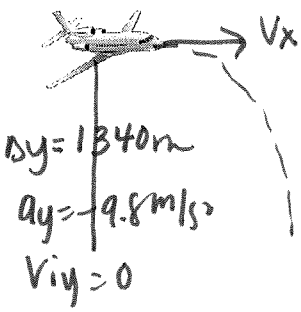
Name Key Hour _____

Practice Test for Projectile Motion

****Make sure to use the GUE**

1. You are flying horizontally in a plane at 230 km/hr at 1,340 meters above the ground. You are trying to drop a box of supplies to a person below. How far in front of him should you drop the box?



$V_x = 230\frac{km}{hr} \times \frac{1000m}{1km} \times \frac{1hr}{3600s} = 63.9\frac{m}{s}$

$\Delta y = 1340m$

$a_y = -9.8 m/s^2$

$V_{iy} = 0$

① $\Delta y = v_{iy}\Delta t^0 + \frac{1}{2}a_y \Delta t^2$

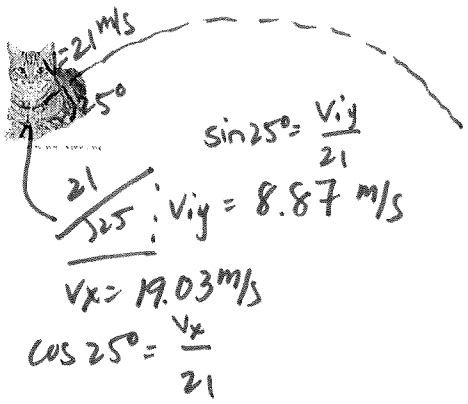
$-1340m = \frac{1}{2}(-9.8 m/s^2)\Delta t^2$

$\Delta t = 16.54 sec$

② $V_x = \frac{\Delta x}{\Delta t}$ $\quad 63.9\frac{m}{s} = \frac{\Delta x}{16.54 sec}$

$\Delta x = 1,057m$

2. The cat is back! He had some serious injuries, but he is O.K. and ready to fly again! The cat is now at the circus with his cannon. He wants to impress his feline friends so he is going to launch himself across the arena with a velocity of 21 m/s at 25° N of E.. What was his maximum height?



$v = 21 m/s$

$25°$

$\sin 25° = \frac{V_{iy}}{21}$

$21 \cdot \sin 25° = V_{iy} = 8.87 m/s$

$V_x = 19.03 m/s$

$\cos 25° = \frac{V_x}{21}$

① Find Δt

$a_y = \frac{v_{fy}^0 - v_{iy}}{\Delta t}$

$-9.8\frac{m}{s^2} = \frac{0 - 8.87 m/s}{\Delta t}$

$\Delta t = 0.91 sec$

(at ½ way pt)

② Find Δy

$\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y \Delta t^2$

$\Delta y = (8.87)(.91) + \frac{1}{2}(-9.8)(.91^2)$

$8.07 + -4.06$

$\Delta y = 4.01 m$

3. A quarterback throws a pass towards a receiver who is 22 yards away. Calculate the **velocity** and the **angle** of the throw if it is in the air for 2.4 seconds total. (1 yard = 0.9144 m)

① $V_x = \frac{\Delta x}{\Delta t} = \frac{20.1m}{2.4sec} = 8.38 m/s$

$\Delta x = 22yd \times \frac{.9144m}{1yd} = 20.1m$

② $a_y = \frac{v_{fy}^0 - v_{iy}}{\Delta t} = -9.8 = \frac{-v_{iy}}{1.2}$ $\quad V_{iy} = 11.76\frac{m}{s}$

$\Delta t = 2.4 sec$ (total)

