Notes 4.1 – Projectiles in Motion

Name: _____ Date: _____ Hour: _____

Learning Goals:
- Distinguish between 1D & 2D motion
- Define & describe the characteristics of a projectile

I. Dimensions of Motion

A. 1-dimensional motion: Objects move in a line (along x or y axis)

B. 2-dimensional motion Objects move in a plane (with an x AND y component)

II. Projectiles

A. Definition: An object with only the force of gravity acting on it (free fall)

B. Characteristics of Projectiles:
1. Net Force: – equals $F_g = m \cdot g$
2. Acceleration: – constant and downward ($-9.8\ m/s/s$)
3. Velocity: – changing & can be in any direction

C. Examples:
1. Ball thrown straight up
2. Ball dropped from rest
3. Ball thrown straight down
4. Ball thrown horizontally from non-zero height
5. Ball thrown at an angle (not horizontal) from non-zero height

*These are the situations we will do calculations with

Notes 4.2 – Force, Acceleration & Velocity of Projectiles (VP8 & VP9)

Name: _____ Date: _____ Hour: _____

Learning Goal: Diagram the force, acceleration & velocity of a projectile in the following situations: 1) dropped from rest, 2) horizontal launch & 3) non-horizontal launch.

I. The Rules

A. Force: = Fg downward (no force in x-dir)

B. Acceleration: = 9.8 m/s/s (no acceleration in x-dir)

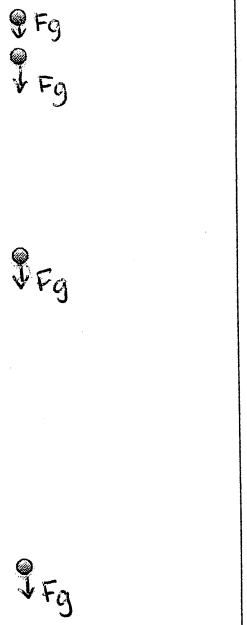
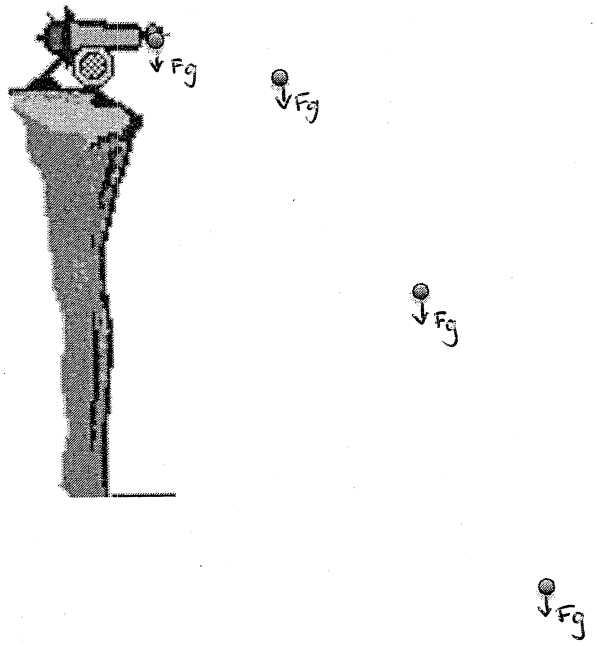
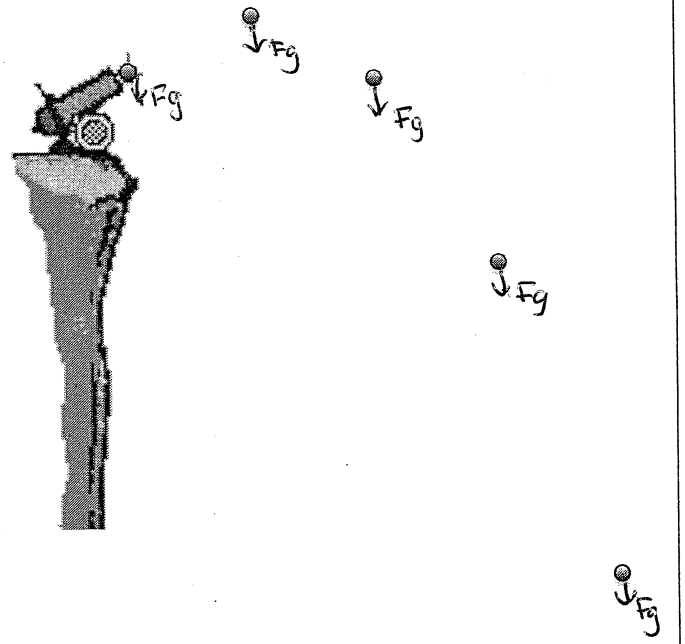
C. Velocity:

