EXAMPLE USING METHOD 2

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: 15 ft (you can express distance in ft or m)

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.

Used for this example — *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:

If you can avoid rounding the initial velocity, do so.

θ (chosen angle of elevation): 45°

V_i (initial velocity): 16 mph ≈ 23.4667 ft/sec

make sure units match those used for distance

distance	velocity
ft	ft/sec
m	m/sec

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:

③ $X = \frac{1}{2}a_x t^2 + V_{ix}t + X_i = \frac{1}{2}(0)t^2 + 16.5935t + 0 = 16.5935t$

④ $Y = \frac{1}{2}a_y t^2 + V_{iy}t + Y_i = \frac{1}{2}(-32)t^2 + 16.5935t + 0 = -16t^2 + 16.5935t$

⑤ Find X and Y for different times ($t = \frac{1}{2}$, $t = 2$, etc.)

$X(\frac{1}{2}) = 16.5935(\frac{1}{2}) = 8.29675$

$Y(\frac{1}{2}) = -16(\frac{1}{2})^2 + 16.5935(\frac{1}{2}) \approx 4.29675$

① V_{ix}: $V_i \cdot \cos(\theta) = 23.4667(\cos 45) \approx 16.5935$

② V_{iy}: $V_i \cdot \sin(\theta) = 23.4667(\sin 45) \approx 16.5935$

Keep as much precision in this result as possible. 4 decimal places are a minimum for rounding.

Point 1: (0, 0)

Point 2: (8.3, 4.3) ← from step 5

Point 3: (15, 0)

Stage 3:

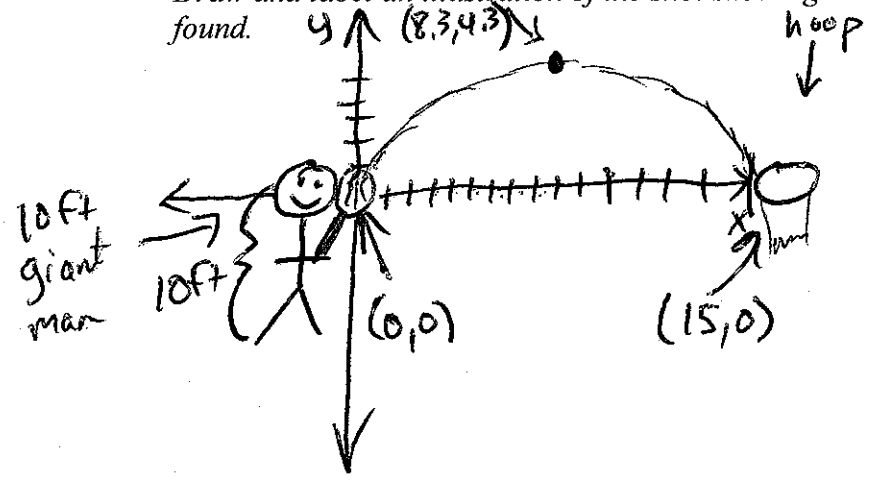
Do a quadratic regression using the three points above in order to find the equation of the parabolic trajectory of the basketball.

① Enter the three points found in Stage 2 into Stat table (Stat → Edit)
(enter x values into L_1, enter y values into L_2)

② Do a Quadratic Regression with these lists L_1, L_2 (Stat → CalcMenu → QuadReg)
(set XList to L_1 and YList to L_2) OR enter QuadReg L_1, L_2

③ Equation: $-0.0773x^2 + 1.1599x$

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



graph should include the 3 points, the height of shooter, and the distance to the hoop.

Also draw in the approximate parabola that represents the path of the ball.