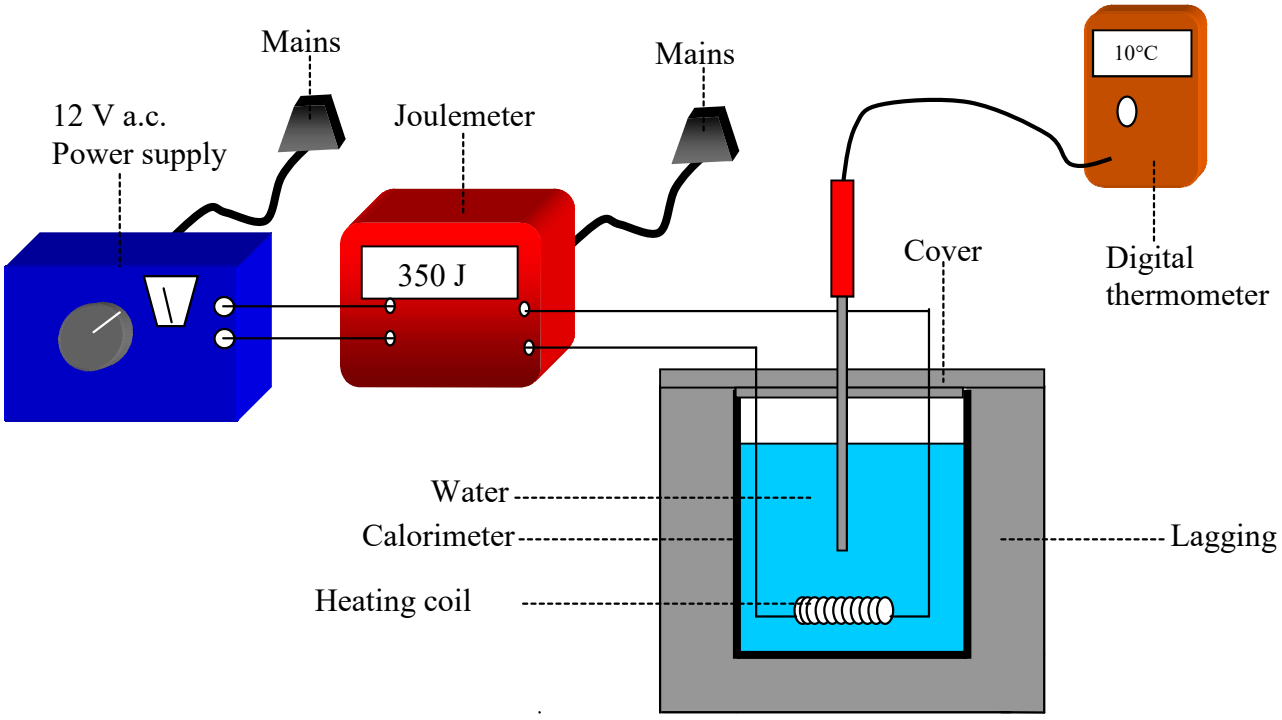
MEASUREMENT OF SPECIFIC HEAT CAPACITY OF WATER BY AN ELECTRICAL METHOD

Apparatus

Joulemeter, calorimeter, heating coil, beaker, lagging, thermometer reading to 0.1 °C, electronic balance and a low voltage a.c. supply.



Procedure

1. Find the mass of the calorimeter m_{cal}.
2. Find the mass of the calorimeter plus the water m_1. Hence the mass of the water m_w is $m_1 - m_{cal}$.
3. Set up the apparatus as shown. Record the initial temperature θ_1.
4. Plug in the joulemeter , switch it on and zero it.
5. Switch on the power supply and allow current to flow until a temperature rise of 10 °C has been achieved.
6. Switch off the power supply, stir the water well and record the highest temperature θ_2. Hence the rise in temperature $\Delta\theta$ is $\theta_2 - \theta_1$.
7. Record the final joulemeter reading Q.

Results

Mass of the calorimeter	m_{cal}	=	
Mass of the calorimeter plus the water	m_1	=	
Mass of the water	m_{w}	=	$m_1 - m_{\text{cal}} =$
Initial temperature of water	θ_1	=	
Final temperature	θ_2	=	
Rise in temperature	$\Delta\theta$	=	$\theta_2 - \theta_1 =$
Final joulemeter reading	Q	=	

Calculations

Given that the specific heat capacity of the calorimeter c_{cal} is known, the specific heat capacity of water c_{w} can be calculated from the following equation:

Electrical energy supplied = energy gained by water + energy gained by calorimeter

$$Q = m_{\text{w}}c_{\text{w}}\Delta\theta + m_{\text{cal}}c_{\text{cal}}\Delta\theta .$$

Notes

If a polystyrene container is used in place of the copper calorimeter, then the energy gained by the water is equal to the electrical energy supplied since the heat capacity of the container is negligible.

The energy equation now reads: $Q = m_{\text{w}}c_{\text{w}}\Delta\theta$.
If a joulemeter is unavailable, electrical energy can be supplied to the heating coil from a power supply unit connected in series to an ammeter and rheostat. A voltmeter must be placed in parallel with the heating coil to measure the potential difference and a stopwatch used to measure the time of current flow.
Switch on the current and the stopwatch simultaneously. Adjust the rheostat to maintain a constant current. Allow the current to flow until a temperature rise of 10 °C has been achieved. Record the steady current I and voltage V readings. Switch off the current and the stopwatch simultaneously. Record the time t in seconds.

If a calorimeter is used the energy equation is: $VIt = m_{\text{w}}c_{\text{w}}\Delta\theta + m_{\text{cal}}c_{\text{cal}}\Delta\theta$.

If a polystyrene container is used the energy equation is: $VIt = m_{\text{w}}c_{\text{w}}\Delta\theta$.