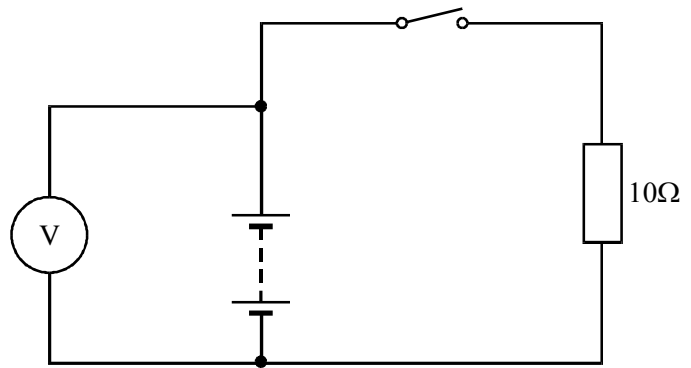


Q1.

A battery is connected to a 10Ω resistor as shown. The EMF (electromotive force) of the battery is 12V.



- (a) (i) Explain what is meant by the EMF of a battery.
- (ii) When the switch is open the voltmeter reads 12.0V and when it is closed it reads 11.5 V. Explain why the readings are different.

(3)

- (b) Calculate the internal resistance of the battery.

(3)

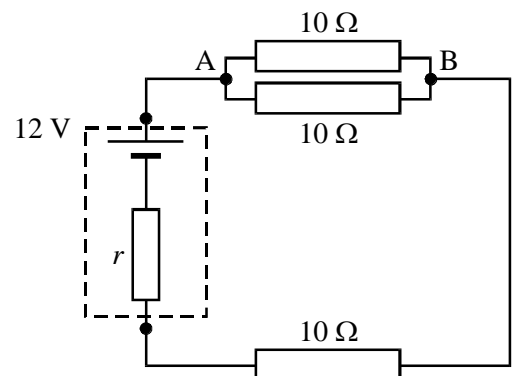
(Total 6 mark)

Q2. A very high resistance voltmeter reads 20V when connected across the terminals of a d.c. power supply. The high resistance meter is disconnected and a second voltmeter of resistance $1.0k\Omega$ is then connected across the supply. The second meter gives a reading of 16V.

- (i) State the EMF of the power supply.
- (ii) Calculate the current which flows through the second meter.
- (iii) Calculate the internal resistance of the power supply.
- (iv) Show that the current is equal to 0.080 A when the supply is short circuited.

(Total 5 marks)

Q3. A battery of EMF 12 V and internal resistance r is connected in a circuit with three resistors each having a resistance of 10Ω as shown. A current of 0.50A flows through the battery. Calculate

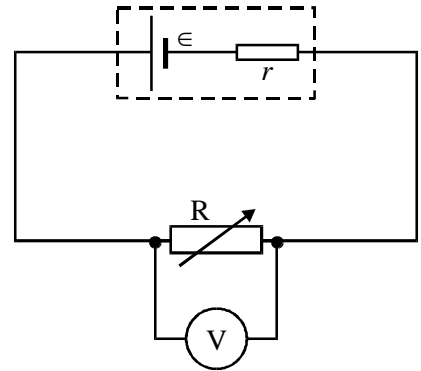


- (i) the potential difference between the points A and B in the circuit,
- (ii) the internal resistance of the battery,
- (iii) the total energy supplied by the battery in 2.0 s,
- (iv) the fraction of the energy supplied by the battery that is dissipated within the battery.

(7)

(Total 7 marks)

Q4. A battery of EMF ϵ and internal resistance r is connected in series with a variable resistor R as shown in the diagram. A voltmeter is connected as shown.

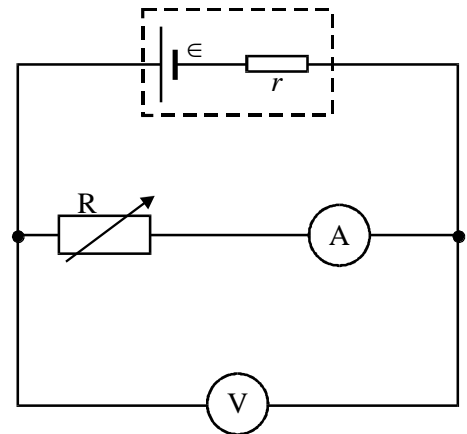


- (a) (i) State what is meant by the EMF of a battery.
- (ii) The reading V on the voltmeter is the voltage across R .
Why is V less than ϵ ?

