8 The efficiency η of a filament lamp may be expressed as

$$\eta = \frac{\text{light energy emitted}}{\text{electrical energy input}}.$$

The efficiency can be determined by measuring the amount of wasted energy produced by the lamp in the form of thermal energy. The efficiency is calculated using

$$\eta = 1 - \frac{\text{thermal energy}}{\text{electrical energy input}}.$$

The efficiency is thought to depend on the potential difference V across the lamp. The relation between the efficiency and the potential difference may be written in the form

$$\eta = aV^b$$

where a and b are constants.

You are provided with a filament lamp of low potential difference and a beaker with water that is to be used in the determination of the thermal energy produced by the lamp. You may also use any of the other equipment usually found in a physics laboratory.

Design an experiment to determine the relationship between η and V.

You should draw a labelled diagram to show the arrangement of your apparatus. In your account you should pay particular attention to

(a) the identification and control of variables,
(b) the equipment you would use,
(c) the procedure to be followed,
(d) how the relationship between η and V is determined from your readings,
(e) any precautions that would be taken to improve the accuracy and safety of the experiment.

Diagram

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