

Newton's Second Law Home Experiment (Rev 11.5.20)

The experiment is located here:

<https://www.ionaphysics.org/HomeLabs/N2HarrisModified/Newton%27s%20Second%20Law%20Experiment.html>

The experiment consists of a wagon being pulled by a falling mass. The friction between the wagon and the surface is adjustable, but we will leave it at zero to simplify the experiment. The distance is also variable by moving the light barrier (LB) but we will leave that constant for the first two parts of the experiment.

You will make several runs of the experiment and then answer questions based upon the data you obtained from the experiment.

Variables:

M the mass of the wagon

m the mass of the hanging (falling) mass

For this experiment we will leave the coefficient of friction at zero (no friction).

Part I Procedure:

Leave the coefficient of friction set at 0.

Set M and m to the value indicated in the chart

Leave the light barrier (LB) set at 0.5 m and click start. The experiment will run and you will see s (the distance) and t (the time) recorded under the clock. You will also see the "start" button changed to "Record Data". Click the Record Data button and the data will be recorded in the lower part of the green area. You should copy this data down. You will need it for the data spreadsheet which accompanies this experiment.

Adjust M and m according to the table below and record t and s for each run.

Calculate the acceleration and force for each run.

M (kg)	m (kg)	t (sec)	s (meters)	Acceleration = $2*s/t^2$ (m/s ²)	Force = F = $m*9.81m/s^2$ (kg m/s ²)	F/A
1	4		0.5			
2	3		0.5			
3	2		0.5			
4	1		0.5			

Comment: In this part of the experiment you kept the total mass (M+m) constant so you could arrive at the answer to the following question:

Question 1: When the mass is constant, what is the relationship between the force and the acceleration?

Part II

Now we will keep the force constant and see what happens to the acceleration when we increase the total mass.

Set M and m according to the table for each run and record the time t, and the distance s. Calculate the acceleration and the force.

M (kg)	m (kg)	t (sec)	s (meters)	Accel = $2*s/t^2$ (m/s ²)	Force = $m*9.81m/s^2$	Total mass = M+m (kg)
1	2		0.5			
2	2		0.5			
3	2		0.5			
4	2		0.5			

Question 2: When the force is kept constant, what is the relationship between the (total) mass and the acceleration?

Part III

For the final runs we will keep the mass and force constant and vary the distance by moving the light barrier:

M (kg)	m (kg)	t (sec)	s (meters)	Acceleration = $2*s/t^2$ (m/s ²)	Force = F = 0 $m*9.81m/s^2$ (kg m/s ²)
2	1		.25		
2	1		.50		
2	1		.75		
2	1		1.0		

Question 3: If the total mass and the force are kept constant, what is the relationship between the distance and the acceleration?