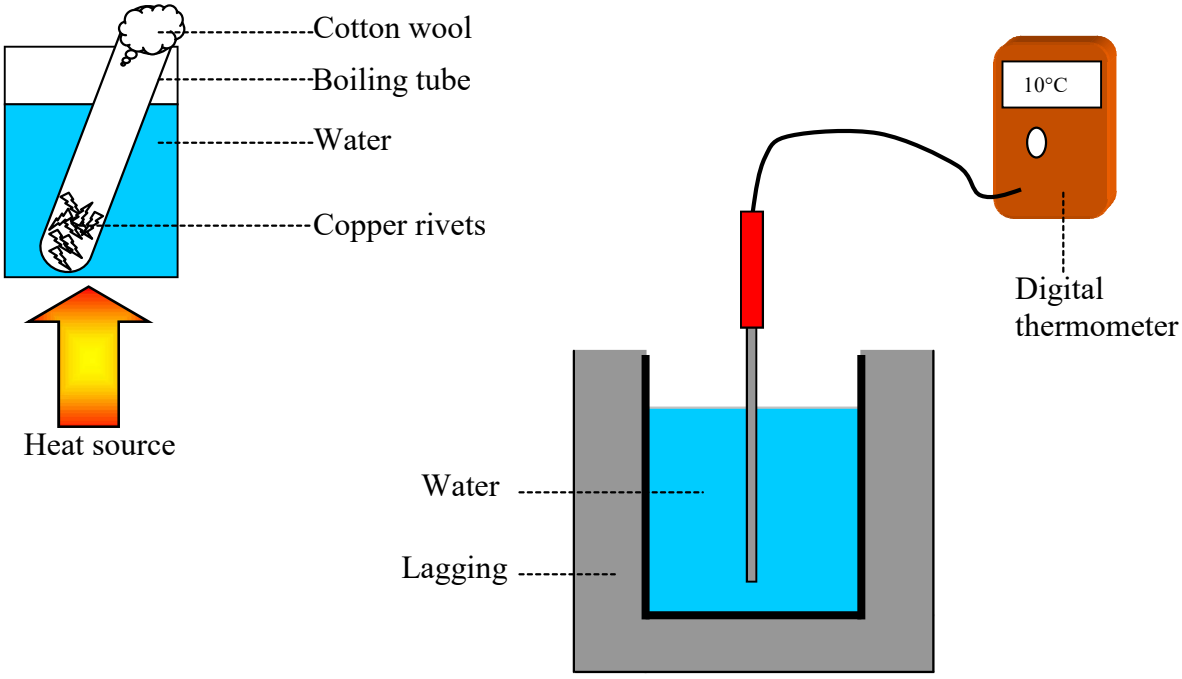
# MEASUREMENT OF THE SPECIFIC HEAT CAPACITY OF A METAL OR WATER BY A MECHANICAL METHOD

## Apparatus

Copper calorimeter, copper rivets, beaker, boiling tube, lagging, thermometer accurate to 0.1 °C, heat source and electronic balance.




## Procedure

1. Place some copper rivets in a boiling tube. Fill a beaker with water and place the boiling tube in it.
2. Heat the beaker until the water boils. Allow boiling for a further five minutes to ensure that the copper pieces are 100° C.
3. Find the mass of the copper calorimeter $m_{cal}$.
4. Fill the calorimeter, one quarter full with cold water. Find the combined mass of the calorimeter and water $m_1$. Hence the mass of the water $m_w$ is $m_1 - m_{cal}$.
5. Record the initial temperature of the calorimeter plus water $\theta_1$.
6. Quickly add the hot copper rivets to the calorimeter, without splashing.
7. Stir the water and record the highest temperature $\theta_2$. The fall in temperature $\Delta\theta_1$ of the copper rivets is 100 °C $- \theta_2$. The rise in temperature $\Delta\theta_2$ of the calorimeter plus water is $\theta_2 - \theta_1$.
8. Find the mass of the calorimeter plus water plus copper rivets $m_2$ and hence find the mass of the rivets $m_{co}$.

## Results

| | | | |
|---|---|---|---|
| Mass of the calorimeter | $m_{cal}$ | = | |
| Mass of the calorimeter plus the water | $m_1$ | = | |
| Mass of the water | $m_w$ | = | $m_1 - m_{cal}$ = |
| Initial temperature of water | $\theta_1$ | = | |
| Initial temperature of rivets | 100° C | | |
| Initial temperature of calorimeter | $\theta_1$ | = | |
| Final temperature of water | $\theta_2$ | = | |
| Final temperature of rivets | $\theta_2$ | = | |
| Rise in temperature of water | $\Delta\theta_2$ | = | $\theta_2 - \theta_1$ = |
| Rise in temperature of calorimeter | $\Delta\theta_2$ | = | $\theta_2 - \theta_1$ = |
| Fall in temperature of rivets | $\Delta\theta_1$ | = | 100° C - $\theta_2$ |
| Mass of calorimeter plus water plus rivets | $m_2$ | = | |
| Mass of rivets | $m_{co}$ | = | $m_2 - m_1$ |

## Calculations

Assume that heat losses to the surroundings or heat gains from the surroundings are negligible.
Given that either the specific heat capacity of water $c_w$ or the specific heat capacity of copper $c_c$ is known, the other specific heat capacity can be calculated from the following equation:

Energy lost by copper rivets = energy gained by copper calorimeter + the energy gained by the water

$$m_{co}c_c\,\Delta\theta_1 = m_{cal}c_c\,\Delta\theta_2 + m_w c_w\,\Delta\theta_2 .$$

If $c_w$ is known, then $c_c$ can be calculated or alternatively if $c_c$ is known, $c_w$ can be found.

## Notes

If a polystyrene container is used in place of the copper calorimeter, then the energy gained by the water is equal to the energy lost by the copper rivets. The energy equation now reads:

$$m_{co}c_c\,\Delta\theta_1 = m_w c_w\,\Delta\theta_2 .$$