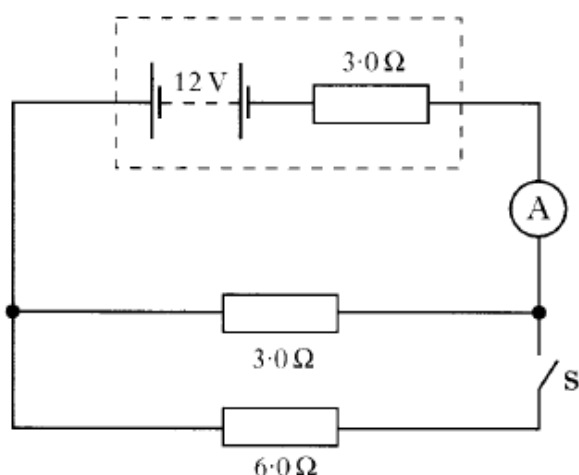## Exercise 12     - Emf and Internal Resistance

## Past Paper Homework Questions

1. A battery of e.m.f. 12 V and internal resistance $3 \cdot 0 \, \Omega$ is connected in a circuit as shown.



When switch **S** is closed the ammeter reading changes from

A    $2 \cdot 0$ A to $1 \cdot 0$ A

B    $2 \cdot 0$ A to $2 \cdot 4$ A

C    $2 \cdot 0$ A to $10$ A

D    $4 \cdot 0$ A to $1 \cdot 3$ A

E    $4 \cdot 0$ A to $6 \cdot 0$ A.

3. The e.m.f. of a battery is

A    the total energy supplied by the battery

B    the voltage lost due to the internal resistance of the battery

C    the total charge which passes through the battery

D    the number of coulombs of charge passing through the battery per second

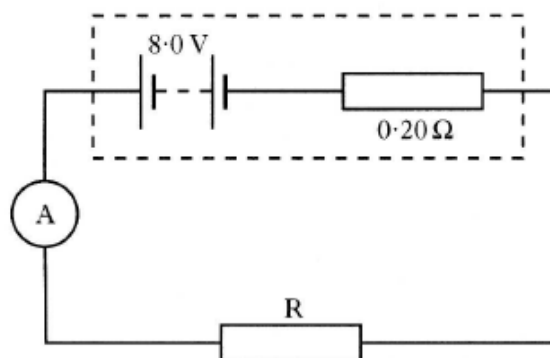E    the energy supplied to each coulomb of charge passing through the battery.

2. A battery of e.m.f. 24 V and negligible internal resistance is connected as shown.
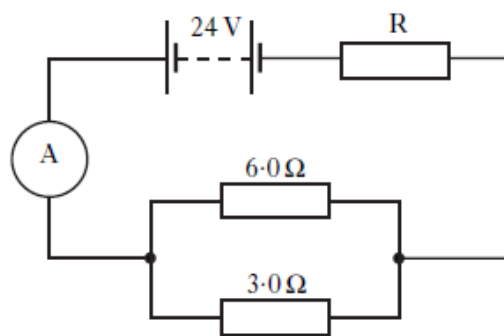


The reading on the ammeter is $2 \cdot 0$ A.

The resistance of R is

A    $3 \cdot 0 \, \Omega$

B    $4 \cdot 0 \, \Omega$

C    $10 \, \Omega$

D    $12 \, \Omega$

E    $18 \, \Omega$.

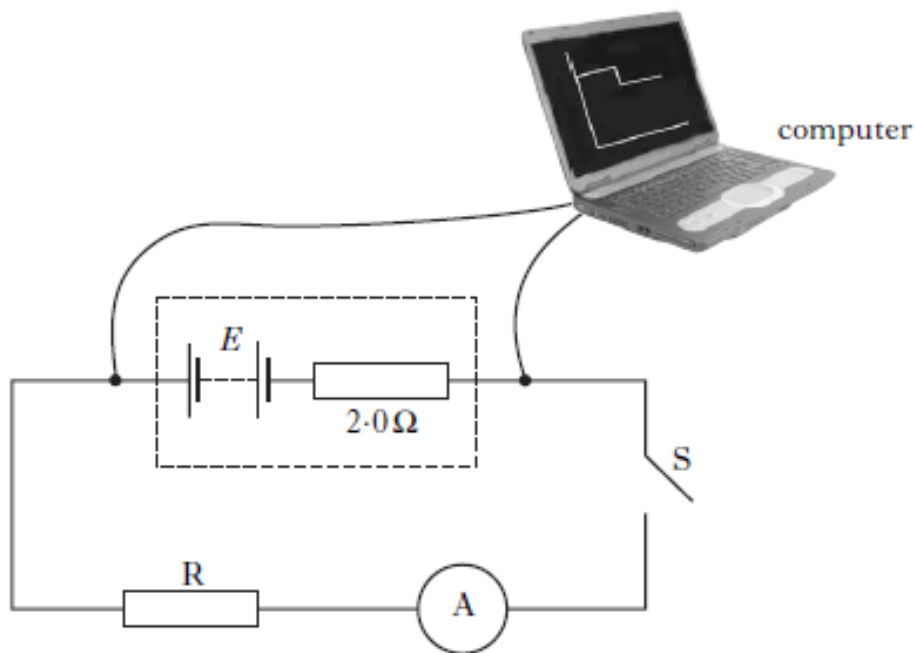4. In the following circuit, the battery has an e.m.f. of $8 \cdot 0$ V and an internal resistance of $0 \cdot 20 \, \Omega$.



