General Certificate of Education
June 2005
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION A) **PHA3/P/TN**

Instructions to Supervisors for the Practical Examination (Unit 3)

CONFIDENTIAL

OPEN ON RECEIPT

The examination will be held on Wednesday 18 May 2005 Morning Session.

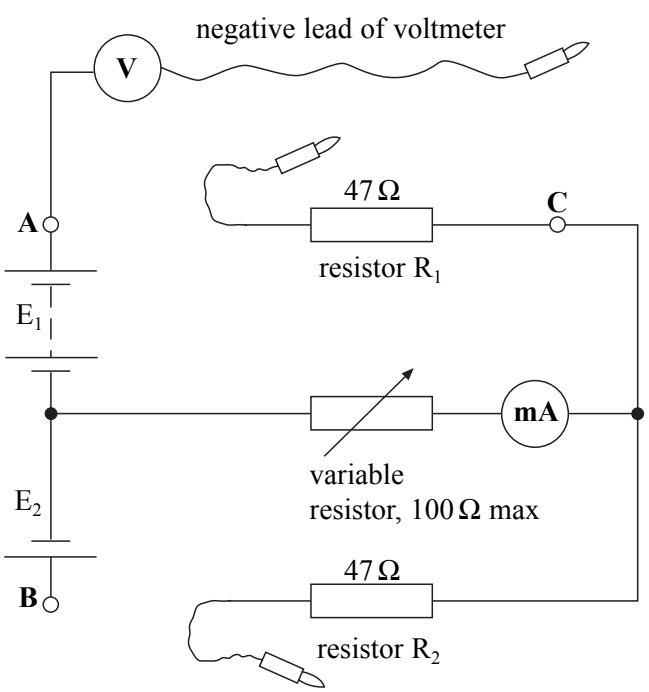
- **These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to the examination.**
- **These instructions explain how to set up the equipment for Question 2.**
- **Question 2 is printed on pages 3 and 4 of this instruction booklet.**
- **Centres are at liberty to make any reasonable minor modifications to the apparatus which may be required for the successful working of the experiment but a note of all such modifications must be forwarded to the Examiner with the scripts. However, any such modifications must permit the experiment to be carried out in the specified manner.**

Candidates will investigate the variation in a voltmeter reading with time as a charged capacitor in a concealed circuit is discharged.

Apparatus required for each candidate:

- ❒ circuit, details shown below, resistances of fixed resistors R_1 and R_2 to be concealed from the candidate
- ❒ two dc power supplies, labelled 'E_1' and 'E_2', the negative terminals of these to be joined: E_1 should be of emf about 3.0 V (e.g. two 1.5 V dry cells in holder) and E_2 should be of emf 1.5 V (a single dry cell in holder)
- ❒ three 4 mm round sockets, to be labelled 'A', 'B' and 'C', as per diagram below
- ❒ one 100 Ω linear rotary potentiometer, rated at 0.1 W or better e.g. RS387-385
- ❒ two 47 Ω resistors, tolerance 1% or better, 0.5 W or 0.6 W, carbon or metal film, to be labelled 'R_1' and 'R_2': flying leads terminating at 4 mm round plugs should be connected to one side of each resistor
- ❒ digital milliammeter capable of reading to 1 mA or better, full scale reading at least 100 mA
- ❒ digital voltmeter capable of reading to 0.01V, full scale reading at least 5 V: the **positive** terminal of the voltmeter should be permanently connected to terminal **A**
- ❒ other connecting leads as required

The circuit is as shown below.



When the flying lead connected to R_1 is joined to terminal A and the flying lead connected to R_2 is joined to terminal B, the milliammeter should show a reading of between 10 mA and 90 mA, according to the setting of the variable resistor. When the negative lead of the voltmeter is connected to terminal B the reading shown should be above 1.50 V: when the negative lead is connected to terminal C, the reading should lie between 1.10 V and 2.50 V, according to the setting of the variable resistor. When the circuit performs as described, remove the flying leads from sockets A, B (and C) to leave the arrangement as shown in the diagram.

Examiners require no information for this question.

2 In this experiment you are required to investigate currents and voltages in a circuit containing two power supplies, E_1 and E_2, the negative terminals of which are joined together.
No description of the experiment is required.

You are provided with the partly completed circuit shown in **Figure 3**.
Terminal **A** is connected to the positive side of E_1 and terminal **B** is connected to the positive side of E_2.
The positive lead of the voltmeter should be **permanently connected** to terminal **A** throughout the experiment.

