Speaker one

We've been using Sir Isaac Newton's theories for hundreds of years and still use his equations today.

Now, how can we test Newton's second law using equipment found in our laboratory?

Speaker two

Well, well, well! We're going to investigate how the resultant force affects an object's acceleration.

This is the equipment you'll need. Pause and take a look.

We're going to need some really accurate timings for this experiment, so we're going to use light gates. The data collected is displayed on the data logger. Your data logger may transfer the results to your computer.

Let's talk through what data we'll collect and how.

First we need to tell the data logger how big our interrupt card is. This is the part which will be detected by the light gate as it passes through. The force to accelerate the trolley will be provided by the masses that we have added to the string. When we release the masses, the force causes the trolley to accelerate.

Now as the trolley passes through the first light gate, the data logger will record how long the light beam is broken for. The data logger then works out the velocity of the trolley at the first light gate, using: velocity equals distance divided by time. The distance is the length of the interrupt card, i.e. 0.1 metres and the time it took to interrupt the light gate as it passes through. We call this our initial velocity or v1.

Speaker two

As the trolley accelerates it passes through the second light gate. Again we will record the velocity on the data logger.

We call this measurement our final velocity or v2. The data-logging system also records the time which has elapsed between the two velocity measurements. And this is shown as delta T. We are going to need all of this data to calculate the acceleration.

Speaker one

Let's remind ourselves of the variables in this investigation. Our independent variable is the force acting on the trolley. This is being provided by the masses that we will add to the end of the string.

Speaker two

Our dependent variable is the trolley's acceleration.

Speaker one

One of our control variables is the overall mass of the system.

To keep this constant when we add masses to the string to increase the accelerating force we must remove them from the trolley at the same time.

Speaker two

We need to start the trolley from behind the first light gate and then release it.

Our accelerating force at this point is one newton. The data is collected for us automatically on the data logger.

Move one newton from the top of the trolley and add it to the other weight on the string.

The total mass of the system hasn't changed but the accelerating force is now two newtons.

We will then repeat the experiment for the resultant force values of three newtons, four newtons

and five newtons.

Speaker one

For health and safety, the masses on the trolley need to be secured. And you can use sticky tack. But make sure you keep the same mass throughout.

Also have something to stop the trolley from crashing off the end.

There should also be sandbags or something similar on the floor underneath the masses.

Speaker two

Go!

Speaker one

We need to process our raw data to work out the acceleration.

So let's have a look. We'll take the one-newton result. Our initial velocity

was 0.43 metres per second. And our final velocity was 0.72 metres per second.

And the time in between was 0.857 seconds. Acceleration equals final velocity minus initial velocity divided by time.

Speaker two

So we do the same calculations for

each value of our independent variable so we have a full set of data to analyse.

Now, you can see our data on the screen right now. Force in newtons on the x-axis. And acceleration in m/s^2 on the y-axis.

Speaker one

Our results definitely support Newton's second law. The one that says force is directly proportional to acceleration as long as the mass is kept constant. I was worried, but yeah,

Newton has triumphed through.