General Certificate of Education
Advanced Level Examination
June 2014

Physics PHY6T/Q14/TN

Unit 6 Investigative and Practical Skills in A level Physics

Investigative Skills Assignment (ISA) Q

Teachers' Notes Confidential

The Exams Officer should make two copies of these Teachers' Notes; one copy for the Head of A-level Physics and one for the technician.
These copies can be released to the Head of A-level Physics and the technician at any point following publication but must be kept under secure conditions at all times.
Teachers can have sight of the Teachers' Notes but no further copies should be made.

All teacher-assessed marks to be submitted by 15 May.

ISA (Q) Thermistor Characteristics

Centre instructions for the investigation

In this ISA, candidates will be required to determine the resistance of a thermistor at various temperatures, with the use of a water bath. Candidates should be familiar with the general characteristics of exponential decrease curves.

Information for centres

Candidates should be told approximately one week before undertaking Stage 1 of the ISA that the investigation will involve measuring the resistance of a thermistor over a range of temperatures. A voltmeter / ammeter method will be expected.

Apparatus

Centres should ensure that the apparatus provided can be used safely. Each candidate will need:

(a) ntc thermistor with a resistance of about $1\,\mathrm{k}\Omega$ at room temperature

(b) two $250\,\mathrm{ml}$ beakers or suitable containers, one two-thirds full of cold water

(c) thermometer capable of reading $0–100\,^{\circ}\mathrm{C}$ with precision $1\,^{\circ}\mathrm{C}$ or better

(d) supply of hot water $(\geq 60\,^{\circ}\mathrm{C})$ and cold water for use in the beakers

(e) protective mat under beaker

(f) stirrer or stirring thermometer

(g) dc power supply, labpack or battery to provide an emf of about $5\,\mathrm{V}$

(h) method of adjusting the current through the thermistor to remain within the range of the ammeter: either dial on labpack or potential divider

(i) connecting leads and crocodile clips/terminal block for thermistor connections

(j) ammeter with range $0–100\,\mathrm{mA}$ and precision $2\,\mathrm{mA}$ or better

(k) voltmeter with range $0–10\,\mathrm{V}$ and precision $0.1\,\mathrm{V}$ or better

Candidates do not need an individual method of heating the water; a central supply of hot water will be used to provide candidates with about $100\,\mathrm{ml}$ of hot water when required.

The thermistor does not need any protective covering but centres may provide protection if this is what they usually do in this type of experiment.

Task sheet

You are going to investigate how the resistance of a thermistor varies over a range of temperatures.

- Draw a diagram of a circuit that will supply a variable potential difference (pd) from a power supply and allow measurements to be taken of the current in the thermistor and the pd across it.
- Connect the circuit you have drawn but do not switch it on yet. Adjust the control dial of your power supply or the potential divider to ensure that when the circuit is switched on the pd across the thermistor will be zero.
- **Ask your supervisor to check your circuit.**
- Switch on the circuit.
- Adjust the pd V across the thermistor to a suitable value.
- Measure and record the room temperature in °C, the pd V across and the current I in the thermistor. Take suitable repeat readings for the current, switching off the circuit between readings and if necessary re-adjusting the pd to its initial value.
- Carefully collect about $100\,\text{cm}^3$ of hot water in one beaker.
- Place the thermistor into the hot water. Measure the current and pd, and the temperature of the water θ. Be aware that the current will be significantly greater at this temperature than at room temperature.
- You are to take readings for temperature θ, I and V as the temperature of the water decreases. You need to decide on an appropriate range of temperatures. In this part of the experiment you are not required to take repeat readings.
- Take precautions to minimise the uncertainty in the temperature measurements.
- Allow the water to cool, adding small amounts of cold water if necessary, and record all of your readings of θ, I and V in a suitable table, including space in this table for processed data.
- Calculate the resistance R of the thermistor at each temperature.
- Plot a graph of R (on the y-axis) against θ, drawing a best-fit curve.
- Record the precision of your thermometer, ammeter and voltmeter.