Shoot Hoops Project

Group Names:_____ Course Number/Section:_____

Goal: *Your ultimate goal is to determine the equation of the parabola that represents the path traveled by a basketball towards the hoop. You will need to determine the maximum height of the ball on this path and the time it takes the ball to reach the hoop.*

Projectile Motion Equations:

1. $X = \frac{1}{2} \cdot a_x \cdot t^2 + V_{ix} \cdot t + X_i$
2. $V_{ix} = V_i \cdot \cos(\theta)$
3.
4. $V_x = V_{ix} + a_x \cdot t$
5. $Y = \frac{1}{2} \cdot a_y \cdot t^2 + V_{iy} \cdot t + Y_i$
6. $V_{iy} = V_i \cdot sin(\theta)$
7. $V_y = V_{iy} + a_y \cdot t$
8. $t_f = \sqrt{\frac{X_f \cdot \sin\theta - (Y_f - Y_i) \cdot \cos\theta)}{-\frac{1}{2} \cdot a_y \cdot \cos\theta}}$
9. $V_i = \frac{X_f}{cos\theta \cdot t_f}$

Variables

- t = time from launch
- t_f = time from launch to impact
- V_i = initial velocity
- θ = angle of elevation
- X = horizontal displacement (distance)
- X_i = initial horizontal displacement
- X_f = final horizontal displacement
- a_x = horizontal acceleration = 0 m/s/s = 0 ft/s/s
- V_{ix} = initial horizontal velocity
- V_x = horizontal velocity at time t.
- Y = vertical displacement (distance)
- Y_i = initial vertical displacement
- Y_f = final vertical displacement
- a_y = vertical acceleration = -9.8 m/s/s = -32 ft/s/s (acceleration of gravity)
- V_{iy} = initial vertical velocity
- V_y = vertical velocity at time t.

PART 1

Stage 1:

State your group's horizontal distance from the hoop. Your distance from the hoop for the shot is equal to ***twice the average*** *of the heights of your group members. Specify the units of measurement used (feet or meters). Make sure your chosen units match those used for the initial velocity.*

Distance from hoop: _____

Height of shooter (Y_i): 10 feet

Height of hoop (Y_f): 10 feet / 3.048 meters

For Part 1, you will assume that the shooter is the same height as the basketball hoop (10 feet tall).

Next choose an initial angle of elevation and find the initial velocity of the basketball. To do this you may use either method below.

METHOD 1:

1. Choose an angle for the shot (i.e. 45 degrees).
2. Compute the total time (t_f) that the basketball travels until it gets to the hoop.
   For this calculation, use Equation 8 where X_f is the distance to the hoop and (Y_f-Y_i) is the difference between the hoop height and the shooter height.
3. Compute initial velocity (V_i) required when using the chosen angle and your group's distance from hoop.
   For this calculation, use Equation 9 where X_f is the distance to the hoop and t_f is the time found in Step 2.

METHOD 2: (Note that this method is much less accurate than Method 1)

1. Use the applet at the following website: http://www.fearofphysics.com/Proj/proj.html
2. Choose an angle for the shot (i.e. 45 degrees).
3. Then choose an Initial Velocity (V_i) to test (10 mph = 14.4 ft/sec = 4.4 m/sec).
   Make sure that you velocity units/second match the distance units that you used.
4. Then try your shot and see if it goes in. If it goes in, you have your angle and initial velocity. If not, then choose a different V_i and try the shot again.

Your goal for Stage 1 is to find the exact initial velocity that must be used with your chosen angle in order for your shot to reach the hoop.

WORK:

θ (chosen angle of elevation): _____

V_i (initial velocity): _____

Stage 2
Using three different times (i.e. $t = 0, t = 1, t = 2$) *and the equations for X and Y, find three points (X, Y) such that each point lies on the parabola created by the basketball in flight.*

WORK:

V_{ix}:

V_{iy}:

Point 1:

Point 2:

Point 3:

Stage 3:
Do a quadratic regression using the three points above in order to find the equation of the parabolic trajectory of the basketball.

Draw and label an illustration of the shot showing the trajectory and any other key information found.

PART 2

Stage 1:

State your group's horizontal distance from the hoop. Your distance from the hoop for the shot is equal to ***twice the sum*** *of the heights of your group members. Specify the units of measurement used (feet or meters). Make sure your chosen units match those used for the initial velocity.*

Distance from hoop: _____

Height of shooter (Y_i): _____

Height of hoop (Y_f): 10 feet / 3.048 meters

Choose one of your group members to be the shooter and enter their height above.

Next choose an initial angle of elevation and find the initial velocity of the basketball. To do this you may use either method below.

METHOD 1:

1. Choose an angle for the shot (i.e. 45 degrees).
2. Compute the total time (t_f) that the basketball travels until it gets to the hoop.
   For this calculation, use Equation 8 where X_f is the distance to the hoop and (Y_f-Y_i) is the difference between the hoop height and the shooter height.
3. Compute initial velocity (V_i) required when using the chosen angle and your group's distance from hoop.
   For this calculation, use Equation 9 where X_f is the distance to the hoop and t_f is the time found in Step 2

METHOD 2: (Note that this method is much less accurate than Method 1)

1. Use the applet at the following website: http://www.fearofphysics.com/Proj/proj.html
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Your goal for Stage 1 is to find the exact initial velocity that must be used with your chosen angle in order for your shot to reach the hoop.

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Using three different times (i.e. $t = 0, t = 1, t = 2$) *and the equations for X and Y, find three points (X, Y) such that each point lies on the parabola created by the basketball in flight.*

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Point 1:

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Stage 3:
Do a quadratic regression using the three points above in order to find the equation of the parabolic trajectory of the basketball.

Draw and label an illustration of the shot showing the trajectory and any other key information found.