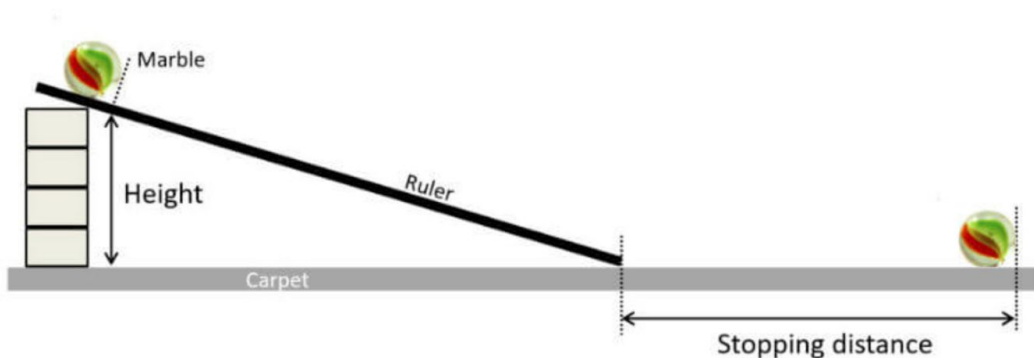**In this task,** you will be using the equipment provided to find the mathematical relationship between the **release height of a marble** and its **stopping distance.**

You will be assessed on your ability to **carry out the investigation,** with direction, and derive a **valid linear mathematical relationship.**

Aim: The aim of this investigation is to find the relationship between the release height of the marble and its stopping distance.

Variables:

Independent variable: **The independent variable in this investigation is the release height of the marble.The independent variable will be changed by releasing the marble in the channel of the ruler from ramps that are different heights above the ground. A suitable range of values for this variable is 2cm, 4cm, 6cm, 8cm, and 10cm.**

Dependent variable: The dependent variable is the stopping distance of the marble.The dependent variable will be measured using a measuring tape from the end of the ramp/ruler to the back of the marble in its final resting position. The readings will be taken from directly above the marble (eg. at 90 degrees to the measuring tape).

Control Variables: Same marble, Same surface, same method of release.

Data

Release Height (cm)	Stopping distance (cm)			
	Trial 1	Trial 2	Trial 3	Average
2	16.2	15.7	15.9	15.9
4	31.6	32.4	31.9	32.0
6	46.8	47.5	47.1	47.1
8	62.6	62.6	62.3	62.5
10	80.3	78.9	79.6	79.6

Plot and Analyse Graph

Draw a graph here. The graph should have a title, X-axis title, Y-axis title, Proper scale and a line of best fit.

The aim of this experiment is to find if there is a relationship between the release height of the marble and the stopping distance. From the above graph you can see that there is a positive linear relationship between the independent variable which is the release height of the marble and the dependent variable which is the stopping distance. This means that as the release height of the marble increases so does the distance at which the marble stops. As all the points are on a straight line it shows a strong relationship between the release height and the stopping distance of the marble.

Discussion

Physics Ideas:

When the marble was placed on the ruler it possessed gravitational potential energy (GPE). When it was released this GPE was transformed into kinetic energy (KE) as it started to roll down the ramp. When the marble reached the end of the ramp all of the GPE had been transformed into KE. As the marble rolled along the carpet the KE was transformed into heat and sound energy due to friction with the carpet and the air. Eventually, all of the KE has been lost and the marble stopped moving. As the release

height increased the amount of GPE also increased causing the marble to have greater KE at the bottom of the ramp and a larger stopping distance.

Reliability and factors that could have gone wrong: Since the data is all consistent with no outliers, it shows that all the variables were tightly controlled. However the following are the factors that could have affected the experiment

- Surface: Different surfaces would have given varied results. For eg: a vinyl surface would have stopped the marble at a further distance.
- Marble: Changing of marble in between the experiment would have changed the results.
- Releasing of marble without force: If the marble was pushed from the top, the stopping distance would have changed, due to extra K.E being added.
- Three trials: Since the experiment was repeated three times that helped to remove any anomalous data.

Connection to real life situation: This experiment shows drivers that the height from which a car travels adds to its speed, which in turn requires more force to stop and can be hazardous. This means that it is better to travel with controlled speed or lower speed while travelling downhill in order to avoid any hazardous situations.