

Instructions to Supervisors for the Practical Examination (Unit 3)

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OPEN ON RECEIPT

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

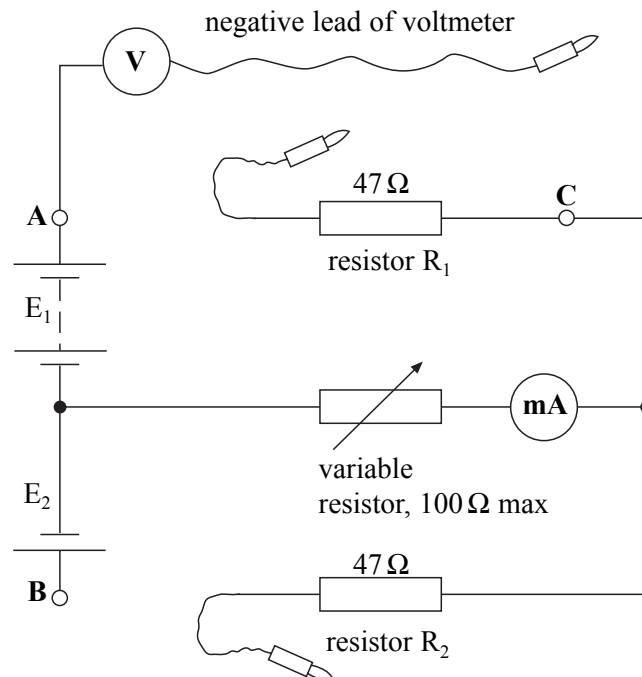
- These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to 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 'E₁' and 'E₂', the negative terminals of these to be joined: E₁ should be of emf about 3.0 V (e.g. two 1.5 V dry cells in holder) and E₂ 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 'R₁' and 'R₂': 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.

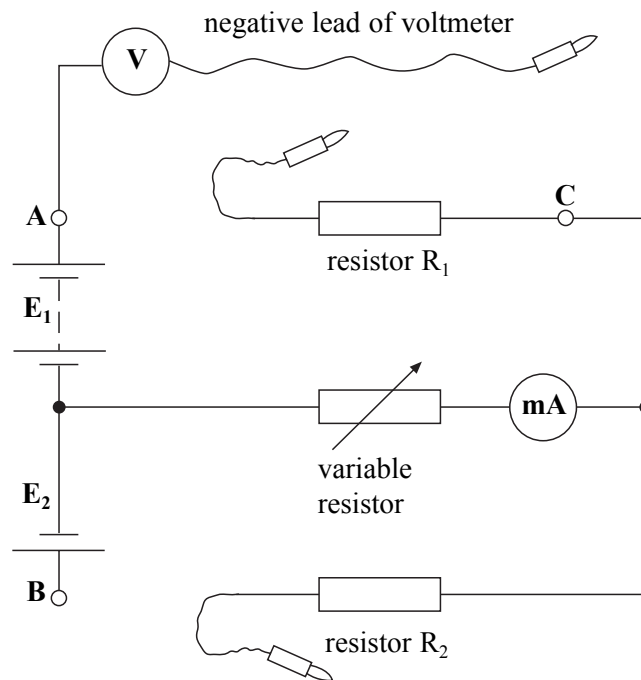


Figure 3

- (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 .

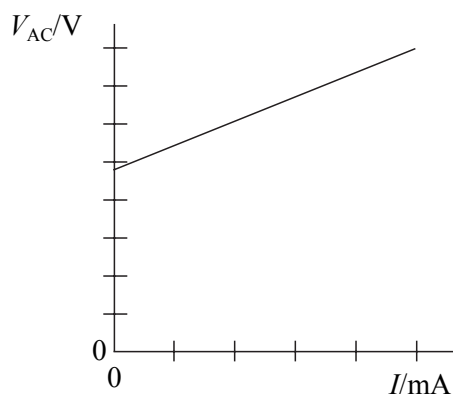


Figure 4

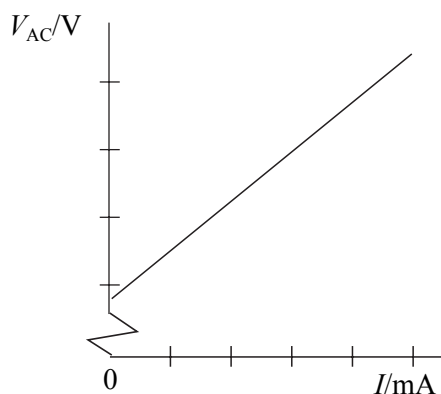


Figure 5

(1 mark)

- (f) What evidence does the experiment provide that current always flows through 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 milliammeter 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