Student's Name: ______________________________ Student's Name: ______________________________

Lab day & time: __________________ Date: _________________

Projectile Motion (M3B) – Data Sheets

Show all calculations and write all results on the data sheets in ink.

Activity 1: Projectile Motion Without Air Resistance *(2.5 p.)*

Start the "Projectile Motion" simulation. There are multiple modes to run this simulation. We will use the "Lab" mode, so switch to this mode.

Set the following initial conditions:

- Initial speed = 15 m/s.
- Initial elevation angle = 25°
- Projectile – Pumpkin
- Mass = 5 kg
- Diameter 0.37 m
- Gravity 9.81 m/s^2
- No air resistance.

Run the simulation, measure the range of the projectile and record the range in the table. Repeat measurements for the same initial speed, but for other values of the elevation angle. Record the results in the table. The get accurate distance measurements use the "Time/Range/Height" tool and align the crosshair with the last point on the trajectory.

Elevation angle	Range of the projectile
25°	
30°	
35°	
40°	

45°	
50°	
55°	
60°	
65°	

What is the elevation angle that correspond to the maximum range? What is the value of the maximum range?

Elevation angle = ________ (°) Maximum range = ____________ (m)

Print the graph with multiple trajectories.

Next, set the elevation angle to the value required for the maximum range, do not change the initial speed, but reduce gravity to the value equal to the acceleration due to gravity on planet Venus, i.e., 8.87 m/s^2. Run the simulation and record the range of the projectile.

What is the elevation angle that correspond to the maximum range? What is the value of the maximum range of a projectile on planet Venus?

Elevation angle = _________ (°) Maximum range = ________ (m)

What is the theoretical prediction for the horizontal component of velocity (X-Velocity) as a function of time in a projectile motion without air resistance?

____

____

What is the theoretical prediction for the horizontal component of acceleration in a projectile motion (no air resistance)?

____

____

The vertical velocity gradually change sign from positive (going up) to negative (going down). What happens to the acceleration at the same moment?

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What is the name of the curve describing the trajectory for the projectile motion without air resistance? ____

Activity 2: Projectile Motion with Air Resistance *(1 p.)*

In this activity, you will measure the range in projectile motion with air present.

Change the gravity back to 9.81 m/s^2 and turn <u>on</u> the air resistance. All other parameters should be the same as for Activity 1.

Find the elevation angle that gives the maximum range. To get the exact value of the elevation angle, you may need to use varying steps, with the final tune in 1° steps. Record the elevation and the range.

Elevation angle = __________ (°) Maximum range = _____________ (m)

In the second part of this activity, double the diameter of the pumpkin projectile from 0.37 m to 0.74 m. This will increase air resistance effect. Find the elevation angle that gives the maximum range. Record the elevation and the range.

Elevation angle = __________ (°) Maximum range = _____________ (m)

Print the trajectory for the elevation angle that gives the maximum range with air resistance.

Activity 3: Projectile Motion Range *(1 p.)*

Consider the following situation: the initial velocity of the projectile has doubled, but the elevation angle has not changed. How is the range of the projectile going to change? Ignore the air resistance.

To answer this question setup another simulation of projectile motion without air resistance. Measure the range and next double the value of the initial velocity keeping all other parameters unchanged.

What is the observed change of the projectile range?

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Check the "M3B - Theory and Procedure" file and find which equation predicts the change of the range with increased (or decreased) velocity.

Equation number: _____________

Return the completed lab report to your lab TA.