# Mandatory Experiments
# (Heat)

| | |
|---|---|
| Heat 1 | Calibration Curve of a Thermometer |
| Heat 2 | Specific Heat Capacity |
| Heat 3 | Specific Latent Heat of Fusion |
| Heat 4 | Specific Latent Heat of Vaporisation |

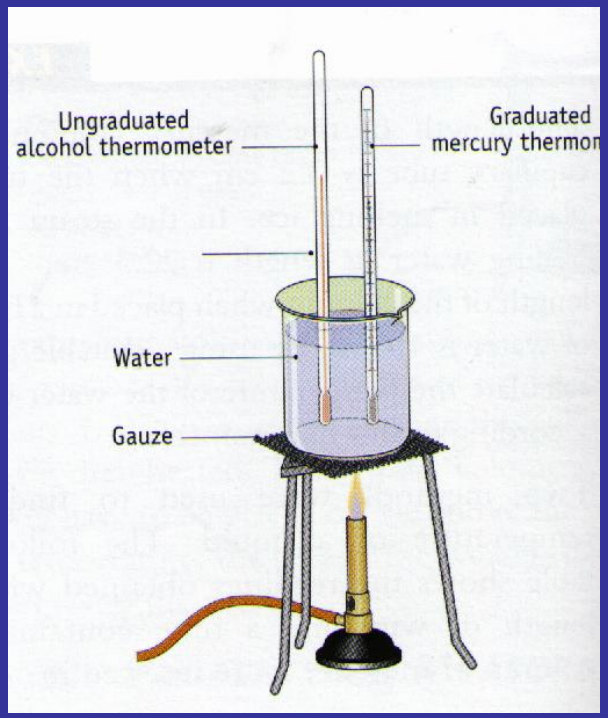
Heat 1

# Calibration Curve of a Thermometer

(using a mercury thermometer as standard)

# Calibration Curve

## Apparatus




Alcohol thermometer (on metre stick)

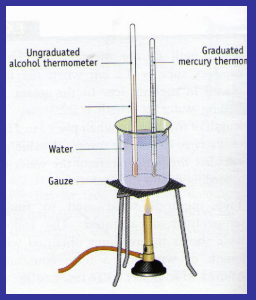
Mercury Thermometer

Beaker & water, etc.

Bunsen

Metre Stick

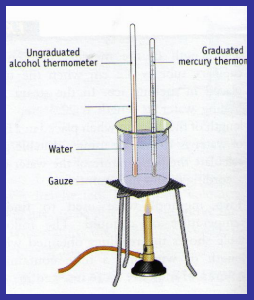
# Calibration Curve




## Procedure

- Heat gently … take readings every 10°
- Measure (2) …
- How are these measurements taken?
- Repeat, every 10°, to graph.

# Calibration Curve

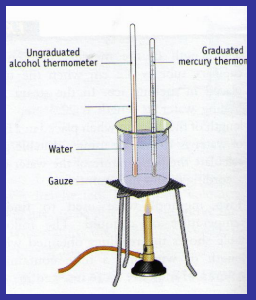



## Procedure

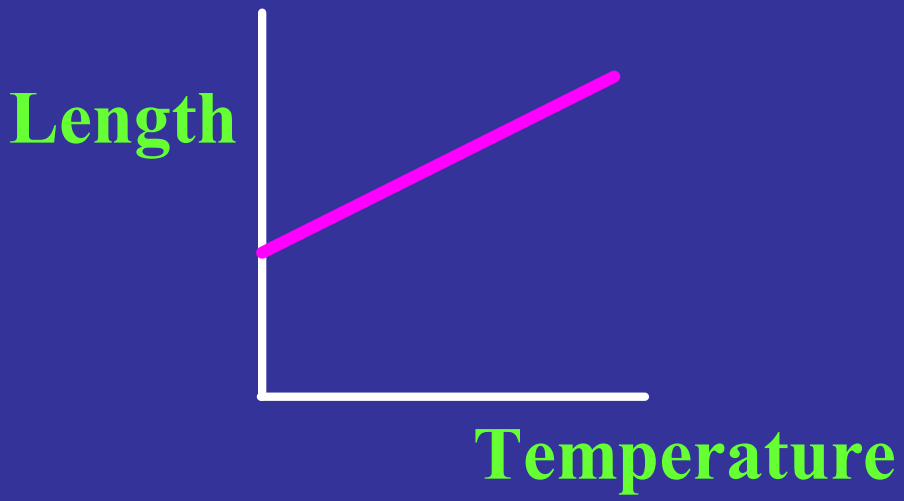
- Heat gently … take readings every 10°
- Measure (2) Length of … & Temperature
- *L* = length of alcohol column

  Temperature from mercury thermometer
- Repeat, every 10°, to graph.

