

## PHY 321 Classical Dynamics – Chapter 2 Review

- I. Concepts
  - a. Newton's Laws of Motion
  - b. Conservation Theorems (Linear and Angular Momentum, Energy)
- II. Terms and Symbols
  - a. free body
  - b. inertia
  - c. inertial vs gravitational mass
  - d. equation of motion
  - e. path independence
  - f. conservative force
  - g.  $T, U, \mathbf{p}, \mathbf{F}, \mathbf{N} = \mathbf{r} \times \mathbf{F}, \mathbf{L} = \mathbf{r} \times \mathbf{p}, \dots$
- III. Problem Types
  - a. Free Fall  $y = v_0 t - \frac{1}{2} g t^2, v^2 = v_0^2 - 2gh, v = v_0 - gt$
  - b. Projectile Motion  $x = v_{0x} t, y = v_{0y} t - \frac{1}{2} g t^2, v_y^2 = v_{0y}^2 - 2gh, v_y = v_{0y} - gt$
  - c. Inclined Plane – no friction  $|a| = g \sin \theta, N = mg \cos \theta$  and friction – angle of repose, etc
  - d. Types of Forces
    - i. Old - Normal, Weight, Tension, Friction, Gravitational,
    - ii. New – Drag, Retarding force
  - e. Computing forces from  $v=v(x)$ , or  $x=x(t)$
  - f. Work:  $W_{12} = \int_1^2 \mathbf{F} \cdot d\mathbf{r} = \Delta T$
  - g. Energy:  $(T = \frac{1}{2} m v^2, U_g = mgh, U_s = \frac{1}{2} k x^2)$
- IV. Methods
  - a.  $\mathbf{F} = \frac{d\mathbf{p}}{dt} \Rightarrow m \frac{dv}{dt} = m\ddot{x} = F.$
  - b.  $\mathbf{F} = -\nabla U$
  - c. Energy Methods  $\frac{1}{2} m v^2 + mgh + \frac{1}{2} k x^2 = \text{const}$
  - d.  $E = T + U \Rightarrow t - t_0 = \pm \int_{x_0}^x \frac{dx}{\sqrt{\frac{2}{m} (E - U(x))}}$
  - e. Potential Energy Plots -  $U(x)$  vs  $x$ , turning points, equilibria
  - f. Stability  $\frac{dU}{dx} = 0, \frac{d^2U}{dx^2} = ?$