Name_____Period_____Date_____

Projectile Motion Simulator Worksheet

Go to the projectile motion simulator at https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html


Fire!

1. Write your best understanding of the word projectile:

2. Name all of the factors you think affect projectile movement (try to list at least five factors):

Click on "Intro"

Part A: Intro – make sure the "Air Resistance" Box is not checked!

1. Play with the simulation a bit until you get the pumpkin to hit the target.
   a. What is the height of the cannon and initial velocity when you hit the target?

2. Click on "Components" under velocity vectors. Then click "slow" on the green toolbar at the bottom so the motion of the pumpkin slows.
3. What is the numerical value of the y-component of the velocity vector just as the pumpkin is shot out?

If shot out horizontally

$V_{iy} = 0$

4. What is the numerical value of the acceleration in the y-direction?

$-9.81 m/s^2$

5. What is the numerical value of the x-component of the velocity vector?

whatever your horizontal velocity is

6. What do you notice about the x-component of the velocity vector throughout the motion? (Does it change magnitude or direction? Remember the length of the arrow indicates the magnitude.)

no change

7. What can you conclude about the acceleration of the pumpkin in the x-direction? (You can click on Components under Acceleration Vectors to check)

x- acceleration = 0

Name_____Period_____Date_____

8. Change the pumpkin to a tank shell and then to a piano. Does the motion change? Why or why not?

No: mass doesn't affect the motion of the object

9. Predict how fast we need to fire an object from the cannon on a 15 m pedestal to hit the target 15m away before firing the cannon.
   a. List the numerical values of a_y, Δy, v_{iy}, and Δx (range)

$a_y = -9.8 m/s^2$ $\Delta x = 15m$ $v_x = ?$

$\Delta y = 15m$ $v_{iy} = 0$

   b. Which equation would we use to find out how much time it takes for the object to hit the ground? Use that equation and solve for t (be careful – we cannot put a horizontal and vertical component in the same equation!)

$\Delta y = \frac{1}{2} a_y (\Delta t)^2$

$t = 1.75 sec$

   c. Now that we know t and the range, which equation could we use to solve for the horizontal velocity (v_x)? Solve for this velocity.

$v_x = \frac{\Delta x}{\Delta t} = \frac{15m}{1.75sec} \rightarrow 8.6 m/s$

   d. Fire the cannon! If you hit the target, nice work! If not, go back and check your calculations.

8.6 or 9m/s will hit the target

Part B: Vectors

Click on the **Vector** portion on the black bar at the bottom of the screen.
Make sure "Air Resistance" is <u>not</u> checked.
Click "Slow" to slow the movement of your object.
Click "Components" under Velocity Vectors.

1. How do the x and y velocity components change or stay the same from the Intro, when we just fired objects out of a cannon horizontally? Why did they change or stay the same?

Click "Components" under Acceleration Vectors.

2. How do the x and y components of the acceleration vector stay the same or change from the intro? Why do they change or stay the same?

acceleration stays the same.

$x = 0 m/s^2$

$y_{accel.} = -9.81 m/s^2$

Name_____Period_____Date_____

Part C: Gravity and Angles Lab

Go to the **Lab** portion on the black bar at the bottom of the screen.

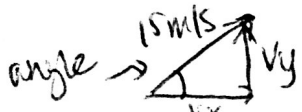
Make sure "Air Resistance" is not checked.

Make sure the gravity is the gravity on Earth (9.81 m/s^2) and fill in the table below. You'll need to calculate the v_x and v_y by breaking the initial velocity vector into its components.

Look back at the Vectors tab if you want to check the direction of force and acceleration.

Drag this icon over to the proper location on the curve to see the maximum height and distance.

