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Physics 110 **CONSTANTS AND EQUATIONS** **Spring 2007**

Constant	Symbol	Value	Constant	Symbol	Value
Acceleration due to gravity	g	$9.80\ m/s^2$	Mass of Earth	M_e	5.98×10^{24} kg
Gravitational constant	G	$6.67 \times 10^{-11}\ Nm^2/kg^2$	Radius of Earth	R_e	6.37×10^6 m

f = final
i = initial
s = x or y, as appropriate to the problem

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Kinematics (constant acceleration)

$$v_{fs} = v_{is} + a_s \Delta t$$ v_f, v_i, a, t

$d = \frac{1}{2}at^2 \rightarrow$ $$s_f = s_i + v_{is}\Delta t + \tfrac{1}{2}a_s(\Delta t)^2$$ x_f, x_i, v_i, t, a

$d = vt$ $$v_{fs}^2 = v_{is}^2 + 2a_s \Delta s$$ $v_f, v_i, a, \Delta x$

Newton's Second Law and Forces

$$\vec{F}_{net} = \Sigma \vec{F}_{ext} = m\vec{a} = \frac{d\vec{p}}{dt}$$

$$\vec{W} = m\vec{g} \qquad F = -k\Delta s$$

$$F = \mu n$$

$$F_{m\ on\ M} = F_{M\ on\ m} = \frac{GMm}{r^2}$$

Linear/Circular/Rotational Connection

$$s = r\theta$$

$$v_t = r\omega$$

$$a_t = r\alpha$$

tangential speed

Centripetal Acceleration

$$a_r = \frac{v_t^2}{r} = \omega^2 r$$

radius

angular frequency (angular speed)

Impulse and Linear Momentum

$$\vec{J} = \int_{t_1}^{t_2} \vec{F}(t)dt = \Delta\vec{p}$$

$$\vec{p} = m\vec{v} \qquad \sum \vec{p}_i = \sum \vec{p}_f$$

Work and Energy

$$W = \int_{s_i}^{s_f} F_s ds \qquad W = \int_{s_i}^{s_f} \vec{F} \bullet d\vec{s}$$

$$\boxed{K = \tfrac{1}{2}mv^2} \qquad \Delta K = W_{net}$$

$$F_x = -\frac{dU}{dx} \qquad \Delta U_{A\to B} = -\int_A^B \vec{F}\cdot d\vec{s}$$

$$K_f + U_f = K_i + U_i$$

$$\Delta K + \Delta U = W_{nc}$$

Potential Energy

$$U = mgy = mgh$$

$$U = \tfrac{1}{2}k(\Delta s)^2$$

$$U = -\frac{GmM}{r}$$

$\boxed{W = \Delta U}$

Orbital Mechanics

$$v(circular) = \sqrt{\frac{GM}{r}}$$

$$v(escape) = \sqrt{\frac{2GM}{r}}$$

$$E(circular) = \frac{U}{2} = -K$$

$$T^2 = \frac{4\pi^2 r^3}{GM}(circular)$$

Torque

$$\tau = rF\sin\phi$$

$$\tau_{net} = \Sigma\tau_{ext} = I\alpha$$

Wave Motion

$$v = \frac{\lambda}{T} = \lambda f = \frac{\omega}{k}$$

$$k = \frac{2\pi}{\lambda}$$

$$D(x,t) = A\sin(kx \pm \omega t + \phi_o)$$

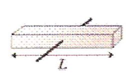
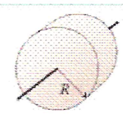
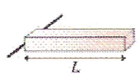
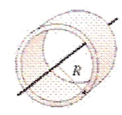
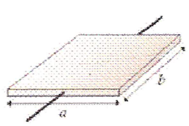
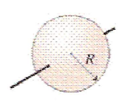
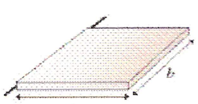
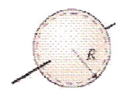
Vector Identities/Quadratic Equation

$$\vec{A} \bullet \vec{B} = |\vec{A}||\vec{B}|\cos\theta$$

$$If\ Ax^2 + Bx + C = 0\ then$$

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

TABLE 13.3 Moments of inertia of objects with uniform density

Object and axis	Picture	I	Object and axis	Picture	I
Thin rod, about center		$\frac{1}{12}ML^2$	Cylinder or disk, about center		$\frac{1}{2}MR^2$
Thin rod, 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		$\frac{2}{5}MR^2$ $\frac{2}{5}MR^2$
Plane or slab, about edge		$\frac{1}{3}Ma^2$	Spherical shell, about diameter		$\frac{2}{3}MR^2$ $\frac{2}{3}MR^2$