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

Some Important Constants

$G = 6.674 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$

$c = 3.00 \times 10^{8}\ \mathrm{m/s}$

$N_A = 6.02 \times 10^{23}$ particles/mole

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

$g = 9.80\ \mathrm{m/s^2}$

$R = 8.31\ \mathrm{J/mol} \cdot K$

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

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

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

Linear Momentum

$$p = mv$$
$$F = \frac{\Delta p}{\Delta t}$$

$p_{\mathrm{tot}} =$ constant

$$\mathrm{PE_{spring}} = \frac{1}{2}kx^2$$

Statics and Torque

$$\tau = rF\sin\theta$$
$$\tau = r_\perp F$$

$F_{\mathrm{net}} = 0$ net $\tau = 0$

Rotational Motion and Angular Momentum

$\omega = \frac{\Delta\theta}{\Delta t}$ $\alpha = \frac{\Delta\omega}{\Delta t}$

$a_t = r\frac{\Delta\omega}{\Delta t}$ $a_t = r\alpha$

$x = r\theta$ $v = r\omega$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$
$$\omega = \omega_0 + \alpha t$$
$$\omega^2 = \omega_0^2 + 2\alpha\theta$$
$$\mathrm{net}\tau = I\alpha$$
$$\mathrm{KE_{rot}} = \frac{1}{2}I\omega^2$$

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

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

$PV = nRT$ $PV = NkT$

$$\bar{KE} = \frac{1}{2}m\bar{v^2} = \frac{3}{2}kT$$

Heat and Heat Transfer

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