Work done against friction

Student activity • investigation and reasoning

YEAR 10 / LESSON 22 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How much energy is transferred when a block is pulled steadily along a surface?

Measure pulling force over a fixed distance and distinguish work against friction from lifting work.

Equipment

- Wooden block with hook, force meter and ruler
- Two secured surface mats, booklet and calculator

Keep blocks away from bench edges. Secure mats, pull slowly within the meter range and do not release stretched equipment. Avoid rough or splintered blocks and sharp abrasive-sheet edges.

Course coverage: Shared Physics / Double Award: 4.11–4.13. Work, energy transfer and gravitational energy.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Place a wooden block with a secure hook on a fixed mat well away from the bench edge. Check the force meter is zeroed and its range is suitable.

2. Mark a 0.30 m travel distance. Pull horizontally at a slow approximately steady speed, keeping the meter level and the block fully on the bench.

3. Read the force during steady sliding, not the initial peak. Record several readings or a representative range and repeat the run three times.

4. Estimate work done by the pulling force using mean steady force × 0.30 m. Explain the approximation if the force fluctuates.

5. Repeat on a second secured surface using the same block and distance. Do not add loads unless specifically approved by staff.

6. Compare with a paper lifting example: raising 0.20 kg by 0.50 m. Calculate mgh and explain why horizontal pulling does not produce that gravitational energy change.

Cleanup

- Ease off the pull, disconnect meters and collect mats and blocks.

Record your evidence

Blank spaces are for your own work

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Reference and task data

For a constant force parallel to motion, W = Fd. During approximately steady horizontal sliding, the pulling work is mainly dissipated into thermal stores of the block and surface. The initial static-friction peak is not the force throughout the journey. For lifting, ΔE_p = mgh refers to vertical height.

Surface / trial	Steady force / N	Distance / m	Estimated work / J
A / 1		0.30	
A / 2		0.30	
A / 3		0.30	
B / 1		0.30	
B / 2		0.30	
B / 3		0.30	

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Find work for 2.0 N over 0.30 m.

2. Why avoid the initial peak reading?

3. Where does energy go during steady sliding?

4. Find energy for lifting 0.20 kg by 0.50 m.

5. Does a large force always mean work is done?

6. Why keep the pull horizontal?