MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01 TEAL **Fall Term 2004**

Exam 1: Equation Summary

One Dimensional Kinematics:

$\vec{\mathbf{v}} = d\vec{\mathbf{r}} / dt$, $\vec{\mathbf{a}} = d\vec{\mathbf{v}} / dt$

$$v_x(t) - v_{x,0} = \int_{t'=0}^{t'=t} a_x(t')dt' \qquad x(t) - x_0 = \int_{t'=0}^{t'=t} v_x(t')dt'$$

Constant Acceleration:

$$x(t) = x_0 + v_{x,0}(t-t_0) + \frac{1}{2}a_x(t-t_0)^2 \qquad v_x(t) = v_{x,0} + a_x(t-t_0)$$

$$y(t) = y_0 + v_{y,0}(t-t_0) + \frac{1}{2}a_y(t-t_0)^2 \qquad v_y(t) = v_{y,0} + a_y(t-t_0)$$

where $x_0, v_{x,0}, y_0, v_{y,0}$ are the initial position and velocities components at $t = t_0$

Newton's Second Law: Force, Mass, Acceleration

$\vec{\mathbf{F}} \equiv m\vec{\mathbf{a}}$ $\vec{\mathbf{F}}^{total} = \vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2$ $F_x^{\ total} = ma_x$ $F_y^{\ total} = ma_y$ $F_z^{\ total} = ma_z$

Newton's Third Law:

$\vec{\mathbf{F}}_{1,2} = -\vec{\mathbf{F}}_{2,1}$

Force Laws:

Universal Law of Gravity: $\vec{\mathbf{F}}_{1,2} = -G\frac{m_1 m_2}{r_{1,2}^{\ 2}}\hat{\mathbf{r}}_{1,2}$, attractive

Gravity near surface of earth: $\vec{\mathbf{F}}_{grav} = m_{grav}\vec{\mathbf{g}}$, towards earth

Contact force: $\vec{\mathbf{F}}_{contact} = \vec{\mathbf{N}} + \vec{\mathbf{f}}$, depends on applied forces

Static Friction: $0 \le f_s \le f_{s,\max} = \mu_s N$ direction depends on applied forces

Kinetic Friction: $f_k = \mu_k N$ opposes motion

Hooke's Law: $F = k|\Delta x|$, restoring