General Certificate of Education
Advanced Subsidiary Examination
June 2015

Physics PHY3T/Q15/TN

Unit 3 Investigative and Practical Skills in AS 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.

WMP/Jun15/PHY3T/Q15/TN/E5

ISA (Q) EMF and Internal Resistance

Centre instructions for the investigation

In this ISA, candidates will be investigating how the current through a cell varies when different resistors are connected to the cell.

Apparatus

Each candidate will need:

(a) 1.5 V 'D type' dry cell in a suitable holder with a $4.7\ \Omega$ resistor, minimum power rating 0.5 W, connected in series with it. The cell and resistor should be placed in a sealed box, labelled 'cell', with terminals labelled '+' and '–' mounted on the outside of the box. To stabilise the condition of the cell, new cells should be used to power a suitable lamp for 5 minutes before being used in the task
(b) digital ammeter with precision 0.01 A or better, with range appropriate to the cell and resistors used
(c) selection of eight resistors appropriate for the range of the ammeter used (eg 1.0, 1.5, 2.2, 3.3, 4.7, 5.6, 6.8 and $8.2\ \Omega$ minimum power rating 0.25 W)
The resistor values should be clearly labelled to two significant figures
(d) a method of connecting the resistors into the circuit, eg crocodile clips, component clip holders or terminal blocks
(e) connecting leads
(f) switch or other suitable means of disconnecting the power supply from the circuit.

Candidates will be instructed to switch off or disconnect the cell between readings. **No explanation for this should be given**. Candidates will be required to set up the circuit and supervisors will need to check each candidate's circuit before it is switched on. In particular, check the polarity of the meters to ensure a positive current reading. Any mistakes should be corrected, and noted on the candidate's script.

Note that other values of resistors may be used in this experiment to avoid centres having to purchase new resistors specifically for this experiment. The value of the concealed resistor connected in series to the 1.5 V cell should be in the middle of the range of the eight resistors used. The ammeter should have a suitable range and precision appropriate for the current obtained with these resistor values, eg if a $47\ \Omega$ resistor is connected to the cell, eight resistors in the range $10–100\ \Omega$ can be used together with a digital milliammeter of range $0–100$ mA.

It is the responsibility of the centre to ensure the apparatus provided can be used safely.

Information for centres

Candidates can be told approximately one week before undertaking Stage 1 of the ISA that they will be investigating how the current drawn from a cell varies when different resistors are connected across it. The ISA test will include questions on electromotive force, internal resistance and electrical power.

Task Sheet

This task is worth 7 marks

You are advised to read through these instructions before beginning your work.

You are going to carry out an experiment to investigate how the current I through a power supply varies with the resistance R connected across it.

Switch the circuit off when you are not taking readings.

- You are provided with a set of resistors. Select the resistor with the **smallest** resistance value.
- Set up a circuit that will allow you to measure the current in the power supply and the resistor when connected in series. If a switch has been provided include the switch in your circuit. If a switch has not been provided you will be told how to disconnect your circuit.
- **Before switching on ask your supervisor to check your circuit.**
- Switch on the circuit and measure the current I in the circuit.
- Record the value of R and the corresponding value of I.
- Switch off, remove the resistor from the circuit and replace it with the resistor with the next highest resistance.
- Switch on the circuit and measure the new value of I.
- Repeat this procedure with all the resistors provided, increasing R each time.
- **Note that you do not need to obtain a further set of values for I and R for this experiment.**
- Record all your data in a suitable table, and include a column for $\frac{1}{I}$.
- Plot a graph of $\frac{1}{I}$ on the y-axis against R and draw a straight line of best fit.

  Start your R axis at 0.
- Record the precision of the ammeter used in your experiment.

After the investigation

At the end of the investigation, hand in all your written work, including the graph, to the supervisor.

This documentation will be required for Stage 2 of the ISA. Ensure that you have entered your centre details, candidate number and name on all sheets you have completed.