WJEC Wales Physics A Level

SP Unit 3 04 : Thermal Physics

Practical notes

1. Estimation of Absolute Zero by Use of Gas Laws

Theory:
Pressure is directly proportional to temperature; when temperature increases, pressure also increases. This is because the particles at a higher temperature have more kinetic energy, so collide more frequently and with greater velocity, exerting a greater force on the walls of their container.

Equipment:
- A gas pressure gauge
- A sealed metal/plastic container which can be connected to the gauge
- Beakers
- Kettle
- Thermometer
- Ice
- Stopwatch

Method:
1. Boil the water in the kettle and pour into the beaker.
2. Connect the container to the gauge and immerse in the beaker.
3. Record the initial temperature of the water, and the pressure reading on the gauge.
4. Place the ice in a larger beaker and place the beaker of boiling water inside it.
5. Take temperature and pressure readings every 5 minutes (timed by the stopwatch) as the water cools.
6. Plot a graph of temperature (x) against pressure (y).
7. Extend the line of best fit until it reaches the x axis (ie. pressure = 0Pa) and read off the temperature value at a pressure of 0. This is the value of absolute zero and should be -273℃.

Safety:
- Boiling water can cause burns. Take care when pouring and do not handle the beaker of boiling water with bare hands.
- Glass beakers may smash and broken glass can cause injury - handle glass carefully and clear up any breakages immediately.

Tips:
- Stir the water with the thermometer before taking a reading to ensure you get an accurate value.
- Allow the container to acclimatise for 2 minutes before taking the first reading.

2. Measurement of the Specific Heat Capacity of a Solid

Equipment:

- Sample of material
- Electric heater
- Ammeter
- Voltmeter
- Wires/leads
- Thermometer
- Insulating block with 3 slots
- Heatproof mat
- Balance

Method:

1. Connect the heater in series with the ammeter and connect the voltmeter across the heater.
2. Measure the mass of the sample material using the balance.
3. Place the sample in one slot of the insulating block, with a thermometer and heater in the other two. Place some water in the thermometer hole first, to help make the reading more accurate.
4. Take the initial temperature reading.
5. Start the heater and stopwatch, and take a reading of current and voltage.
6. Take a temperature reading every minute.
7. Continue for 10 minutes, then turn the heater off and allow the apparatus to cool.
8. Repeat 3 times and calculate the average temperature for each minute.

Graphs and Calculations:

Plot a graph of the material's temperature change, $\Delta\theta$ (temperature reading - initial temperature) against energy supplied by the heater (E = VIt).

Using **$E = mc\Delta\theta$** where E is energy supplied (J) , m is mass (kg), c is specific heat capacity (J/kgK), calculate the specific heat capacity.

- Gradient of temperature-energy graph = $\Delta\theta/E$
- Inverse of gradient (one over gradient) = $E/\Delta\theta$
- Divide the inverse of the gradient by the mass, m, to obtain c. as c = $\frac{E}{\Delta\theta m}$