- X-direction: constant
- Y-direction: changing -9.8 m/s/s

D. What happens in the x-direction does not affect what happens in the y-direction (& vise versa)

II. Diagrams

A. Diagraming FORCE after released or shot

Dropped from Rest	Horizontal Launch	Non-Horizontal Launch
~~after released~~ 		

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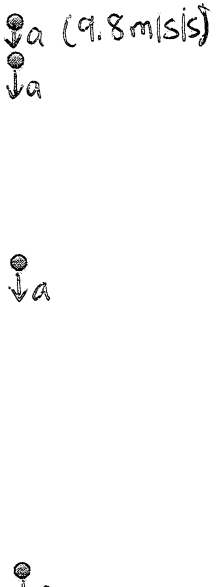
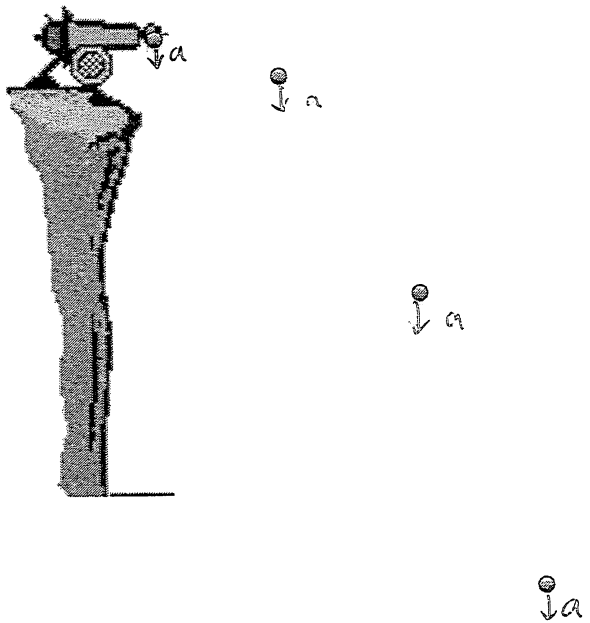
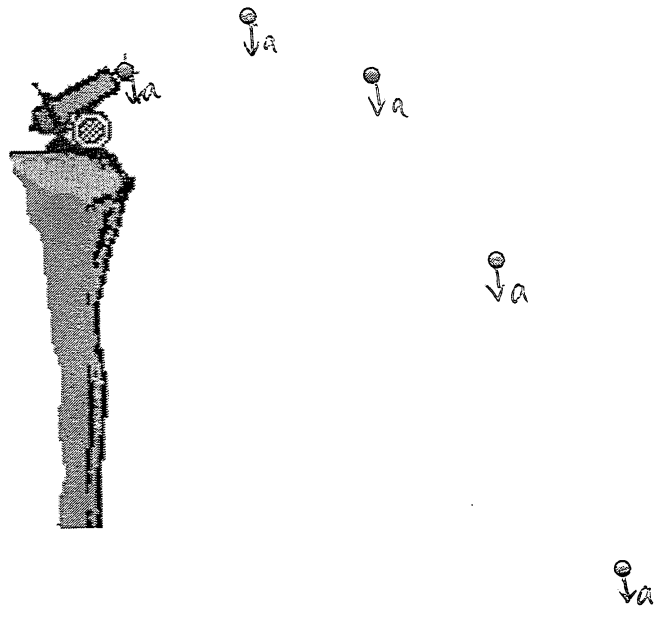
II. Diagrams

B. Diagraming Acceleration

Dropped from Rest	Horizontal Launch	Non-Horizontal Launch
$a = 9.8\ m/s/s$ 	$a = 9.8\ m/s/s$ 	

