Name: ____

Second Quarter Project: Day 1
QUADRATICS! Data Collection

Group Members

Recorder: ____

Timer: ____

Instructions

Each person is going to have their own data set for when they are the thrower.

Throwing:
In the designated area, the Thrower is going to throw the ball straight up in the air. The Timer will start the clock as soon as the ball is released and stop the clock when it hits the ground. (Try having the Timer count down

Bouncing:
In the designated area, the Thrower is going to bounce the ball. The Timer is going to start the clock as soon as the ball hits the ground for the first bounce and stop the clock when the ball hits the ground again. (Try judging by the sound of the bounce.) The Recorder will write the time in the table below. Repeat two more times. Note to the Thrower: the higher you bounce the ball, the easier it is for the Timer to make an accurate measurement.

Collect Data

TIME (in seconds)

	Throwing:	**Bouncing:**
Trial 1		
Trial 2		
Trial 3		

Is the ball travelling the same speed throughout the bounce? What about when it is thrown? Explain your answer.

Sketch the path of the ball when it is thrown.

Sketch the path of the ball for one bounce.

Name: ____

Second Quarter Project: QUADRATICS!

Day 2 Data Collection

Group Members

Recorder: ____

Timer: ____

Thrower: ____

Instructions

For the throwing experiment, average the times from all 3 trials and record it in the table below. Do the same thing for the bouncing experiment. After all of the averages are reported, find the class average for each experiment and record it in the table.

Averaged Data

	AVG. TIME (in seconds)	
	Throwing:	**Bouncing:**
Trial 1		
Trial 2		
Trial 3		
Class Avg.		

How does your data compare to the class average? Why do you think that is the case?

Which is better for taking data: averaging several trials, or averaging only a few trials? Explain your answer.

Name: ____

Second Quarter Project: Day 3
QUADRATICS! Velocity

Group Members

Recorder: ____

Timer: ____

Thrower: ____

Background

One of the most basic equations in physics is:

$$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2$$

x = position (in ft.) after some time, t (in seconds)
x_0 = initial position (in ft)
v_0 = initial velocity (in ft/s)
a = -16 ft/s^2 for gravity = acceleration (gravity pulls us downward, so it's negative)

If we say that the ground is the origin (0 ft.), we can actually use our time data solve this equation to find the initial velocity of the ball. (In other words, we can figure out how fast the ball was going when it left the ground or the thrower's hand!) *Note*: we are only concerned about the ball's vertical position.

Instructions

Without plugging in any numbers, rewrite the equation so that it reads v_0 = ….

Now plug in your numbers and solve for v_0 for the case when your ball was bounced and when it was thrown. Then solve for v_0 using the class averages. Show your work.

(Hint: you can assume that the initial position of the ball is the same as the position of the ball at the final recorded time for both bouncing and throwing.)

Name: ____

Calculated Velocities:

	Throwing:	**Bouncing:**
Trial 1		
Trial 2		
Trial 3		
Average		
CLASS AVG.		

Questions

1. Let's assume that the clock started when thrower released the ball 6 feet above the ground, and the clock stopped when the ball hit the ground. How does that change your calculation for the initial velocity of the ball when it was thrown?

Another basic equation in physics is $v = v_0 + a \cdot t$, where v is the velocity of the ball at some time, t.

2. Look at this equation and consider again: does the velocity of the ball change during its path? Briefly explain.

3. On Earth, gravity is a constant acceleration. What does the graph of a constant look like?

4. Without plotting any points, what type of graph would you expect if you were to graph time on the horizontal axis vs. velocity on the vertical axis?

Name: ____

Second Quarter Project: Day 4
QUADRATICS! Heights

Group Members

Recorder: ____

Timer: ____

Thrower: ____

Background

Since we have solved for initial velocity, we can now use the same equation to find the maximum of the ball. Recall the equation:

$$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2 .$$

Now think about the path of the bouncing ball that you drew. You should notice that the ball was traveling up the first half of the time, and it was falling the other half of the time. This means we can say that the ball reaches its peak position (maximum height) when t = *half* of your recorded time. Now that we know a, v_0, t, and x_0 (assume $x_0 = 0$ for both throwing and bouncing, and recall a = -16 ft/s), we can solve for x to find the maximum height!

Instructions

Plug in t/2 for t in the equation above. Using the initial velocities you calculated before, fill in the table. SHOW YOUR WORK.

*Hint: remember order of operations!

Calculated Maximum Heights (ft.):

	HEIGHT (ft.)	
	Throwing:	**Bouncing:**
Trial 1		
Trial 2		
Trial 3		
Average		

Name: ____

Questions

1. Write the equation for position in *standard form*. Without plotting any points, what do you think the graph would look like if you put t on the horizontal axis and position (x) on the vertical axis?

2. Make a guess: what is the velocity of the ball at the highest point? (You can't get this part wrong.)

3. Use the equation for velocity, $v = v_0 + a \cdot t$, to solve for the velocity of the ball at the highest point (show work below).

4. Does this make sense?

Name: ____

Second Quarter Project: QUADRATICS!