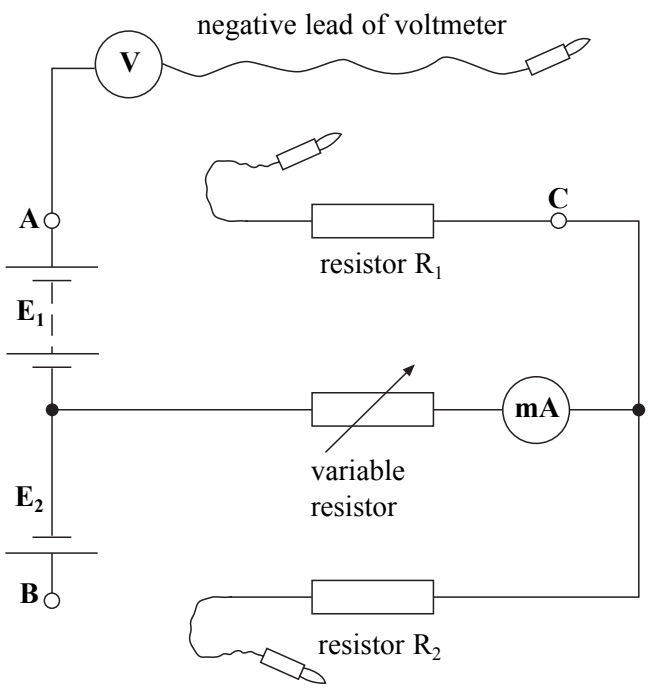


Figure 3

(a) Connect the negative lead of the voltmeter to terminal **B**.
Read and record the voltmeter reading V_{AB}.

(1 mark)

QUESTION 2 CONTINUES ON THE NEXT PAGE

(b) **Figure 3** shows flying leads joined to the resistors R_1 and R_2.
Connect the flying lead joined to R_1 to terminal **A**.
Connect the flying lead joined to R_2 to terminal **B**.
Connect the negative lead of the voltmeter to terminal **C**.
Adjust the setting of the variable resistor until the voltmeter reading V_{AC} is at a minimum.
Read and record V_{AC} and the milliammeter reading, I.
By adjusting the setting of the variable resistor, read and record further readings of V_{AC} and I up to and including the maximum values that can be obtained.
Record all your measurements in the space provided on page 10.

Measurements and observations. *(7 marks)*

(c) Using the grid on page 11 of this booklet plot a graph of your results with V_{AC} on the vertical axis and I on the horizontal axis. *(5 marks)*

(d) (i) Read and record the intercept, V_0, on the vertical axis of your graph.

(ii) Evaluate $\frac{V_{AB}}{V_0}$.

(3 marks)

(e) Student A produces a graph with a conventional origin, as shown in **Figure 4**.
Student B produces the graph with a false origin on the **vertical axis**, as shown in **Figure 5**.
Explain how the graph drawn by student B reduces the uncertainty in V_0.

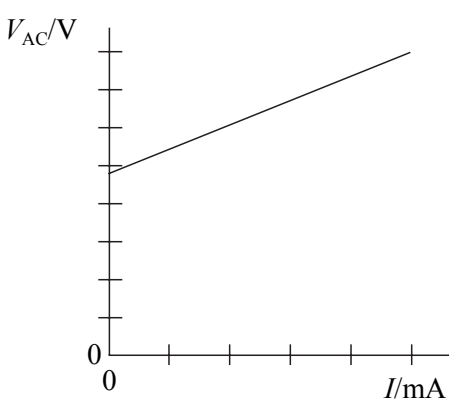


Figure 4

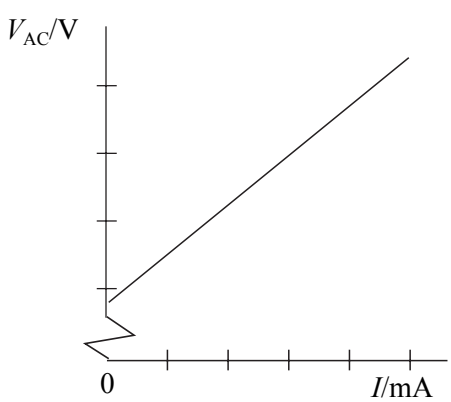


Figure 5

(1 mark)

(f) What evidence does the experiment provide that current always flows though resistor R_1 from terminal **A** to terminal **C**? *(1 mark)*

(g) The voltage, V_{AC}, across resistor R_1 determines the **direction** of the current through resistor R_2.
When V_{AC} is **greater than** V_{AB} the current direction through R_2 is away from terminal **B**.
When V_{AC} is **less than** V_{AB} the current direction through R_2 is towards terminal **B**.

(i) What can you say about the current in resistor R_2 when V_{AC} **is the same as** V_{AB}.

(ii) Read from your graph the milliameter reading $V_{AC} = V_{AB}$.

(iii) By considering your answers to part (g)(i) and part (g)(ii), deduce the current through resistor R_1 when $V_{AC} = V_{AB}$.

(iv) Deduce the resistance of resistor R_1. *(4 marks)*

END OF QUESTIONS