# Calibration Curve




## Results



# Calibration Curve

**Precautions / Questions**

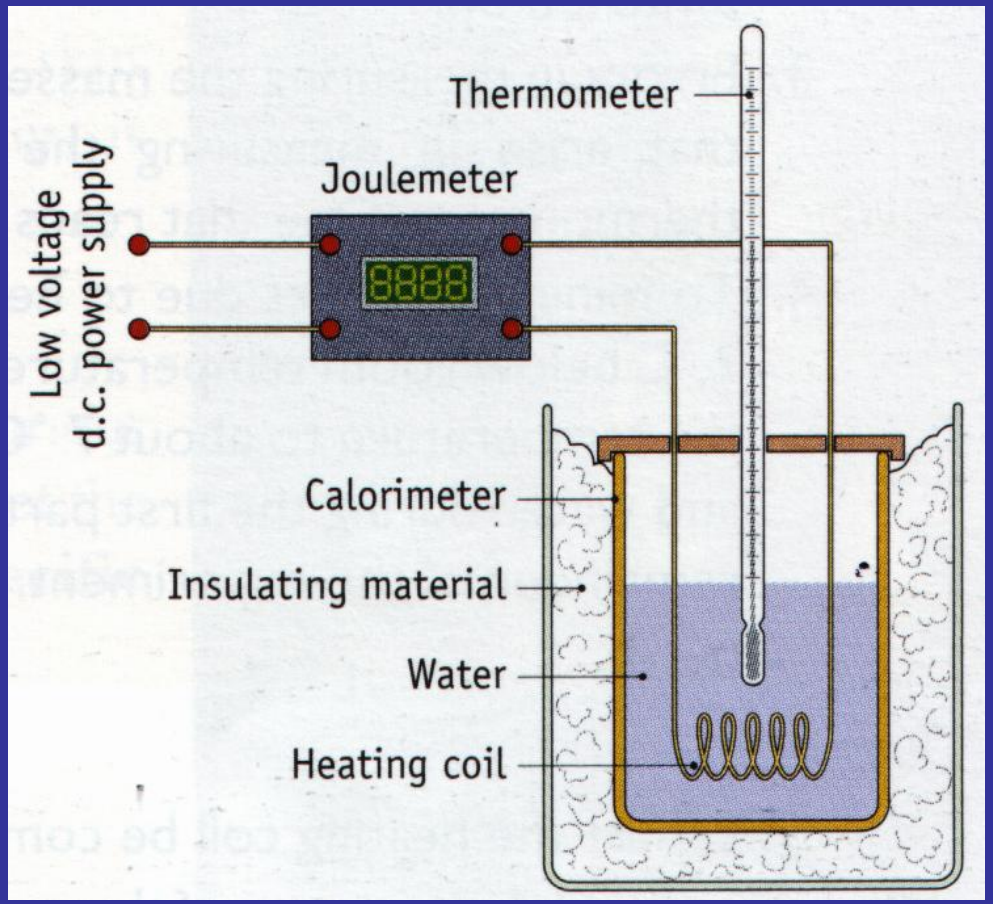
1. Give two precautions taken to ensure an accurate result.
2. Why is the water heated slowly?
3. Why is the water stirred?
4. What is a thermometric property and what is this thermometer's thermometric property?
5. Repeat the readings as the water cools. Why?
6. How would you use the calibration curve to measure the temperature of hot water?
7. What is thermal equilibrium?

Heat 2

# Measurement of Specific Heat Capacity

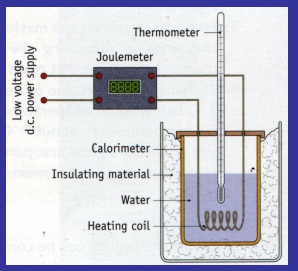
# SHC

## Apparatus




- Calorimeter & Lid
- Water
- Lagging
- Heating Coil
- Thermometer
- Joulemeter
- Power Supply

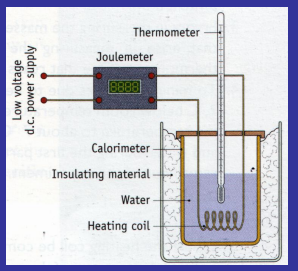
# SHC




## Procedure

- Switch on … temp. rises 10° to 30°
- Measure (4)…
- How are these measured?
- Repeat … other ?? … Why repeated?