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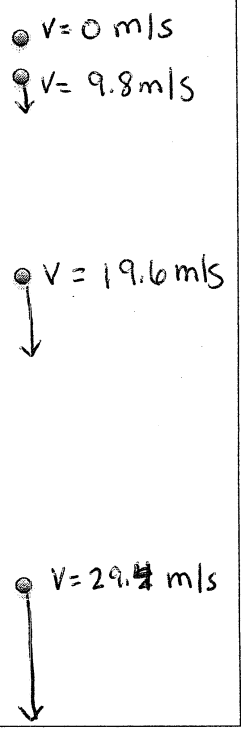
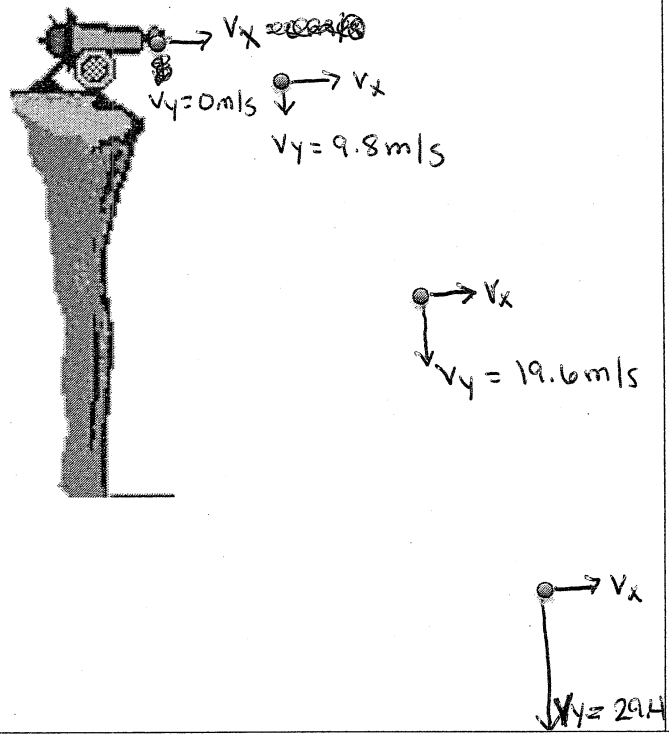
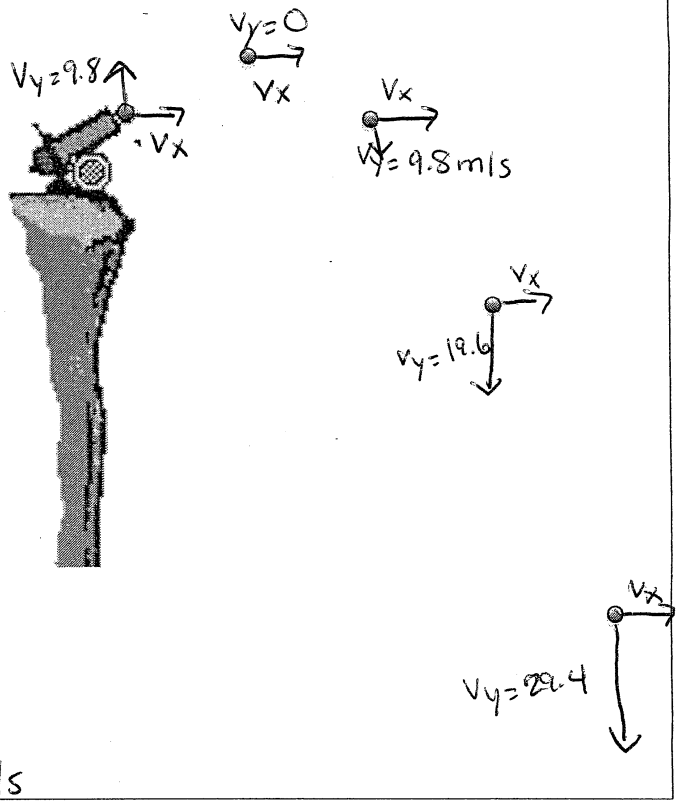
III. Diagrams

C. Diagraming **Velocity** www.physicsclassroom.com/shwave/projectile.cfm

Dropped from Rest	Horizontal Launch	Non-Horizontal Launch
		

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Notes 4.3 – Projectile Math

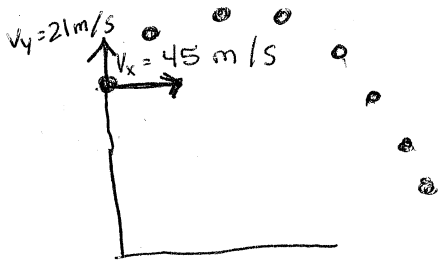
Name: _____ Date: _____ Hour: _____

Learning Goals:
- Calculate changes in velocity of a thrown or hit object (P3.4f)

Overview: For all projectiles...
- Horizontal (x-direction) velocity never changes
- Vertical (y-direction) velocity changes by -9.8m/s for every second it's in the air
- Equation: $v_f = v_i + at$

Example Problems: Based on Launch Type

1. A ball is launched at an angle off a cliff. This launches gives it a horizontal velocity of 45 m/s and a vertical velocity of 21 m/s.



   a. What is the ball's v_x after 3.5 seconds?

$a_x = 0 m/s^2$ **45 m/s**

$V_f = V_i + at \rightarrow V_f = 45 + 0(3.5)$

   b. What is the ball's v_y after 3.5 seconds?

$V_f = V_i + at$

$V_f = 21 + (9.8)(3.5)$

$= -13.3 m/s$

$a_y = -9.8 m/s^2$

2. A ball is launched horizontally with a speed of 23 m/s.
   a. What does "horizontally" tell you?

No V_y V_i is V_x only = 23 m/s

   b. What is the ball's v_x after 7 seconds?

23 m/s

   c. What is the ball's v_y after 7 seconds?

y-dir $V_f = V_i + at$

$= 0 + (9.8)(7)$

$= -68.6 m/s$

3. A ball is launched straight upward with a speed of 10.7 m/s.
   a. What does "straight upward" tell you?

No V_x

Thrown upward $V_{y\,(initial)} = 10.7$ m/s (up)

   b. What is the ball's v_x after 6.3 seconds?

0 m/s

$V_f = V_i + at$
$= 0 + 0(6.3)$
$= 0$

   c. What is the ball's v_y after 6.3 seconds?

$V_f = V_i + at$
$= 10.7 + (-9.8)(6.3)$
$= -51.04$ m/s

4. A ball is dropped from rest.
   a. What does "dropped from rest" tell you?

free fall no V_i in either direction

   b. What is the ball's v_x after 10 seconds?

$V_f = V_i + at$
$V_f = 0 + 0(10)$ 0 m/s

   c. What is the ball's v_y after 10 seconds?

$V_f = V_i + at$
$V_f = 0 + (-9.8)(10)$
$= -98$ m/s