Physics | **Name ______________________**
Basketball Lab | **Date ______________________**

Purpose – To develop mathematical and graphical representations that describes the motion of falling objects.

Directions –

- Open Logger Pro software
- Adjust the detector reading by doing the following: Click on **Experiments**, **Set up Sensors, Show All Interfaces, Motion detector tab, Choose Reverse Direction.**
- Push **collect** and wait to you hear the clicking to throw the basketball vertically up toward the motion detector. Allow the ball to return to the ground without interruption. **Be careful not to hit the motion detector. Remember, the motion detectors need a minimum distance of 50 cm to accurately record data.**
- If the results from your first attempt look acceptable, continue with the analysis questions. If the results show a curve that is not smooth, repeat until you are satisfied with the segment.

Analysis –

Motion Maps

1. Using arrows to symbolize the motion of the object, draw a motion map that describes both the upward path and the return trip for the ball. Provide labels for your velocity and acceleration arrows.

Position vs. Time Graph

2. Draw a sketch of the position vs. time graph (**only the part that represents the motion**) that resulted from this experimentation.

3. Describe the motion of the ball for the entire trip (according to the graph above).

4. View the position vs. time graph with a tangent line (click on analyze, then tangent).
   a) What does this tangent line give you?

   b) What does the above quantity represent?

5. While still looking at this graph with the tangent feature, move the tangent line along the curve.
   a) What is happening on the way up? What does this indicate about the speed of the ball?

   b) What is happening on the way down? What does this indicate about the speed of the ball?

   c) What is the velocity at the top? What should it be close to?

6. Investigate the time for the ball's trip.
   a) How much time does it take for the ball to reach the top?

   b) How much time does it take for the ball to go from the highest point to the original release position?

   c) What is the **total** time for the ball to travel to its highest point then back to the original release position?

Velocity vs. Time Graph

7. Draw a sketch of the velocity vs. time graph that resulted from this experimentation.

8. Describe the motion of the ball for the entire trip (according to the graph above).

9. What quantity does the slope on a velocity vs. time graph describe?

10. Perform these steps to find a numeric value for your answer to question 8: uncheck tangent line, drag and highlight a portion of the velocity vs. time graph, go to analyze linear fit.
    a) What is the acceleration?

    b) What is the equation of the line?

    c) What is your experimental acceleration close to?

Acceleration vs. Time Graph

11. Draw a sketch of the acceleration vs. time graph that resulted from this experimentation.

12. Describe the motion of the ball for the entire trip (according to the graph above).

13. What is the ball's acceleration at the top of the trip?

Conclusions –

14. According to your analysis, what is true about the acceleration due to gravity?

15. At the maximum height your ball obtained (after you threw it vertically upward), what was its acceleration?

16. What happens to the velocity of an object as it moves vertically upward? What is its final velocity at the top?

17. What happens to the velocity of an object as it returns to the ground?

18. **Calculations –** A tennis ball is thrown straight up with an initial speed of 22.5 m/s. It is caught at the same distance above the ground. Use the constant acceleration equation to solve for the following:
    a) How high does the ball rise?

    b) How long does the ball remain in the air (*the whole trip in the air*)?

$v_f = v_i + at$ $\Delta x = \frac{1}{2}(v_i + v_f)t$ $v_f^2 = v_i^2 + 2a\Delta x$ $\Delta x = v_i t + \frac{1}{2}at^2$