

Information for the Quiz on Ch. 5

Fundamental Concepts

Things you must know:

- (1) Definition of and approximation for average velocity (and the position update formula)
- (2) Definition of momentum $\gamma = \frac{1}{\sqrt{1 - (|\vec{v}|/c)^2}}$
- (3) The Momentum Principle (also, the momentum update formula and derivative form)
- (4) Definitions of particle energy and kinetic energy
- (5) The Energy Principle

Specific Results

Projectile Motion:

$$x_f = x_i + v_{xi} \Delta t$$

$$y_f = y_i + v_{yi} \Delta t - \frac{1}{2} g (\Delta t)^2$$

$$v_{xf} = v_{xi}$$

$$v_{yf} = v_{yi} - g \Delta t$$

$$\vec{F}_{\text{grav on 2 by 1}} = -G \frac{m_1 m_2}{|\vec{r}|^2} \hat{r}$$

$$U_{\text{grav}} = -G \frac{m_1 m_2}{|\vec{r}|}$$

$$|\vec{F}_{\text{grav}}| \approx mg \text{ near Earth's surface}$$

$$\Delta U_{\text{grav}} \approx mg \Delta y \text{ near Earth's surface}$$

$$\vec{F}_{\text{elec on 2 by 1}} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{|\vec{r}|^2} \hat{r}$$

$$U_{\text{elec}} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{|\vec{r}|}$$

$$|\vec{F}_{\text{spring}}| = k_s |s|$$

$$K \approx \frac{1}{2} m v^2 = \frac{p^2}{2m} \text{ for } v \ll c$$

$$E^2 - (pc)^2 = (mc^2)^2$$

$$W = \vec{F} \cdot \Delta \vec{r} \text{ (small displacement)}$$

$$Y = \frac{F_T/A}{\Delta L/L} \text{ (macro)}$$

$$Y = \frac{k_{s,i}}{d} \text{ (micro)}$$

$$v = d \sqrt{\frac{k_{s,i}}{m_a}}$$

$$\vec{F}_{\parallel} = \frac{d|\vec{p}|}{dt} \hat{p}$$

$$\vec{F}_{\perp} = |\vec{p}| \frac{d\hat{p}}{dt} = |\vec{p}| \frac{|\vec{v}|}{R} \hat{n}$$

$$x(t) = A \cos(\omega t)$$

$$\omega = \sqrt{\frac{k_s}{m}}$$

$$T = \frac{2\pi}{\omega}$$

Physical Constants

$$c = 3 \times 10^8 \text{ m/s}$$

$$g = 9.8 \text{ m/s}^2$$

$$G = 6.7 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2$$

$$m_{\text{proton}} = 1.7 \times 10^{-27} \text{ kg}$$

$$m_{\text{electron}} = 9 \times 10^{-31} \text{ kg}$$

$$N_A = 6.02 \times 10^{23} \text{ atoms/mole}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$1/4\pi\epsilon_0 = 9 \times 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2$$

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$