PHYS 211X
General Physics I

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Formulas

Position:

$$x, y, s, \text{ or } p = \vec{v}\Delta t = \int \vec{v} dt \tag{1}$$

$$x = \left(\frac{v_0 + vf}{2}\right)\Delta t \tag{2}$$

$$x = v_0 t + \left(\frac{1}{2}\right)\vec{a}t^2 \tag{3}$$

$$\tag{4}$$

Velocity:

$$\vec{v} = \vec{a}\Delta t = \frac{d}{dt}[p] = \int (\vec{a}) dt \tag{5}$$

$$\vec{v} = v_0 + \vec{a}t \tag{6}$$

$$\vec{v}_f^2 = v_0^2 + 2\vec{a}\Delta x \tag{7}$$

$$\tag{8}$$

Acceleration

$$\vec{a} = \frac{d}{dt}[\vec{v}] \tag{9}$$

Projectile Motion:

$$y_f = y_0 + v_0(\Delta t) + \frac{1}{2}a(\Delta t^2) \tag{10}$$

Force:

$$\vec{F} = m\vec{a} \tag{11}$$

Friction:

$$f = \mu N \tag{12}$$

Drag:

$$\vec{F_D} \text{ or } D = \frac{1}{2}\rho C_D A v^2 \tag{13}$$

Circular Motion:

$$\vec{v} = r \tag{14}$$

$$a_{cent} = \frac{m\vec{v}^2}{r} \tag{15}$$

$$f = \mu n \tag{16}$$

$$v_{cent/crit} = \sqrt{gr} \tag{17}$$

$$N = mr\omega^2 \tag{18}$$

$$N = 3mg \tag{19}$$

$$\omega = \frac{\Delta\theta}{\Delta t} \tag{20}$$

$$\tag{21}$$

Total Energy:

$$E = K + U \tag{22}$$

$$KE_i + U_i = KE_f + U_f \tag{23}$$

$$\frac{1}{2}mv_i^2 + mgy_i = \frac{1}{2}mv_f^2 + mgy_f \tag{24}$$

PE of a spring:

$$U = 1/2kx^2 \tag{25}$$

$$U_p = \frac{1}{2}k(x - L_0)^2 \tag{26}$$

Total Potential Energy:

$$U_{tot} = mg + k(y - L_0) \tag{27}$$

Work:

$$W_{int} = -\frac{F_x}{\Delta} \tag{28}$$

$$F_x = -\frac{dU}{dx} \tag{29}$$

Key

v = velocity, meters/second
y = height, meters
x = distance, meters
t = time, seconds
m = mass, kilograms
a = acceleration, meters/second^2
θ = angle, degrees
g = gravity: 9.8 meters/second^2
ω = angular velocity, radians or degrees/second, counter-clockwise
F = force, Newtons, kilogram $\cdot$ meters/second^2
μ = coefficient of friction
N = normal force, Newtons
A = area, meters^2
ρ = volumetric mass density, kilograms/meters^3
C_D = drag coefficient (geometry dependant)
K = kinetic energy
U = potential energy