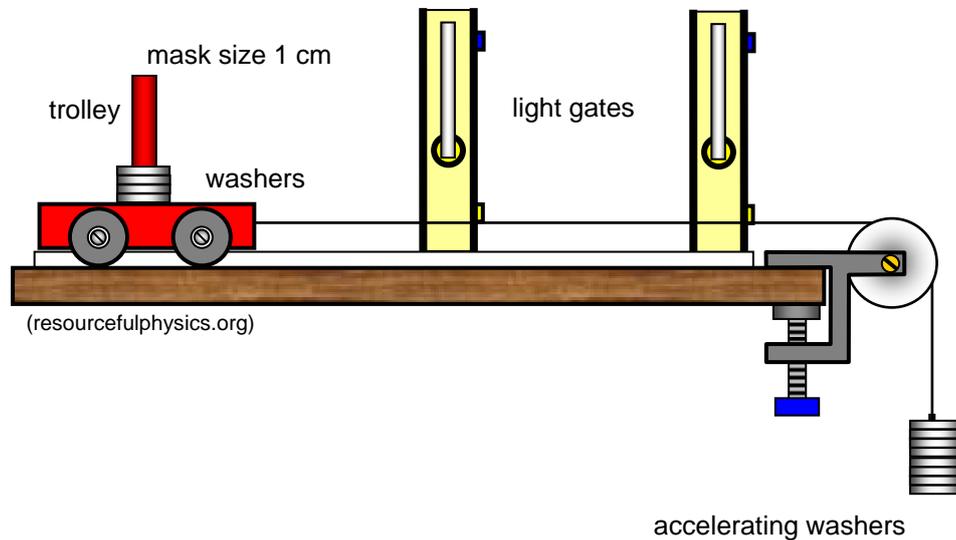


TAP 211- 1: The effect of force and mass on the acceleration of an object



The aim of the experiment

The aim of this experiment is to investigate the effect of force and mass on the acceleration of an object, in this case a trolley.

You will need

- ✓ a trolley,
- ✓ a white plastic track,
- ✓ a pulley,
- ✓ thread,
- ✓ twelve washers (mass 10 g each, or 10 g masses and a holder)
- ✓ metre rule
- ✓ light gates and timer or stopwatches

What to do

Set up your apparatus as shown in the diagram. The trolley should be able to run for 0.6 m. This is the length over which the trolley accelerates. Compensate for friction by tilting the track slightly so that the trolley runs steadily down with no increase in speed when there is no force pulling it.

Start with ten of your twelve washers on the trolley and the other two on the thread hanging down.

The mass to be accelerated is the mass of the trolley and twelve washers while the accelerating force is the weight of the two suspended washers (0.2 N).

Allow the trolley to accelerate down the track and record the time taken: take two repeats and take an average.

Repeat the procedure by taking one washer off the trolley and adding it to the suspended washers – the accelerating force is now 0.3N (same total mass). Carry on until you have only two washers left on the trolley.

Calculate the acceleration of the trolley using $a = 2 L/t^2$ where L is the distance between the light gates

Draw up a table with the following headings:

Accelerating force (N)	Total mass (kg)	time to travel L/s				acceleration = $2 L/t^2$ ($m s^{-2}$)
		1	2	3	mean	

Plot a graph of acceleration (y – axis) against force (x- axis).

Use the graph to answer the following questions:

- 1 From Newton's 2nd Law you would expect the graph of acceleration against force to be a straight line which passes through the origin.
- 2 Explain why you would expect this to be the case.
- 3 Explain what the gradient of the graph represents.
- 4 Calculate the gradient of the graph and explain whether it agrees with your answer to question (3).
- 5 Your results may show some scatter. Explain why this might be and the causes of any inaccuracy.
- 6 Does the experimental result support Newton's Second Law of Motion?

Practical advice

The friction changes with different slope angles. It is best to try the experiment out first and decide if it is worth tilting the slope to friction compensate.

The acceleration could be measured directly with a motion sensor attached to a computer

External references

This activity is taken from Resourceful Physics <http://resourcefulphysics.org/>