TAP 110-2: Calibration of a thermistor

Data and graphs show the difference in electrical behaviour of metals and semiconductors. This experiment gives direct evidence for the effect of temperature on the resistivity of a semiconductor.

You will need

- ✓ Thermistor e.g. disc type 4.7 kΩ at 25°C
- ✓ digital multimeter set on resistance range
- ✓ two crocodile clips
- ✓ 4 mm connecting leads
- ✓ 250 ml beaker
- ✓ source of hot water – an electric kettle is simplest
- ✓ thermometer
- ✓ ice cubes
- ✓ clamp, stand and boss

What to do

1. Place the thermistor in the beaker. Use crocodile clips and leads to attach the multimeter, which should be set on the 10 kΩ range. Pour in hot water.
2. Record temperature and resistance in a table. Cool the thermistor by steps by adding cold water. You should obtain ten or more pairs of readings as temperature is taken down near 0 °C.

Data analysis

1. Plot a graph of resistance against temperature in Kelvin. Write in words the pattern you have found.

Practical advice

Encourage students to plot the graph while the data are collected. To establish a range of values, they will need to note the thermistor resistance and room temperature before starting.

The resistance will rise as temperature falls, given an n.t.c. (negative temperature coefficient) thermistor!

More able students may be asked to check whether the curve displays equal ratios of resistance changes over equal intervals of temperature. Point out that this pattern is called 'exponential'.

Second-year students might return to this activity, to plot ln(R) versus *temperature* / K and check whether it produces a straight line.

This is a good practice exercise for the making sense of data task.

Note that the exponential relationship is only approximately correct.

Alternative approaches

If you cannot afford the teaching time for students to do their own experiment, you could either do it as a demonstration or simply provide raw data, as tabulated below:

Temperature / K	Resistance / □
281	790
288	620
297	420
305	300
314	250
322	180
333	150
341	120
347	97
352	88
357	73
363	61
369	50

Social and human context

Because thermistors are cheap and they have a low thermal capacity, they can be used in temperature sensors, e.g. to make a disposable thermometer.

External references

This activity is taken from Advancing Physics Chapter 5, 320E