Your teacher may watch to see if you can…
- follow instructions safely
- take careful measurements.

Aim

To investigate the effect of mass on the acceleration of a trolley.

Prediction

1   You will accelerate a trolley using a constant force. What effect do you think the mass of the trolley will have on the acceleration? Explain your prediction if you can.

Method

Apparatus

- trolley
- ramp
- blocks to prop up the end of the ramp
- string
- pulley
- masses
- sticky tape

- card
- sticky putty
- balance
- 2 light gates
- datalogger
- 2 clamps and stands
- box of crumpled newspaper

⚠ **Safety**

Make sure masses cannot fall on your feet by placing a box of crumpled newspaper on the floor beneath them.

A   Prop up one end of the ramp and place a trolley on it. Adjust the slope of the ramp until the trolley just starts to move on its own. Gravity pulling the trolley down the slope is now slightly greater than the friction in the trolley's wheels.

B   Stick a piece of card to the top of the trolley using sticky putty. Leave enough space to stack some masses on top of the trolley. Measure the length of the card and write it down.

C   Find the mass of the trolley and write it down.

D   Fasten the pulley at the bottom end of the ramp, and arrange the string and masses as shown below.
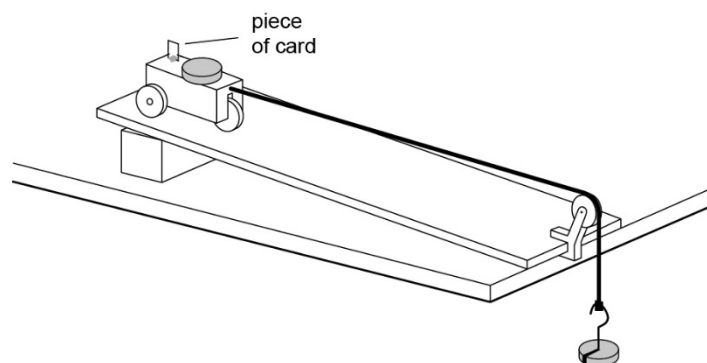
E   Set up two light gates, one near the top of the ramp and one near the bottom. Adjust their positions so that the card on the top of the trolley passes through each gate as it runs down the ramp.

F   Put a mass on the end of the string. You will keep this mass the same for all your tests. You will have to decide what mass to use.

G   Release the trolley from the top of the ramp and write down the speed of the trolley (from the datalogger) as it passes through *each* light gate. Also write down the time it takes for the trolley to go from one light gate to the other. Repeat this two more times, so you have three sets of results.

H   Repeat step **G** for other masses on the trolley. You will have to decide what masses to use and how many different masses you are going to test.

Recording your results

2 Draw a table like this for recording your results. You need to repeat the four rows here for every different mass you put on your trolley.

Mass added to trolley (kg)	Total mass of trolley and masses (kg)	Run number	u – 1st velocity reading (m/s)	v – 2nd velocity reading (m/s)	Time between velocity measurements (s)	Acceleration (m/s²)
		1				
		2				
		3				
		Mean				

3 Calculate the acceleration for each run using the equation in the box.

4 Find the mean acceleration for each trolley mass.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$a = \frac{(v - u)}{t}$$

Considering your results

5 Plot a scatter graph to show your results. Put the total mass of the trolley on the horizontal axis and the mean acceleration on the vertical axis. Draw a line or curve of best fit through your points.

6 a What relationship between acceleration and mass does your graph show?

b Is this what you predicted?

Evaluation

7 a How close are the points on your graph to the line of best fit?

b What does this tell you about the quality of the data you have gathered?

8 How do your results compare to the results obtained by other groups?

9 How certain are you that your conclusion is correct? Explain your answer.