# SHC




## Procedure

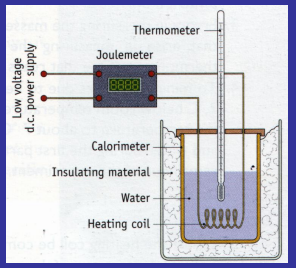
- Switch on … temp. rises 10° to 30°
- Measure … $Q$ $m_C$ $m_W$ $\Delta\theta$ ($c_C$ known)
- Joulemeter: $Q$ = (final reading – initial reading)

  Electric balance: $m_C$ $(m_C + m_W)$

  ➔ $m_W = (m_C + m_W) - m_C$

  Thermometer: $\Delta\theta = \theta_{FINAL} - \theta_{INITIAL}$
- Repeat … other masses and $\Delta\theta$ … average $c_W$

# SHC




## Results

$$Q = m_C c_C \Delta\theta + m_W c_W \Delta\theta$$

Get average $c_W$

# SHC

## Precautions / Questions

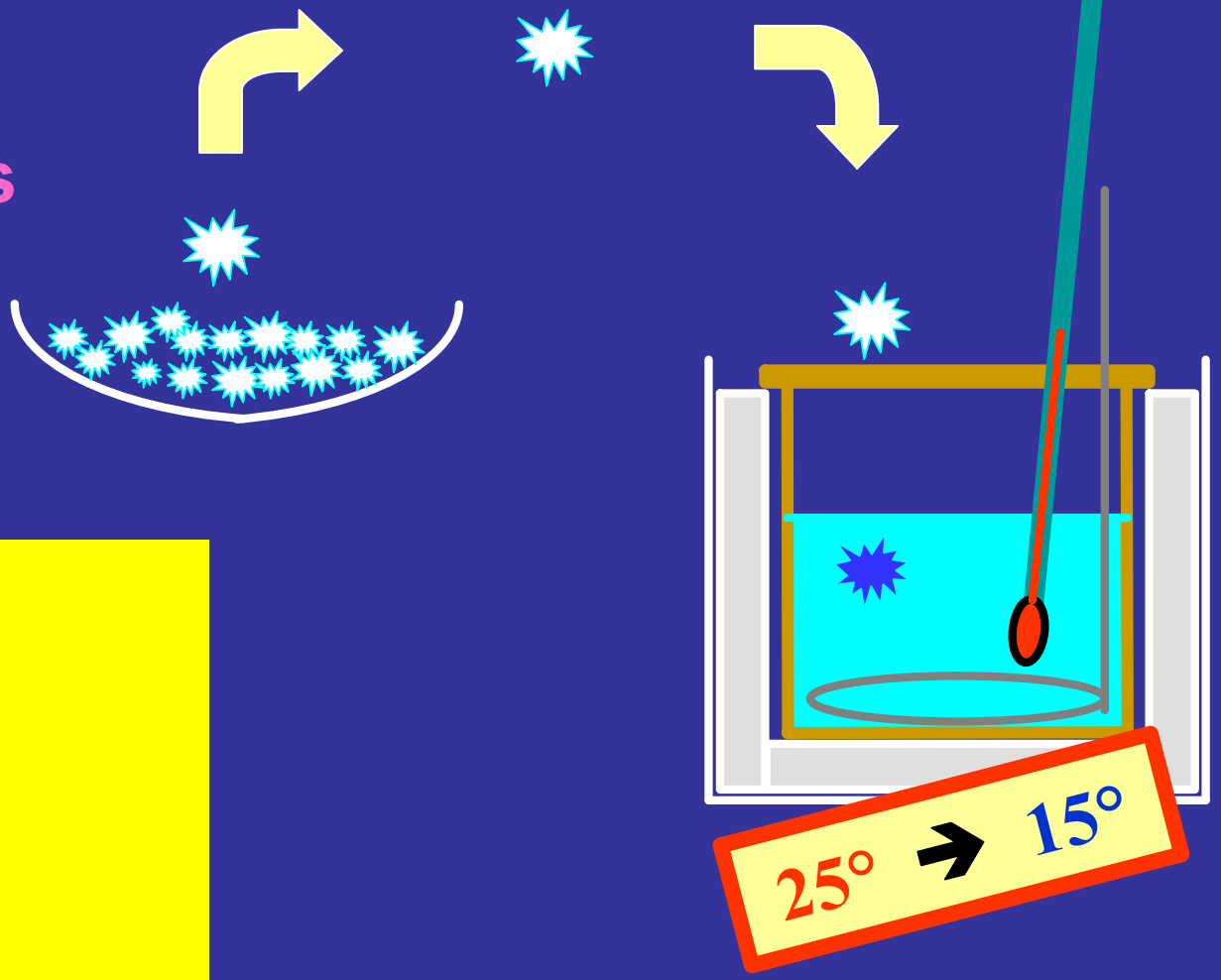
1. Give three precautions taken to ensure an accurate result.
2. Why is the liquid pre-cooled? (2)
3. A sensitive thermometer should be used. What does this mean?
4. Why should the liquid be stirred, and when should it be stirred?
5. How is the accuracy affected by supplying a larger quantity of energy?
6. How is the accuracy affected by having, (i) a small rise in temperature, (ii) a large rise in temperature?
7. How is the accuracy affected if the temperature takes a long time to rise due to a low current being used?
8. Where in the liquid, top or bottom, is the heating coil placed? Explain.
9. Why should the calorimeter be well insulated?
10. Why is a lid placed on the calorimeter?
11. Why should the calorimeter be polished?
12. For greatest accuracy, what characteristic should the thermometer have?
13. List three precautions taken to minimise heat losses.
14. Why would it be less accurate if a greater mass of liquid was used while supplying the same quantity of energy?