$\frac{1}{2}\Delta t = 1.2 sec$

③ $V^2 = V_x^2 + V_{iy}^2$

$V^2 = (8.38)^2 + (11.76)^2$

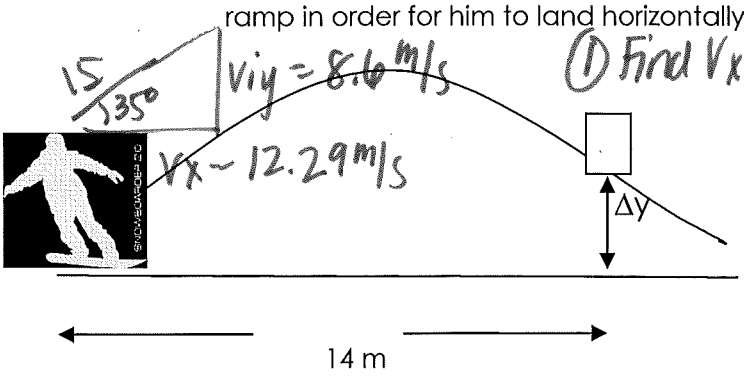
$V = 14.4\frac{m}{s}$

④ $\tan\theta = \frac{V_{iy}}{V_x} = \frac{11.76}{8.38}$

$\theta = 54.5°$ N of E

Name _____ Hour _____

4. A snowboarder leaves a jump 15 m/s at 35° N of E. At what height should he place the ramp in order for him to land horizontally 14 meters away?



① Find Vx, Viy ② $V_x = \frac{\Delta x}{\Delta t}$ to find Δt

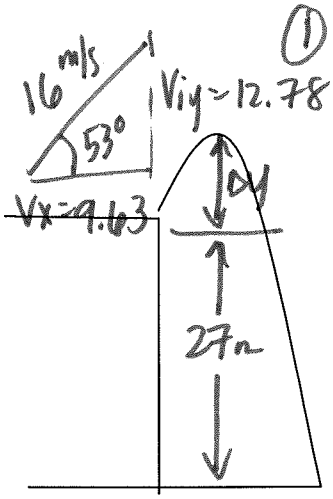
$12.29\frac{m}{s} = \frac{14m}{\Delta t}$ $\Delta t = 1.14 sec$

③ $\Delta y = V_{iy}\Delta t + \frac{1}{2}a_y \Delta t^2$ (at 1.14 sec)

$(8.6)(1.14) + \frac{1}{2}(-9.8)(1.14)^2$

$\Delta y = 3.44m$

5. You shoot a potato gun at 16 m/s at 53° N of E off of the edge of a cliff that is 27 meters high. With what speed will it hit the ground in **miles per hour**?



① Solve Vx & Viy ② Find Δt to peak $a_y = \frac{V_{fy}^{\,0} - V_{iy}}{\Delta t}$

③ Find Δy at peak $-9.8 = \frac{-12.78}{\Delta t}$

$\Delta y = V_{iy}\Delta t + \frac{1}{2}a_y \Delta t^2$ $\Delta t = 1.3 sec$

$(12.78)(1.3) + \frac{1}{2}(-9.8)(1.3)^2$

$\Delta y = 8.39m$

④ Add Δys

$8.39m + 27m =$

35.3 m TOTAL

⑤ Find Vf $V_f^2 = V_i^2 + 2a\Delta y$

$V_f^2 = 2(9.8)(35.3m)$

$V_f = 26.3 m/s$

⑥ $\frac{26.3m}{s} \times \frac{1mi}{1609m} \times \frac{3600s}{1hr} =$ 58.8 mph

Other things to know:

1. What happens to the horizontal AND vertical velocity during the flight of a horizontal projectile?

constant increases

2. What happens to the horizontal AND vertical velocity during the flight of an angled projectile?

constant

3. What are the variables and units of the following? Horizontal distance, vertical distance, height, horizontal velocity, final vertical velocity.

Δx, m Δy, m Δy, m

Vx, m/s Vfy, m/s

4. What is the difference between Δy and Viy? Which one can be solved for using trig?

Δy = height

Viy = initial vertical velocity → Viy

***After you have done all you can, get a copy of Mrs. B.'s key and correct anything that is wrong in a different color.**

If you want another problem like #5, change the angle to 70° and resolve it. (ans: 61.5 mph.)