

Projectile Motion Lab With Fixed Initial Speed (FRQ)

Part (a)

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

Note: To earn the first point, it must be possible to use the written equations to arrive at a correct final equation.

0	1	2
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Student response accurately includes two of the following criteria.

- 1 point is earned for using appropriate kinematics equations for the sphere's horizontal and vertical motions.
- 1 point is earned for combining the equations to get a correct equation for y in terms of x , v_0 , and g .

Example Responses:

$$x = v_{x0}t = v_0t$$

$$y = y_0 + v_{y0}t + \frac{1}{2}a_yt^2 = \frac{1}{2}gt^2$$

$$t = x/v_0$$

$$y = \frac{1}{2}gt^2 = \frac{1}{2}g(x/v_0)^2 \text{ or } \frac{1}{2}\frac{gx^2}{v_0^2}$$

Part (b)

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1	2	3	4	5
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Student response accurately includes four of the following criteria.

- 1 point is earned for listing relevant/appropriate equipment that matches the measured quantities.
- 1 point is earned for a plausible/practical way to directly or indirectly determine whether the claim is true, using the available equipment.
- 1 point is earned for measuring x , the horizontal displacement of the sphere.
- 1 point is earned for measuring y , the vertical displacement of the sphere, for at least two different values of y .
- 1 point is earned for attempting to reduce uncertainty using at least three different launch heights, or at least two experimental trials at each of two launch heights.

Example Response:

Quantity to be Measured	Symbol for Quantity	Equipment for Measurement
Initial height above floor for bottom of sphere	y	Meter stick
Horizontal distance from launch point to where sphere hits the floor	x	Meter stick

- Move the launcher to the maximum height possible on the stand.
- With the sphere in the launcher, use the meter stick to measure the height y from the floor to the bottom of the sphere. Also, mark the spot on the floor below the center of the sphere.
- Launch the sphere and note approximately where the sphere hits the floor.
- Place the two sheets of paper at the location where the sphere hit the floor.
- Launch the sphere again, so that a mark is made on the plain paper when the sphere hits the sheets of paper. If the sphere misses the paper sheets, reposition the sheets and repeat the launch until the sphere hits the sheets.
- Put the sphere in the launcher, and use the meter stick to measure the horizontal distance x from the mark made in step 1 to the mark on the paper where the sphere hit the floor.
- Repeat steps 2 through 6 for launch heights of 20%, 40%, 60%, and 80% of the maximum launch height.

Part (c)ii

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0

1

2

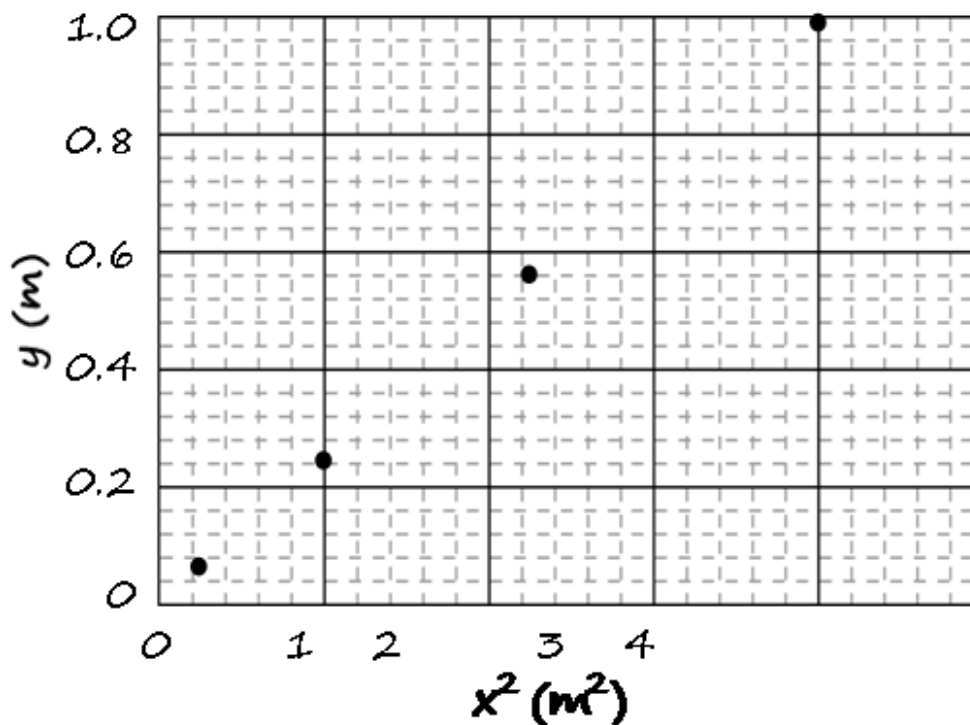
Student response accurately includes both of the following criteria.

1 point is earned for using a correct scale that uses more than half the grid and for correctly labeling the axes, including units, as appropriate.

1 point is earned for correctly plotting the data or quantities calculated from the data.

Example Response:

Horizontal Displacement x (m)	Vertical Displacement y (m)	x^2 (m ²)	
0.50	0.065	0.25	
1.00	0.245	1.00	
1.50	0.560	2.25	
2.00	0.990	4.00	



Part (c)iii

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

Note: if students graph y versus x which results in a parabola, it is not sufficient for a student to simply note that a graph of y versus x is curved, or that the graph "looks like a parabola".) Students must say that y increases by a factor of approximately 4 whenever x is doubled, or similar.

0	1
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Student response accurately includes the following criteria.

- 1 point is earned for a reasonable justification that y is proportional to x^2 .

Example Response:

The data points in a graph of y versus x^2 lie along a straight line.

0	1	2
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Student response accurately includes both of the following criteria.

- 1 point is earned for a graph of v_x that is a constant and less in magnitude than indicated by the dashed line.
- 1 point is earned for a graph of v_y that is identical to the graph indicated by the dashed line.

Example Response:

