Kinematics: $v_x = \dfrac{dx}{dt}$ $a_x = \dfrac{dv_x}{dt}$ $v_{x_f} = v_{x_i} + a_x\Delta t$ $x_f = x_i + v_{x_i}\Delta t + \dfrac{1}{2}a_x\Delta t^2$

$v_{x_f}^2 = v_{x_i}^2 + 2a_x(x_f - x_i)$ $a_{rad} = \dfrac{v^2}{r}$ $\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$ $T = \dfrac{2\pi r}{v}$ $f = 1/T$

Forces and Potentials: $\sum \vec{F}_i = \vec{F}_{\text{net}} = m\vec{a}$ $f_s \le \mu_s n$ $f_k = \mu_k n$

$F_s = -k(x - x_R)$ $F_g = \dfrac{GM_1M_2}{r^2}$ $GMT^2 = 4\pi^2 r^3$

Rotation: $\omega = \dfrac{d\theta}{dt}$ $\alpha = \dfrac{d\omega}{dt}$ $v = \omega r$ $a_{tan} = \alpha r$ $a_{rad} = \omega^2 r$ $\omega = 2\pi f$

$\Delta\theta = \omega_i\Delta t + \dfrac{1}{2}\alpha\Delta t^2$ $\omega_f = \omega_i + \alpha\Delta t$ $\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$ $\tau = rF\sin\phi$

$I = \sum_i m_i r_i^2$ $Mx_{cg} = m_1x_1 + m_2x_2 + \cdots = \sum_i m_i x_i$ $\sum \tau_{ext} = I\alpha$

Momentum: $\vec{p} = m\vec{v}$ $L = rp\sin\phi = r_\perp p$ (particle) $L = I\omega$ (rigid body)

Work-Energy: $W = \vec{F}\cdot\vec{r}$ $P = \dfrac{\Delta E}{\Delta t}$ $U_g = mgy$ $U_s = \dfrac{1}{2}kx^2$ $K = \dfrac{1}{2}mv^2$

$K = \dfrac{1}{2}I\omega^2$ $K = \dfrac{1}{2}MV_{cm}^2 + \dfrac{1}{2}I_{cm}\omega^2$

Oscillations: $F = -kx$ $x = A\cos(2\pi ft + \phi)$ $\omega = 2\pi f$ $T = \dfrac{1}{f}$ $f = \dfrac{1}{2\pi}\sqrt{k/m}$

$f = \dfrac{1}{2\pi}\sqrt{g/L}$ $E = \dfrac{1}{2}kA^2$ $v_{\max} = 2\pi fA$ $a_{\max} = (2\pi f)^2 A$

Fluids: $\rho = M/V$ $p = F/A$ $p = p_{\text{atm}} + \rho gh$ $F_B = \rho_f V_{disp}\, g$ $A_1v_1 = A_2v_2$

$p_1 + \dfrac{1}{2}\rho v_1^2 + \rho gy_1 = p_2 + \dfrac{1}{2}\rho v_2^2 + \rho gy_2$ $Q = v_{\text{avg}}A = \dfrac{(p_1 - p_2)\pi r^4}{8\eta L}$

Thermodynamics: $T_K = T_C + 273.15$ $E_{th} = \bar{K}_{tr} = \dfrac{3}{2}Nk_BT$ $W = \int_{V_i}^{V_f} pdV$

$Q = nC_V\Delta T$ $Q = nC_p\Delta T$ $C_V = \dfrac{3}{2}R$ $C_p = C_V + R$ $Q = W + \Delta E_{th}$

$Q = mc\Delta T$ $Q = \pm mL$ $pV = nRT = Nk_BT$ $e = \dfrac{|W|}{|Q_H|}$ $e_{\max} = 1 - \dfrac{T_C}{T_H}$

$COP = \dfrac{|Q_C|}{|W|}$ $COP_{\max} = \dfrac{T_C}{T_H - T_C}$

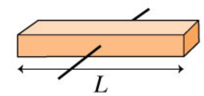
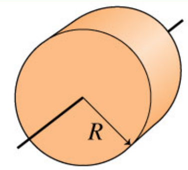
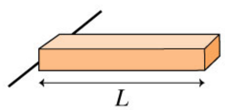
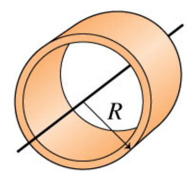
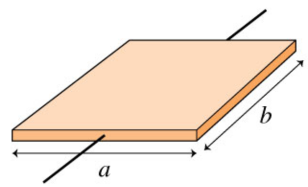
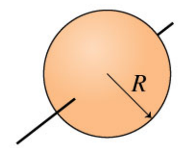
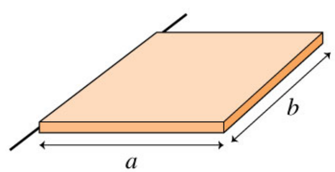
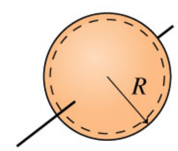
Vectors: $A_x = A\cos\theta$ $A_y = A\sin\theta$ $A = \sqrt{A_x^2 + A_y^2}$ $\tan\theta = \dfrac{A_y}{A_x}$

$\vec{A}\cdot\vec{B} = AB\cos\phi_{AB}$ $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$ $\vec{A}\times\vec{B} = \hat{n}AB\sin\phi_{AB}$

Math: $ax^2 + bx + c = 0$ $\quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $\quad (1 + x)^n \approx 1 + nx$ for $x \ll 1$

Constants: $g = 9.8\text{m/s}^2$ $\quad G = 6.67 \times 10^{-11}\text{Nm}^2/\text{kg}^2$ $\quad R_{Earth} = 6.37 \times 10^6\text{m}$
$M_{Earth} = 5.98 \times 10^{24}\text{kg}$ $\quad M_{Sun} = 1.99 \times 10^{30}\text{kg}$ $\quad c = 2.998 \times 10^8\text{m/s}$
$T_z = -273.15°\text{C}$ $\quad 1\text{atm} = 1.013 \times 10^5\text{N/m}^2 = 101.3\text{kPa}$ $\quad \rho_{water} = 1000\text{kg/m}^3$
$k_B = 1.38 \times 10^{-23}\text{J/K}$ $\quad N_A = 6.022 \times 10^{23}$ $\quad R = 8.3145\text{J/mol} \cdot \text{K}$
$v_{sound} = 343\text{m/s}$ $\quad 1\text{eV} = 1.602 \times 10^{-19}\text{J}$

TABLE 7.1 Moments of inertia of objects with uniform density and total mass M

Object and axis	Picture	I	Object and axis	Picture	I
Thin rod (of any cross section), about center		$\frac{1}{12}ML^2$	Cylinder or disk, about center		$\frac{1}{2}MR^2$
Thin rod (of any cross section), about end		$\frac{1}{3}ML^2$	Cylindrical hoop, about center		MR^2
Plane or slab, about center		$\frac{1}{12}Ma^2$	Solid sphere, about diameter		$\frac{2}{5}MR^2$
Plane or slab, about edge		$\frac{1}{3}Ma^2$	Spherical shell, about diameter		$\frac{2}{3}MR^2$