

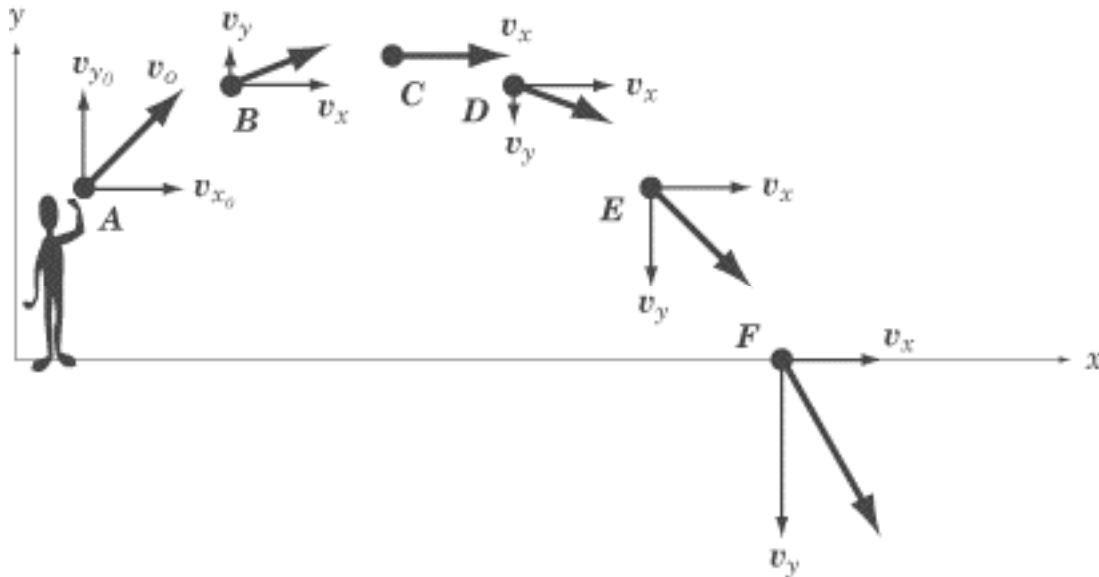
## Basketball Throw

### Projectile Motion w/ an initial vertical velocity

**Purpose:** To determine the mathematical models for x-position, y-position, x-velocity and y-velocity vs time and to obtain values for the horizontal and vertical accelerations for a basketball thrown at an angle.


**Background:** Gravity only affects a projectile in the vertical direction. Projectile motion, therefore, can be broken down into two independent parts:







- Vertical motion at a constant downward acceleration
- Horizontal motion at a constant horizontal speed



**Hypotheses:** Write on a separate sheet of paper or the form attached. Address all parts of the purpose statement.

#### Data Collection:

1. In LoggerPro 3 go to *File>Open*, Choose *Sample Movies>Basketball Shot>Basketball Shot.cml*
2. On the movie, set the scale by clicking . On the man click at his feet and drag a line to the top of his head. In the dialogue box that comes up, put **1.88** in *distance* and **m** in *units*. This is the height of the man – this scale converts movie pixels to meters.

3. On the movie, advance frame-by-frame until the point where the ball just leaves the man's hands using this button, . If necessary go back a frame with this button .
4. To set the origin, click  and then place the pointer in the middle of the basketball and click. Then click  to show the origin.
5. To sync the movie time to the data collection time, click . In the dialogue box that comes up, enter **0** in **Graph time** and check the **Synchronize Video Analysis Data Set with Selected Data Set** box. This will sync your origin with  $t=0$ .
6. Now to gather your data. Click  to add a point. After clicking the button, click in the middle of the basketball. Note that a point is then plotted on the graph and the movie advances to the next frame. Continue to add points in this manner until the basketball bounces off the floor.
7. Print your data table (*File>Print Data Table*).

### Data Analysis

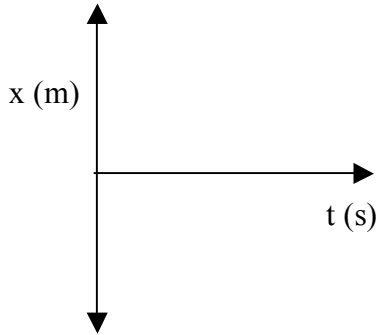
8. To get each different graph, click on the label on the y-axis to plot the desired variable vs time. You can change the range of the y-axis by clicking on numbers on that axis and typing in the desired ones.
9. Highlight your data, by clicking and dragging a box around the data on the graph.
10. Under the "Analysis" menu, you will fit a mathematical model to your curve by using either "Linear Fit" or "Curve Fit". Under "Curve Fit", you will have several options. You must find the best fit ("RMSE" should be minimized – this is a measure of how well your data fits the equation).
11. Print each of your graphs (*File>Print Graph*) with the best fit curve and write the mathematical model for each, including units on all numbers.
12. Find the horizontal and vertical accelerations and explain your method.

**Conclusion** – follow usual guidelines for lab reports.

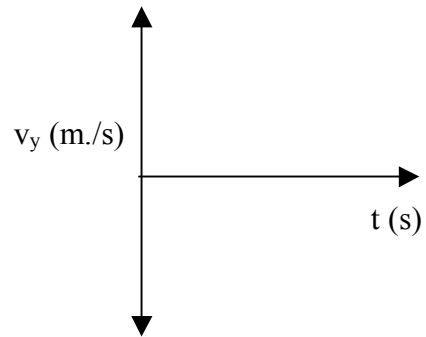
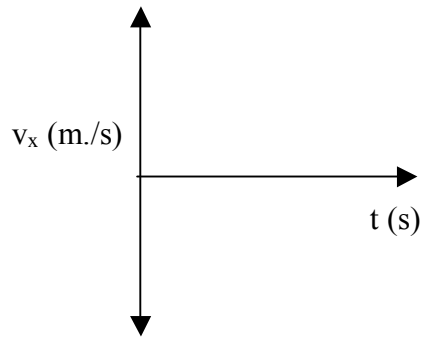
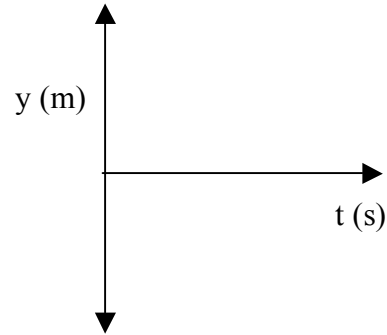
**Extension** – What is the vertical displacement from the highest point the ball reaches to the floor? How long does it take the ball to cover this displacement? Compare this to the amount of time required for a ball to freefall from rest from this height.

**HYPOTHESIS** - Sketch each of the graphs and **EXPLAIN WHY** they would look like this, i.e. what kind of motion is happening in the horizontal and vertical directions? Refer to the background information and the diagram on the first page.

HORIZONTAL



VERTICAL



$$a_x = \underline{\hspace{2cm}} \text{ m/s}^2$$

$$a_y = \underline{\hspace{2cm}} \text{ m/s}^2$$