Delta T$
$\frac{Q}{t} = \frac{kA(T_2 - T_1)}{d}$
$\frac{Q}{t} = \sigma e A T^4$

Oscillatory Motions and Waves

$F = -kx$
$f = \frac{1}{T} \quad T = \frac{1}{f}$
$T = 2\pi\sqrt{\frac{L}{g}}$
$T = 2\pi\sqrt{\frac{m}{k}}$
$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$