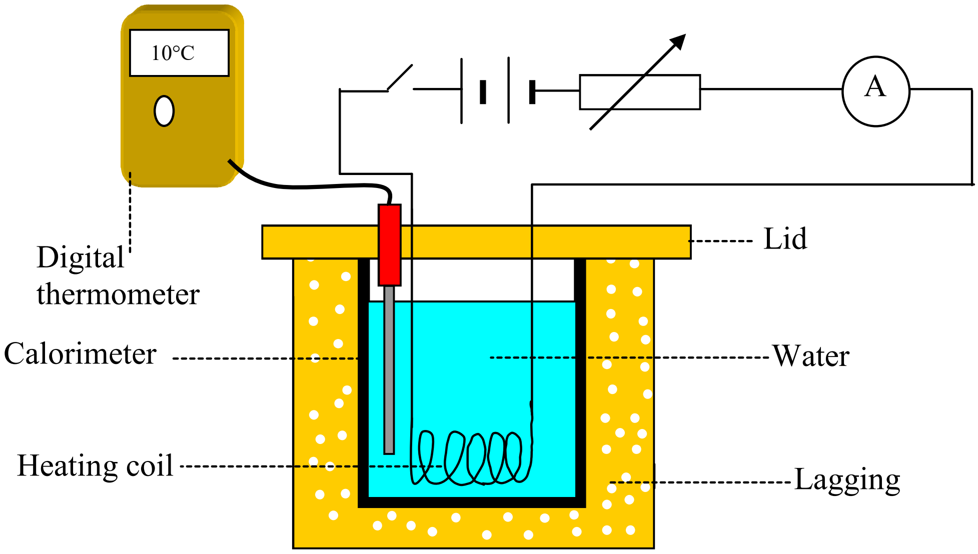
VERIFICATION OF JOULE'S LAW (As $\Delta\theta \propto I^2$)

Apparatus

Lagged beaker or calorimeter with a lid, heating coil, battery or low voltage power supply, rheostat, ammeter or multimeter, thermometer, stopwatch, balance.



Procedure

1. Put sufficient water in a calorimeter to cover the heating coil. Set up the circuit as shown.
2. Note the temperature.
3. Switch on the power and simultaneously start the stopwatch. Allow a current of 0.5 A to flow for five minutes. Make sure the current stays constant throughout; adjust the rheostat if necessary.
4. Note the current, using the ammeter.
5. Note the time for which the current flowed.
6. Stir and note the highest temperature. Calculate the change in temperature $\Delta\theta$.
7. Repeat the above procedure for increasing values of current I, taking care not to exceed the current rating marked on the rheostat or the power supply. Take at least six readings.
8. Plot a graph of $\Delta\theta$ (Y-axis) against I^2 (X-axis).

Results

θ_1/°C	θ_2/°C	$\Delta\theta$ /°C	I/A	I^2/A^2

A straight-line graph through the origin verifies that $\Delta\theta \; \alpha \; I^2$ i.e. Joule's law.

Notes

Ensure that the rheostat current limit exceeds 3 A.

The heat energy produced is the mass multiplied by specific heat capacity multiplied by rise in temperature: $H = mc\,\Delta\theta$.
The energy liberated per second in the device is defined as the electrical power. This energy is $P = RI^2$.
Therefore $RI^2 = mc\,\Delta\theta\;/t$
or $I^2 = (mc/Rt)\;\Delta\theta$.
As the mass, specific heat capacity, resistance and time are constant, $\Delta\theta \; \alpha \; I^2$.
Hence $P \; \alpha \; I^2$