Day 5 Graphs

Group Members

Recorder: ____

Timer: ____

Thrower: ____

Background

Recall the equations:

$$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2$$

$$v = v_0 + a \cdot t$$

(Assume $x_0 = 0$ for both throwing and bouncing, and recall a = -16 ft/s)

Instructions

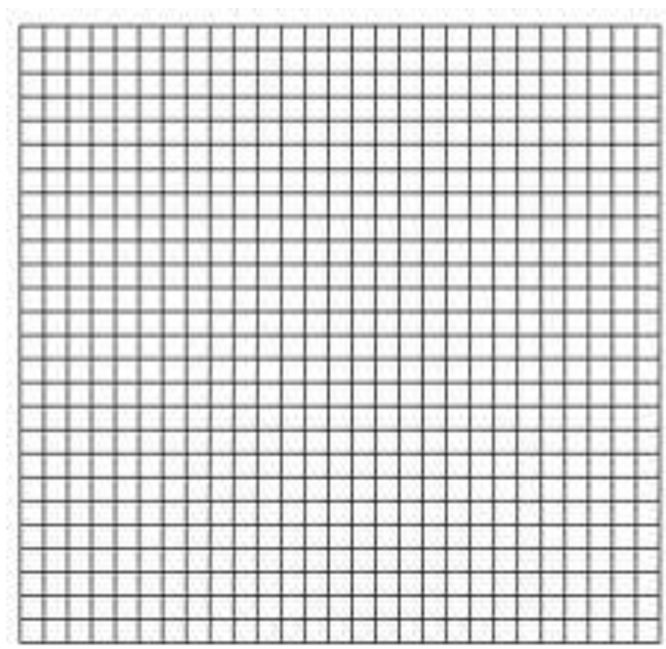
For each trial write the equation and fill in the table. Graph the height of the ball, x, as it changes with time, t. LABLE YOUR GRAPHS!

THROWING:

Equation (in vertex form):

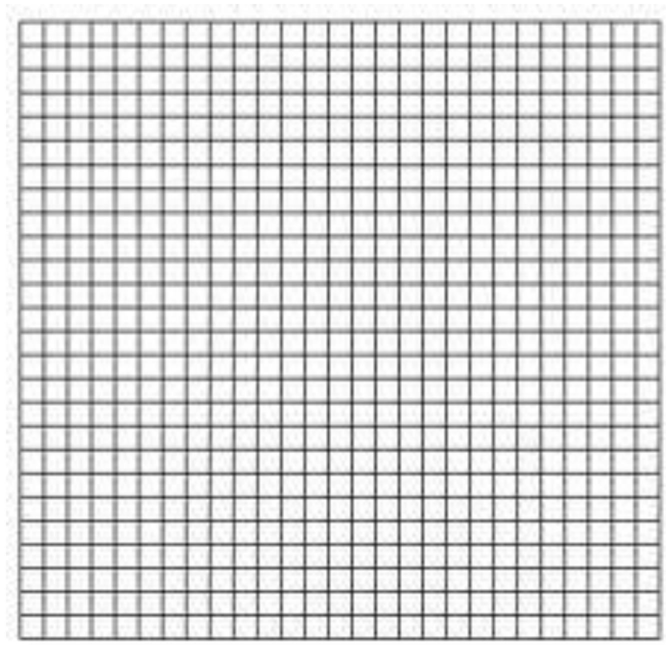
Using My Avg.

x	**t**
	0



Name: ____

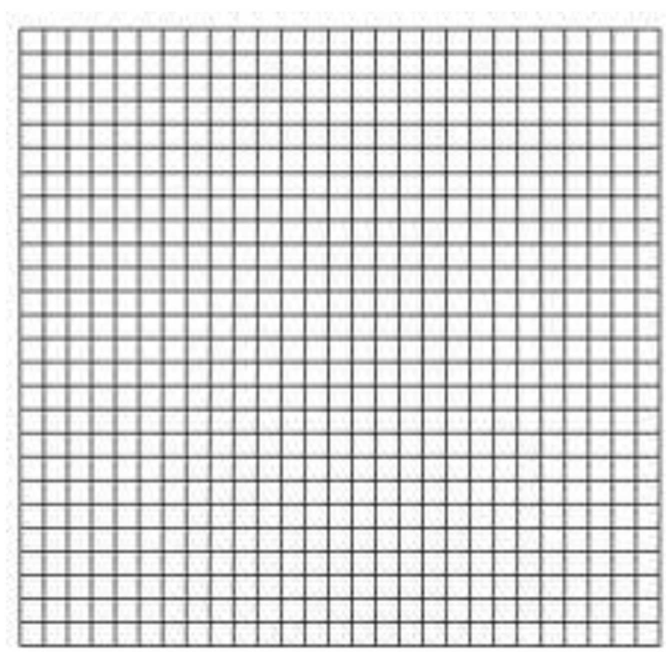
THROWING:
Equation (in vertex form):



Using Class Avg.

x	t
	0

BOUNCING:
Equation (in vertex form):



Using My Avg.

x	t
	0

BOUNCING:
Equation (in vertex form):

Using Class Avg.

x	**t**
	0

Questions

1. In real life, what do the vertices of you graphs represent? What about the axes?

2. Let's imagine that you bounce a ball off of a cliff. Using the class average for the initial velocity, find how long it would take from the initial bounce for the ball to drop 30 feet below the edge of the cliff.

   Draw and label the graph corresponding to this situation.

Name: ____

3. Let’s compare velocity and position as time passes. On the same graph (with t as the horizontal axis), plot v and x, both on the vertical axis. What do you notice about the horizontal intercept of the velocity?