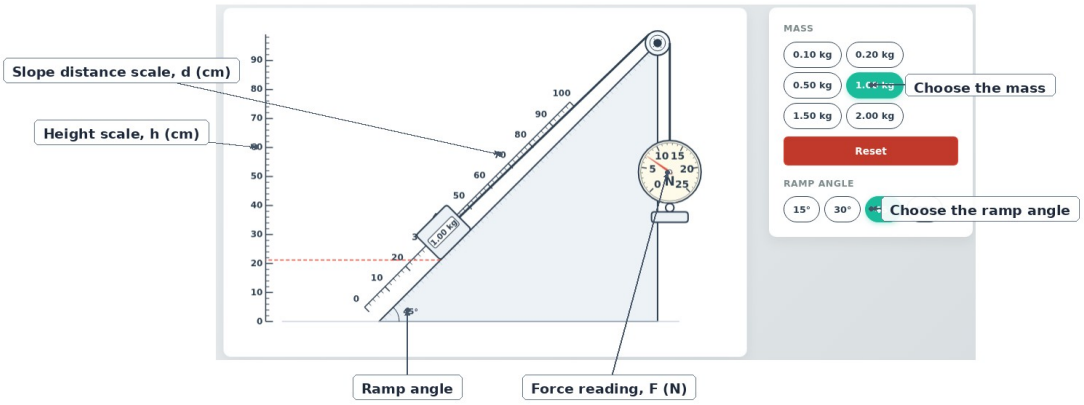
Work Done

Work Done and Energy Transferred on a Ramp

Aim:

You are investigating whether the work done pulling a mass up a ramp is equal to the energy gained by the mass, and whether the angle of the ramp changes either of these.



Prediction:

Set the mass to 0.50 kg. Do you predict the force F needed to pull it up the ramp will be bigger, smaller, or the same at a steep angle (60°) compared with a shallow angle (15°)?

My prediction: .....

Test it in the simulation.

Method:

1. Select 0.50 kg and set the angle to 60°. Drag the handle down and read the force F on the spring balance dial.
2. Change the angle to 15° and read F again. Repeat for 30° and 45°, recording the angle and F for each in your results table.
3. Reset. Select 0.50 kg, 30°. Pull the handle so the slope-distance scale d reads 30 cm, then read the height scale h. Record θ, F, d and h.
4. Repeat for slope distances 20 cm and 40 cm at the same angle, recording d and h each time.
5. Change the angle to 60°. Pull to d = 30 cm and record θ, F, d and h again.
6. Reset. Select 0.50 kg, 30°, and pull the handle until the height scale reads h = 20 cm. Record θ, F, d and h.
7. Repeat step 6 at 15°, 45° and 60°, each time pulling so the block ends at the same height h = 20 cm. Record all four rows.
8. Away from the screen, calculate Work W = F × d and GPE = m × g × h for every row (g = 10 N/kg, and remember to convert d and h from cm to m) and fill in the last two columns.

Results:

Angle θ (°)	Force F (N)	Distance d (cm)	Height h (cm)	Work W (J)	GPE (J)

Analysis:

Look at your first four rows (F at 15°, 30°, 45°, 60° for the same mass). What pattern do you notice in F as the angle increases?

Look at your d and h readings at a fixed angle. What pattern do you notice between d and h? Now compare d and h at the same slope distance but a different angle — what changes?

Compare your Work W and GPE values across all rows, especially the four rows with h = 20 cm at different angles. What do you notice?

Explaining why:

Work done, W (J) = force, F (N) × distance moved in the direction of the force, d (m)

Gravitational potential energy, GPE (J) = mass, m (kg) × gravitational field strength, g (N/kg) × height, h (m)

For the same final height, does F change with the angle? Does d change with the angle?

Does F × d change with the angle, or does it stay the same? A ramp does not let you avoid doing work — what does it let you do instead?

If the ramp were vertical (θ = 90°), what would F equal, and what would happen to d? If the ramp were flat (θ = 0°), what would F have to be, and what would happen to h?

A removalist has a long ramp and a short ramp for loading a fridge into a van. Which should they choose, and why? Will they do less work either way?