

Set #4 - for Wd Oct. 29

Read HR&K

Ch. 3 - Sects. 3.1 through 3.5 and Ch. 4

Read K&K

Ch. 1 - Sects. 1.10, 1.11 and Notes 1.1-1.5 (p. 36-41)

Read Feynman Vol. 1

Ch. 5, 8 & Ch. 9

From HR&K: Ch. 4 Exercise 15, 19. Problems 7, 10, 21, 23, 26.**From K&K: Ch. 1** Problems 1.19, 1.22, 1.26.

1. Consider a projectile launched from level ground. Find the launch angle θ_o for which the projectile traces the maximum trajectory length. Ignore air resistance.

2. Consider projectile motion with air resistance, $\vec{a}_{\text{res}} = -k\vec{v}$, $k > 0$. Using the expressions for $x(t)$ and $y(t)$ derived in class:

a) Show that the maximum altitude reached is

$$y_{\text{max}} = \frac{v_o}{k} \sin \theta_o - \frac{g}{k^2} \ln\left(1 + \frac{k}{g} v_o \sin \theta_o\right).$$

b) Show that the expression above reduces to $y_{\text{max}} = \frac{v_o^2}{2g} \sin^2 \theta_o$ for the case of no air resistance.

c) Find x_{max} , the maximum horizontal distance.

3. A particle is projected vertically upward in a constant gravitational field with an initial velocity v_o . There is a retarding force $F_{\text{ret}} = -mkv^2$, where m is the mass of the particle.

a) Use $a = \frac{dv}{dt} = v \frac{dv}{dy}$. Integrate to get $y(v)$ during the ascending phase of the motion. Show:

$$y_{\text{max}} = \frac{1}{2k} \ln\left(1 + \frac{v_o^2}{v_T^2}\right), \quad \text{where } v_T^2 = \frac{g}{k}.$$

b) Similarly integrate during the descending phase of the motion and show that the particle returns to the initial position (ground) with velocity

$$v_f = \frac{v_o v_T}{\sqrt{v_o^2 + v_T^2}}.$$

What is the physical meaning of v_T ?

c) Does it take longer to go up or to come down? Explain without using equations.

4. Use the subscript notation and show the following identities:

a) $(\vec{A} \times \vec{B}) \cdot (\vec{C} \times \vec{D}) = (\vec{A} \cdot \vec{C})(\vec{B} \cdot \vec{D}) - (\vec{A} \cdot \vec{D})(\vec{B} \cdot \vec{C})$

b) $(\vec{A} \times \vec{B}) \times (\vec{C} \times \vec{D}) = \vec{B}[\vec{A} \cdot (\vec{C} \times \vec{D})] - \vec{A}[\vec{B} \cdot (\vec{C} \times \vec{D})]$

c) $\vec{A} \times [\vec{B} \times (\vec{C} \times \vec{D})] = (\vec{A} \times \vec{C})(\vec{B} \cdot \vec{D}) - (\vec{A} \times \vec{D})(\vec{B} \cdot \vec{C})$