

How moving and lifted objects store energy

Grade 7 science (Year 8 · Class 7) · Lab

Name: _____ Date: _____ Class: _____

How does the height from which a ball is released change how far it can push a cup? This lab links release height, gravitational potential energy and kinetic energy, using only a ramp, a ball bearing and a ruler.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS3-1, MS-PS3-2

Aim

To find how the release height of a rolling ball affects how far it pushes a plastic cup, and so how its energy changes.

Equipment

- A grooved ramp (a plastic curtain rail or a folded card) and two or three books
- A steel ball bearing of mass 16 g (0.016 kg)
- A lightweight plastic cup lying on its side
- A metre rule and a marker pen

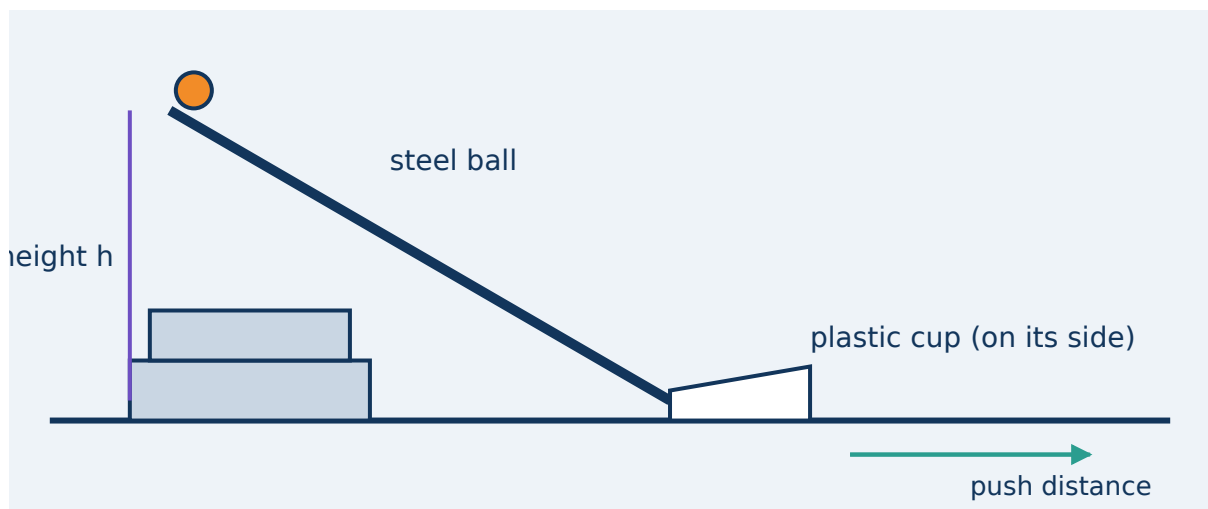
Safety

Safety

Place the ramp away from the table edge and keep feet clear so no rolling ball can hit you. Pick up any ball that rolls onto the floor straight away so nobody slips on it.

Method

1. Prop the ramp on books so it makes a gentle slope. Place the cup on its side at the bottom, with its open end facing the ramp.
2. Release the ball from a height of 5 cm above the table. Measure how far the cup slides and record it.
3. Repeat three times at each height and calculate the mean.
4. Repeat for heights of 10, 15, 20 and 25 cm. Reset the cup each time.



The ball is released from different heights and pushes the cup along the table.

Results

Sample measurements from one group are shown below.

Release height (cm)	Push 1 (cm)	Push 2 (cm)	Push 3 (cm)	Mean push (cm)
5	1.7	1.9	1.8	1.8
10	3.8	4.1	3.8	3.9
15	6.0	6.3	6.0	6.1
20	7.6	8.0	7.8	7.8
25	10.0	10.4	10.2	10.2

Analysis questions

Question 1 Variables

1. State the independent variable.
2. State the dependent variable.
3. Name two variables that must be kept the same.

Question 2 Energy at the top

Calculate the gravitational potential energy of the ball at each release height in millijoules (mJ). Use $g = 9.8 \text{ N/kg}$. $1 \text{ J} = 1000 \text{ mJ}$.

Question 3 Draw the graph

Plot a graph of mean push distance (y-axis) against release height (x-axis). Draw a straight line of best fit through the origin and describe the pattern.

Question 4 Gradient

Use the point (25 cm, 10.2 cm) to calculate the gradient of the line. State what it means.

Question 5 Prediction

Predict the push distance for a release height of 30 cm and say how reliable the prediction is.

Question 6 Why distance shows energy

Explain why the push distance can be used to compare the kinetic energy of the ball at the bottom.

Question 7 Energy losses

The ball cannot transfer all its original gravitational potential energy to the cup. Suggest two reasons.

Question 8 Improving the lab

Look at the spread of the three pushes at 25 cm. State the range and suggest one improvement.