(3)

- (b) In order to measure ϵ and r , an ammeter is used in the circuit, as shown

The value of R is decreased in steps and at each step the readings V and I on the voltmeter and ammeter, respectively, are recorded. These are shown in the table.



reading on voltmeter/ V	reading on ammeter/ A
4.0	0.07
3.0	0.14
2.0	0.21
1.0	0.28

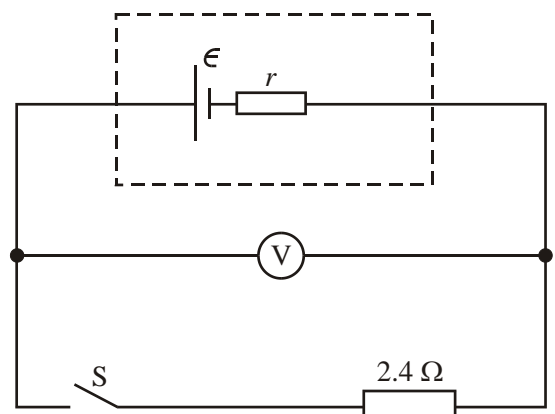
- (i) Plot a graph of V (on y axis) against I (on x axis) on the graph paper provided.
- (ii) Determine the values of ϵ and r from the graph, explaining your method.

(8)

(Total 11 marks)

Q5. In the circuit shown on the right the battery has emf ϵ and internal resistance r .

- (a) (i) State what is meant by the emf of a battery.
- (ii) When the switch S is open, the voltmeter, which has infinite resistance, reads 8.0 V. When the switch is closed, the voltmeter



A Level Standard EMF and internal resistance questions (a sheet of graph paper is required)

reads 6.0 V. Determine the current in the circuit when the switch is closed.

(iii) Show that $r = 0.80 \Omega$. (4)

(b) The switch S remains closed. Calculate

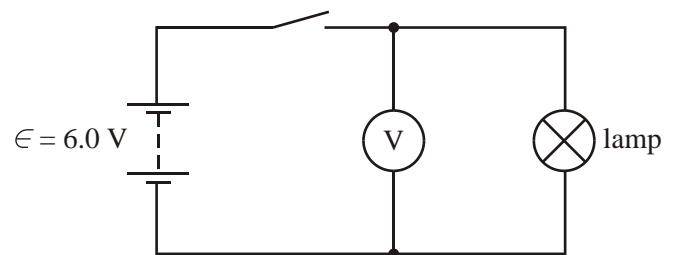
(i) the power dissipated in the 2.4Ω resistor,

(ii) the total power dissipated in the circuit,

(iii) the energy wasted in the battery in 2 minutes.

(4)
(Total 8 marks)

6. (a) In the circuit shown, the battery has an EMF of 6.0 V. With the switch closed and the lamp lit, the reading on the voltmeter is 5.4 V.



(3)

Explain without calculation, why the voltmeter reading is less than the EMF of the battery.

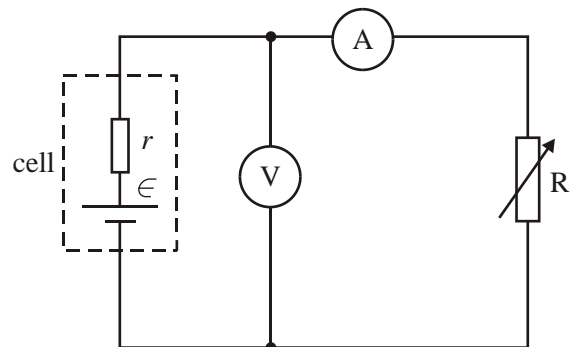
(b) A torch is powered by two identical cells each having an EMF of 1.5 V and an internal resistance r . The cells are connected in series. The torch bulb is rated at 1.6 W and the voltage across it is 2.5 V.

(i) Draw the circuit described.

(ii) Calculate the internal resistance of each cell.

(5)

(c) In the circuit on the right the cell has emf ϵ and internal resistance r . The voltage V across the cell is read on the voltmeter which has infinite resistance, and the current I through the variable resistor R is read on the ammeter.



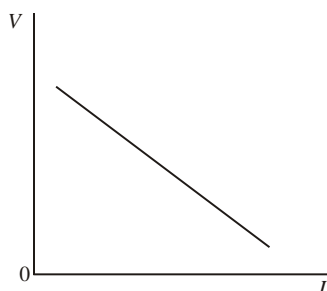
By altering the value of the variable

resistor R , a set of values of V and I is

obtained. These values, when plotted, give the graph shown

on the left. Show how the values of ϵ and r may be

obtained from this graph. Explain your method.



(3)

(Total 11 marks)

48 Marks Total