

Student activity AP1.14.1
Lesson reference: P1.14 Using electricity

Book links: Page 198
Specification links: P1.2.1 d, P1.3.1 a–c

Efficiency of a motor

Equipment required per student/group:

Low voltage d.c. motor
Low voltage d.c. power supply
Ammeter
Voltmeter (a joulemeter could be used in place of the ammeter and voltmeter)
Connecting leads and crocodile clips
Winding reel to attach to motor
Pulley and stand
1 m string
Hanger and 50 g masses (200 g per group)
Metre rule
Stopclock

Health and Safety notes:

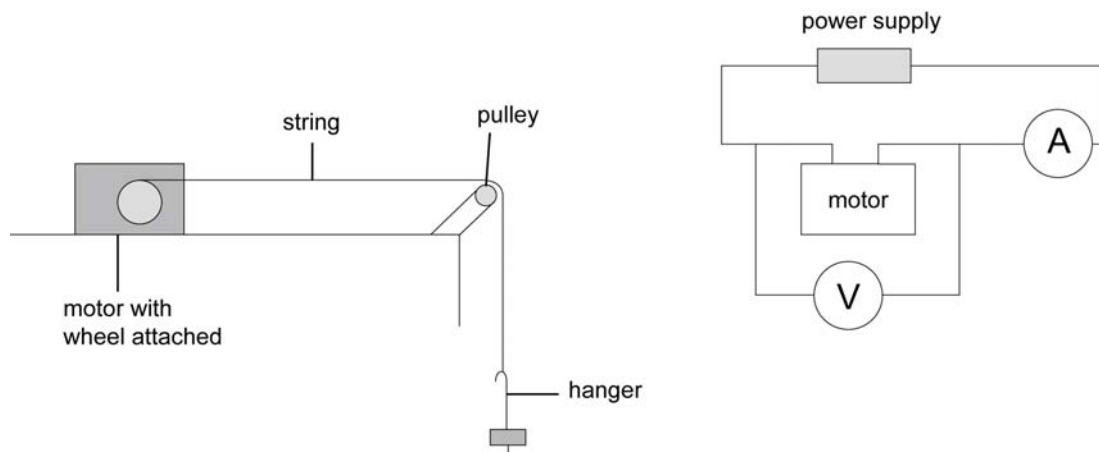
- Do not attempt to exceed the maximum working voltage of the motor.

Getting started

You are going to investigate the efficiency of an electric motor when it is lifting different masses.

Investigating

Collect your apparatus and set up the apparatus as shown in the diagram. Connect up the circuit for the motor as shown in the circuit diagram.





- 1 Do not add any extra masses to the hanger at this stage.
- 2 Measure and mark out a vertical distance of 0.5 m. You are going to time how long the motor takes to raise the hanger this distance.
- 3 Switch on the power to the motor and check that the string will wrap around the winding reel properly. Switch off the motor.
- 4 Reset the hanger and switch on the motor again. Record the voltage across and current flowing through the motor.
- 5 Reset the hanger. This time, record how long it takes for the motor to lift the hanger through 0.5 m.
- 6 Repeat steps 3–5 three times, each time adding a 50 g mass to the hanger, so that the motor is lifting 100 g, 150 g, and then 200 g.

Thinking about

The power used by the motor is given by:

Power (W) = voltage (V) × current (A)

The energy supplied to the motor is given by:

Energy supplied to motor (J) = power (W) × time taken to lift hanger 0.5 m

The work done in raising the hanger is given by:

Work done (J) = mass of hanger (g) × 0.005

Efficiency is given by:

efficiency = $\frac{\text{useful energy transferred}}{\text{total energy supplied}}$

= $\frac{\text{energy needed to lift the hanger and masses}}{\text{energy supplied to the motor}}$

- A Calculate the energy needed to lift the hanger and masses.
- B Calculate the energy supplied to the motor to lift the hanger and masses.
- C Calculate the efficiency of the motor.
- D Plot a graph of efficiency against load for the motor.

Asking questions

- A Was the efficiency of the motor the same for all loads? Explain your answer.
- B Why did you record the time taken to lift the hanger three times?
- C How did you make sure you carried out a fair test?
- D If you carried out your experiment again, is there any way you could improve it?

Spreading the word

Write a report giving details of how you carried out your experiment, your results, and your conclusions.