Pre-AP

Kinematics
2 Dimensional Motion
Projectile Example Problem

Name ______________________

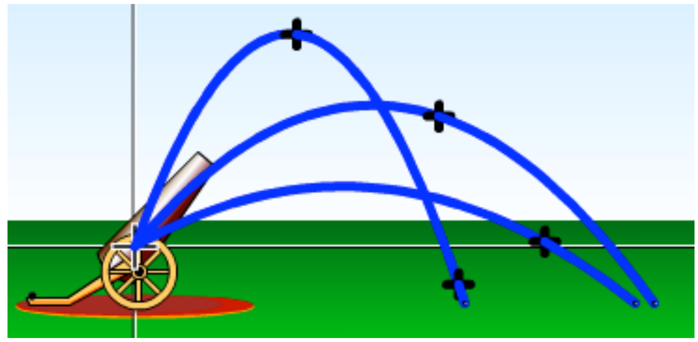
Teacher ____________________

Period _____

Purpose – To investigate projectiles fired at angles.

An object is fired at a speed of 14 m/s at three different angles.

- Identify the trajectories in the chart below on the diagram to the right as v_1, v_2 or v_3.
- Resolve each of the velocity vectors into horizontal and vertical components.
- Rank the time of flight for each velocity.



Velocity	Horizontal Component	Vertical Component	Time of Flight
v_1 = 14 m/s at 30°			
v_2 = 14 m/s at 50°			
v_3 = 14 m/s at 70°			

Launch the Projectile Motion simulation. http://phet.colorado.edu/en/simulation/projectile-motion

Adjust the speed to 14 m/s then fire three projectiles at 30°, 50° and 70°. Keep all other initial conditions as given.

Draw an FBD for each of the three shots and circle one of the three choices, ↑ ↓ zero, that describes the projectile's motion. Ignore air resistance.

v_1 while ascending	v_2 at the apex	v_3 while descending
v: ↑ ↓ zero a: ↑ ↓ zero ΣF: ↑ ↓ zero	v: ↑ ↓ zero a: ↑ ↓ zero ΣF: ↑ ↓ zero	v: ↑ ↓ zero a: ↑ ↓ zero ΣF: ↑ ↓ zero

Circle either constant, changing or zero, draw an arrow in the direction of the velocity and give the value of the acceleration of the projectile while in the air. Ignore air resistance.

While the projectile is ascending its:
- horizontal velocity is constant/changing/zero and points _______ and the acceleration is _________
- vertical velocity is constant/changing/zero and points _________ and the acceleration is _________

When the projectile is at the apex its:
- horizontal velocity is constant/changing/zero and points _______ and the acceleration is _________
- vertical velocity is constant/changing/zero and points _________ and the acceleration is _________

While the projectile is descending its:
- horizontal velocity is constant/changing/zero and points _______ and the acceleration is _________
- vertical velocity is constant/changing/zero and points _________ and the acceleration is _________

In the chart to the right, identify each of the following equations as describing either horizontal or vertical motion.

List the two different types of motion.

________________, ________________

Which type of motion describes the horizontal equation(s) ____________________________

Which type of motion describes the vertical equation(s) ____________________________

Equation	Horizontal Motion	Vertical Motion
$v = \frac{\Delta d}{\Delta t}$		
$a = \frac{v_f - v_i}{\Delta t}$		
$\Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$		
$a = \frac{v_f^2 - v_i^2}{2\Delta d}$		

What ties the horizontal and vertical equations of motion together? ____________________________

Rewrite the equations below adding the subscripts “x” and “y” to the appropriate variables. Where appropriate replace the acceleration “a” with “g”.

		Projectile Motion Equation	
Equation		Horizontal (X)	Vertical (Y)
$v = \frac{\Delta d}{\Delta t}$	becomes		
$a = \frac{v_f - v_i}{\Delta t}$	becomes		
$\Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$	becomes		
$a = \frac{v_f^2 - v_i^2}{2\Delta d}$	becomes		

Adjust the cannon’s position until the crosshair on the cannon lies on the horizon (ground level). Fire a projectile at 14 m/s at 40° above the horizontal. Calculate the time of flight, the range and the maximum height of the projectile. Use the tape measure to check your answers.

All measurements will be made with the tape measure in the horizontal or vertical position.

Time of Flight	Range	Height
time = 1.84 seconds		

Left click on the cannon and hold. Adjust the vertical elevation of the cannon. Fire another projectile at 14 m/s at 40° above the horizontal. How does the vertical elevation affect the time of flight, the range and height of the projectile?