Heat 3

# Measurement of Specific Latent Heat of Fusion of Ice

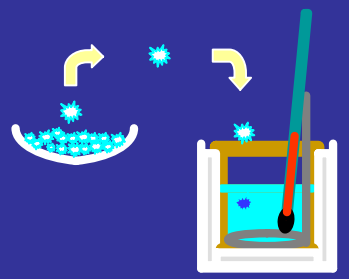
# SLH of Fusion

## Apparatus




- Calorimeter
- Lagging & Lid
- Water
- Thermometer
- Ice – small pieces
- Cloth

# SLH of Fusion

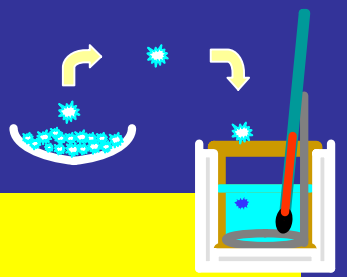


## Procedure

- Add ice (small pieces & dry) … 25° ➔ 15°
- Measure (5)…
- How are these measured?
- Repeat … other ?? … Why repeated?

# SLH of Fusion

## Procedure



- Add ice (small pieces & dry) … 25° ➔ 15°
- Measure (5) … $m_{ICE}$ $m_C$ $m_W$ $\Delta\theta_{RISE}$ $\Delta\theta_{FALL}$
- <u>Electric Balance ..</u>

  Mass of calorimeter ($m_C$)

  Mass of calorimeter + water ($m_2$)

  Mass of calorimeter + water + melted ice ($m_3$)

  $m_W = m_2 - m_C$ $\quad\quad$ $m_{ICE} = m_3 - m_2$

  <u>Thermometer</u>

  Initial temp. of water = $\theta_1$

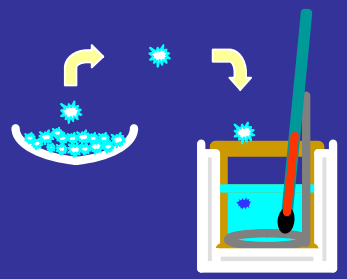
  Final temp. of water + melted ice = $\theta_2$

  Temp. of ice = 0 °C

  $\Delta\theta_{RISE} = \theta_2 - 0 = \theta_2$ $\quad\quad$ $\Delta\theta_{FALL} = \theta_1 - \theta_2$
- Repeat … other masses & temp. changes

