Phys 131 2023

Lecture 10

Tues: Warm Up 4 (D2L)

Thurs: Discussion / quiz

Ex:

Projectile motion

Recall that a projectile is an object that moves only under the influence of Earth's gravity.

Quiz 1 80% – 90% ≶ 50% – 80%

For a projectile the acceleration is constant

$\vec{a}$ ↓

$a_x = 0 \, m/s^2$

$a_y = -g = -9.8 \, m/s^2$

Note that this ultimately implies that the vertical and horizontal components of motion are independent

Demo: Ball vertical vs horizontal

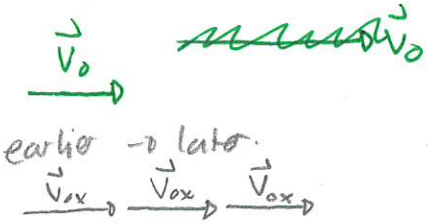
Quiz 2 50% – 80% ≶ 30%

Demo: Cart / ball launcher.

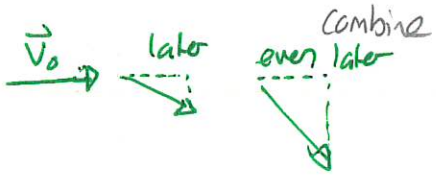
We can assess qualitative aspects of the motion

Horizontal	Vertical
* horizontal component of velocity stays constant since $v_x = v_{ox} + a_x t \Rightarrow v_x = v_{ox}$	* vertical component changes since $v_y = v_{oy} - gt$

* example



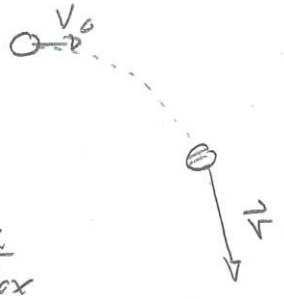
earlier to later



Quiz 3 —

Quiz 4 80% } 90%-

The trajectory will be curved as the velocity vector angles vertical. One can exactly show that it is a parabola



$$x = x_0 + v_{ox}t + \tfrac{1}{2}a_x t^2 \Rightarrow \quad x = v_{ox}t \Rightarrow t = \frac{x}{v_{ox}}$$

$$y = y_0 + v_{oy}t + \tfrac{1}{2}a_y t^2 \Rightarrow \quad y = y_0 + \frac{v_{oy}}{v_{ox}}x - \frac{g}{2}\frac{x^2}{v_{ox}^2}$$

$$\Rightarrow \quad y = \underbrace{-\frac{g}{2v_{ox}^2}}_{\text{constant}}x^2 + \underbrace{\frac{v_{oy}}{v_{ox}}}_{\text{constant}}x + \underbrace{y_0}_{\text{constant}}$$

It's a curved path, not straight!

Again the set up for projectile motion is

$$V_x = V_{ox} + a_x t \qquad V_y = V_{oy} + a_y t$$

$$X = X_o + V_{ox} t + \tfrac{1}{2} a_x t^2 \qquad y = y_o + V_{oy} t + \tfrac{1}{2} a_y t^2$$

$$V_x^2 = V_{ox}^2 + 2a_x (X - X_o) \qquad V_y^2 = V_{oy}^2 + 2a_y (y - y_o)^2$$