Angle	Initial Speed	Initial (Calculate)		Maximum		Direction of	
		Vx	Vy	Height	Range	Force	Acceleration
30	15						
45	15						
60	15						



Adjust to the gravity on Venus : 8.87 m/s^2 and repeat

Angle	Initial Speed	Initial (Calculate)		Maximum		Direction of	
		Vx	Vy	Height	Range	Force	Acceleration
30	15						
45	15						
60	15						

Adjust to the gravity on Saturn : 10.44m/s^2 and repeat

Angle	Initial Speed	Initial (Calculate)		Maximum		Direction of	
		Vx	Vy	Height	Range	Force	Acceleration
30	15						
45	15						
60	15						

1. What did you learn about different angles?

2. What do you think is the angle that gives the maximum possible horizontal distance? Why?

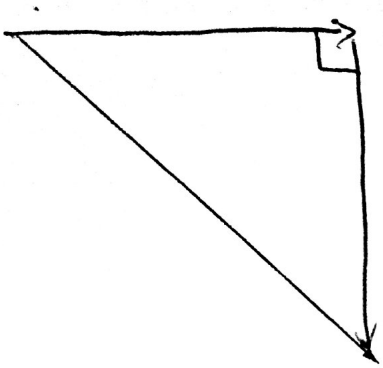
3. Were there any surprises in this activity?

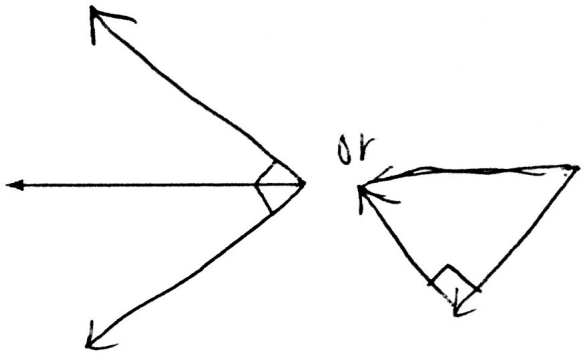
4. If the gravity only affects the "y" component, why do you think the objects have a larger range (Δx) with less gravity and a smaller range with a higher gravity?

Name_____Period_____Date_____

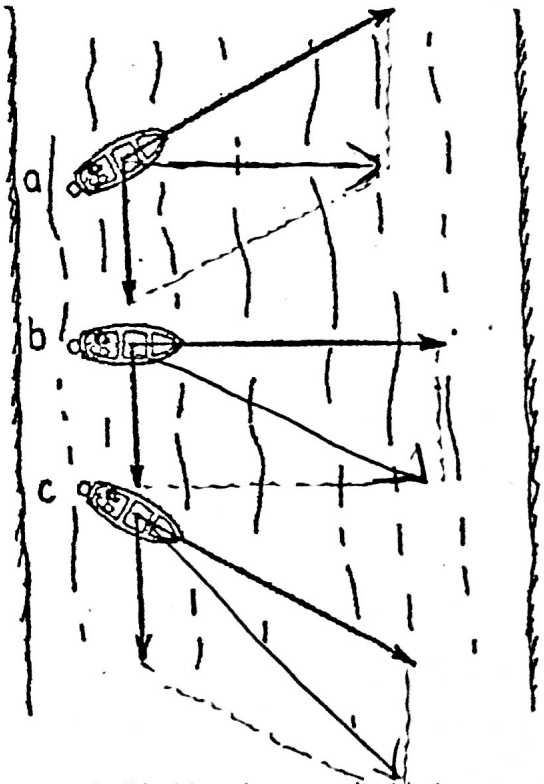
Part 4: Practice Conceptual Problems

1) Draw two component vectors that are perpendicular to each other that would add to equal the provided vector.





2) To the right we see top views of 3 motorboats crossing a river. All have the same speed relative to the water, and all experience the same water flow. (Hint: it may help to figure out the resultant vector for each boat)



a) Which boat takes the shortest path to the opposite shore? a
resultant is direct path to the shore

b) Which boat reaches the opposite shore first? b
vertical current doesn't affect horizontal velocity

c) Which boat provides the fastest ride? c
vertical current adds to vertical component of the boat's velocity

3) At the instant a horizontally pointed cannon is fired, a cannonball held at the canon's side is released and drops to the ground. Which cannonball strikes the ground first, the one fired from the cannon or the one dropped? Explain.

Both hit the ground @ the same time