  … to get average *I*

# SLH of Fusion



## Results

$$m_{ICE} \cdot L + m_{ICE} \cdot c_W \cdot \Delta\theta_{RISE} = m_C \cdot c_C \cdot \Delta\theta_{FALL} + m_W \cdot c_W \cdot \Delta\theta_{FALL}$$

**Get average $L$**

# SLH of Fusion

## Precautions / Questions

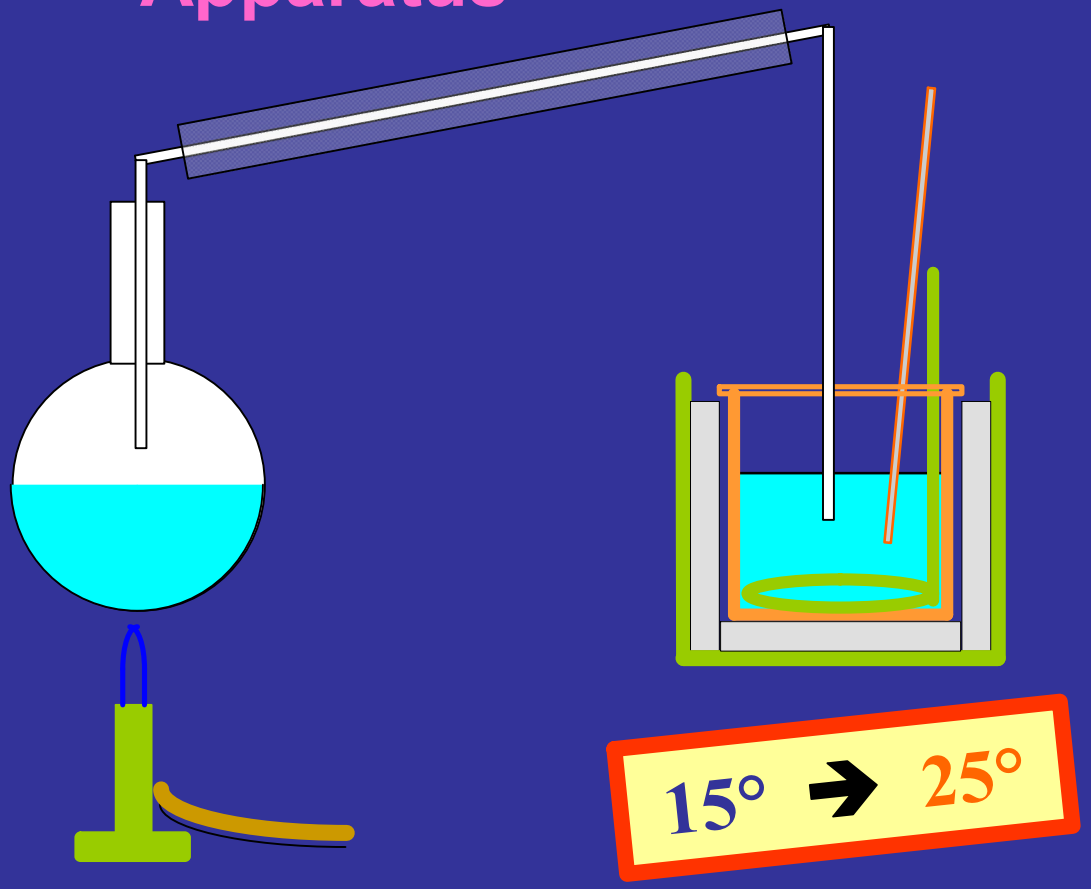
1. Give three precautions taken to ensure an accurate result.
2. Why is the water in the calorimeter pre-heated? (2)
3. Why should the ice be crushed?
4. Why should the ice be dried before adding it to the water?
5. How do you ensure that the ice is at 0°C before adding it to the water in the calorimeter?
6. A sensitive thermometer should be used. What does this mean?
7. Why should the liquid be stirred, and when should it be stirred?
8. How is the accuracy affected by supplying a larger mass of ice?
9. How is the accuracy affected by having, (i) a small fall in temperature, (ii) a large fall in temperature?
10. Why should the calorimeter be well insulated?
11. Why should the calorimeter be polished?
12. For greatest accuracy, what characteristic should the thermometer have?
13. List three precautions taken to minimise heat losses.
14. Why would it be less accurate if a greater mass of water was used while adding the same mass of ice?
15. The accepted value for the specific latent heat of fusion of ice is 3.3 x 105 J kg- If your answer was different to this suggest two reasons why so.
16. Why should splashing be avoided when adding ice to the water in the calorimeter?

