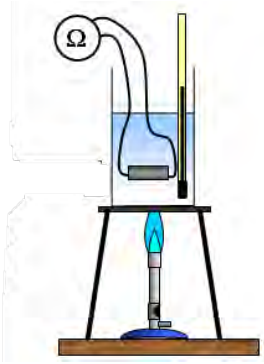
Edexcel Physics A Level

Core Practical 12

Calibrate a Thermistor in a Potential Divider circuit as a Thermostat

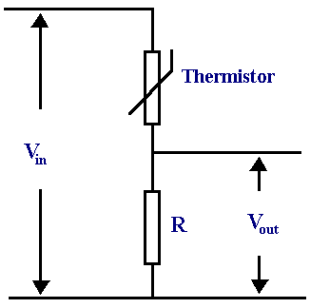
Method



- Set up a circuit with a power source, a fixed resistor, a thermistor, and an ohmmeter (around the NTC thermistor)
- Set up a Bunsen burner, tripod, gauze, beaker with ice, stirring rod, mercury thermometer to 0.5 C, and waterproof thermistor
- The temperature of water in the beaker changes in 2-5◦c increments from 0-100°C (using crushed melting ice to get close to 0°C and placing the thermistor in the interface of the steam and water to get close to 100°C)
- Allow time for the temperature to reach equilibrium, stir the water, and ensure the thermometer bulb is completely submerged in the water and level with the thermistor
- Measure the resistance using the ohmmeter
- Vary the temperature and record resistance
- Plot a calibration curve of resistance against temperature
- Use the temperature graph to find the resistance at a given temperature, and use to set up a potential divider circuit using;

$$V_{out} = V_{in} \times \frac{R_1}{R_1 + R_2}$$

for a required output voltage at a given temperature and input voltage



Safety

- Boiling water/bunsen burner includes a risk of scalds and burns so, do not handle the beaker when hot
- Do not exceed the voltage limit of the thermistor
- Keep leads away from hot things to prevent melting the plastic coating
- Support the thermistor to prevent it tipping the beaker over

Evaluation

- Alternative to using the ohmmeter: measure current and pd with voltmeter and ammeter with adequate ranges
- Fixed points with a linear change of a property in temperature are a requirement to form a temperature scale
- Heating slowly allows the semiconductor to adjust to the temperature of the water and the thermometer
- Improvement: Heat very slowly over long periods of time using a data logger with temperature and resistance probes for the water and thermistor respectively
- Read temperature off thermometer at eye level to avoid parallax errors
- If the fixed resistor's resistance is too high, V_{out} won't vary enough with temperature and if it's too low, V_{out} may vary across a bigger range than the voltmeter can handle
- Simultaneous reading of two variables (temperature and resistance) may result in systematic error
- Check meter for zero error by connecting a lead across terminals so no systematic error in resistance measurements
- Use a small current and switch off circuit between readings so no heating effect in addition to hot water which would make results inaccurate