Heat 4

# Measurement of Specific Latent Heat of Vaporisation of Water

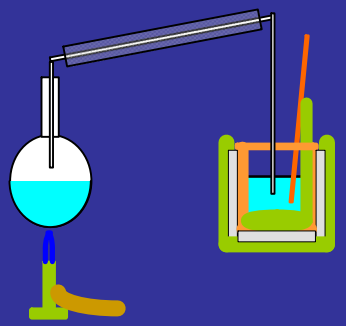
# SLH of Vaporisation

## Apparatus




- Calorimeter
- Lagging & Lid
- Water
- Thermometer
- Steam Generator
- with lagged delivery tube

# SLH of Vaporisation

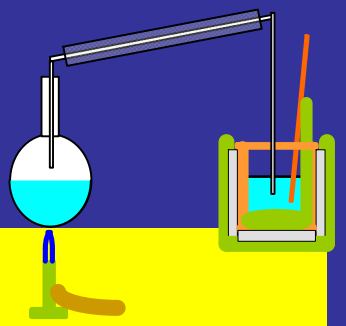


## Procedure

- Add dry steam … 25° ➔ 15°
- Measure (5)…
- How are these measured?
- Repeat … other ?? … Why repeat?

# SLH of Vaporisation

## Procedure



- Add dry steam … 25° ➔ 15°
- Measure (5) … $m_{STEAM}$ $m_C$ $m_W$ $\Delta\theta_{RISE}$ $\Delta\theta_{FALL}$
- **Electric Balance ..**

  Mass of calorimeter ($m_C$)

  Mass of calorimeter + water ($m_2$)

  Mass of calorimeter + water + condensed steam ($m_3$)

  $m_W = m_2 - m_C$ $\quad$ $m_{STEAM} = m_3 - m_2$

  **Thermometer**

  Initial temp. of water = $\theta_1$

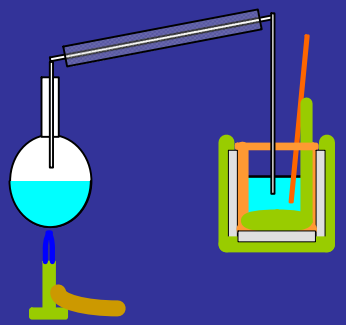
  Final temp. of water + condensed steam = $\theta_2$

  Temp. of steam = 100 °C

  $\Delta\theta_{RISE} = \theta_2 - \theta_1$ $\quad$ $\Delta\theta_{FALL} = 100 - \theta_2$

- Repeat … other masses & temp. changes … to get average *L*

# SLH of Vaporisation



## Results

$$m_{STEAM} \cdot L + m_{STEAM} \cdot c_W \cdot \Delta\theta_{FALL} = m_C \cdot c_C \cdot \Delta\theta_{RISE} + m_W \cdot c_W \cdot \Delta\theta_{RISE}$$

**Get average $L$**

# SLH of Vaporisation

## Precautions / Questions

1. Give three precautions taken to ensure an accurate result.
2. Why is the water in the calorimeter pre-cooled? (2)
3. What is the function of the steam trap? Give two other ways of doing this
4. Why should the water in the steam generator be boiling for 2 minutes before placed the delivery tube into the calorimeter?
5. Why should the end of the delivery tube be dried before putting it into the calorimeter?
6. Why might adding a greater mass of steam improve the accuracy of the experiment?
7. What is the function of the steam-trap?
8. A sensitive thermometer should be used. What does this mean?
9. Why should the liquid be stirred, and when should it be stirred?
10. How is the accuracy affected by supplying a larger mass of steam?
11. How is the accuracy affected by having, (i) a small rise in temperature, (ii) a large rise in temperature?
12. Why should the calorimeter be well insulated?
13. Why should the calorimeter be polished?
14. For greatest accuracy, what characteristic should the thermometer have?
15. List three precautions taken to minimise heat losses.
16. Why would it be less accurate if a greater mass of water was used while adding the same mass of steam?
17. The temperature of the steam used was 100 °C. The initial and final temperatures of the water in the calorimeter were 10°C and 19 °C, respectively. Why is the rise in temperature less accurate than the fall in temperature?. Give two ways of improving this value.