The reading on the ammeter is $4 \cdot 0$ A.

The resistance of R is

A    $0 \cdot 5 \, \Omega$

B    $1 \cdot 8 \, \Omega$

C    $2 \cdot 0 \, \Omega$

D    $2 \cdot 2 \, \Omega$

E    $6 \cdot 4 \, \Omega$.

5. A power supply of e.m.f. $E$ and internal resistance $2 \cdot 0\,\Omega$ is connected as shown.
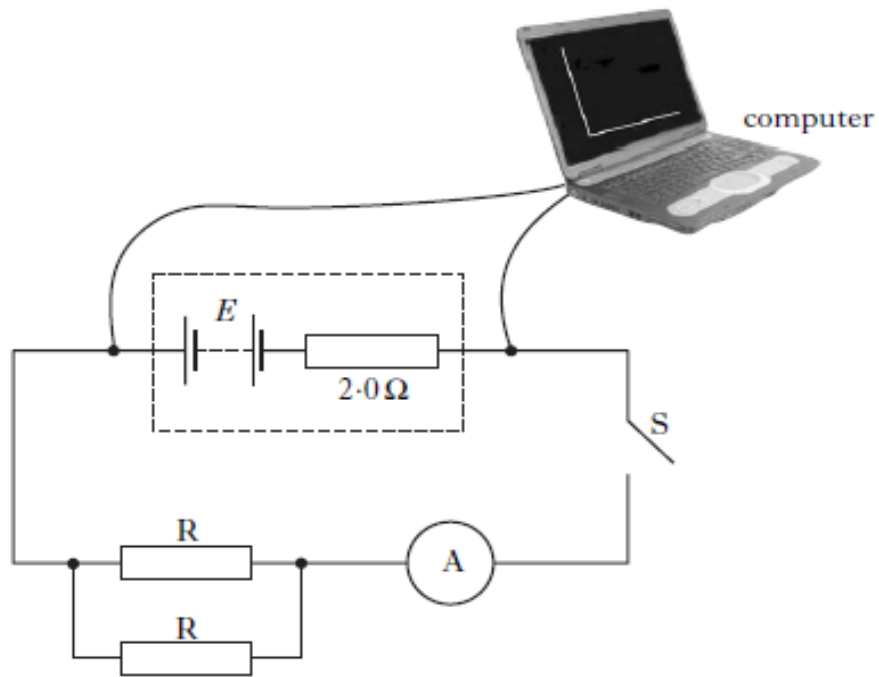


computer

The computer connected to the apparatus displays a graph of potential difference against time.

The graph shows the potential difference across the terminals of the power supply for a short time before and after switch S is closed.
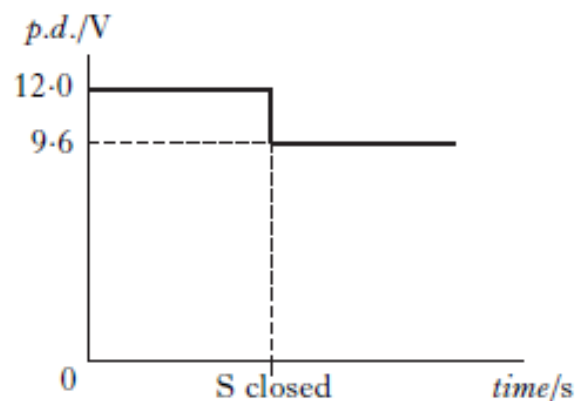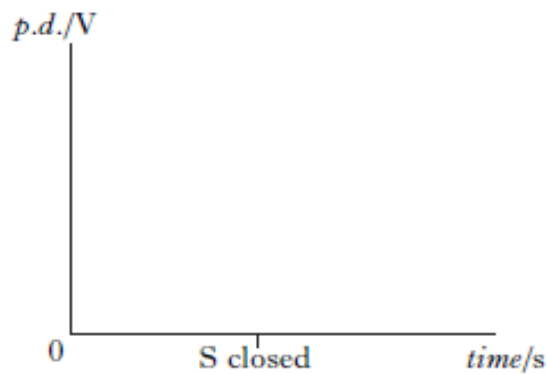


(a) State the e.m.f. of the power supply. 1

(b) Calculate:

   (i) the reading on the ammeter after switch S is closed; 3

   (ii) the resistance of resistor R. 2

(c) Switch S is opened. A second identical resistor is now connected in parallel with R as shown.



computer

$2.0\,\Omega$

E

R

R

A

S

The computer is again connected in order to display a graph of potential difference against time.



p.d./V

0

S closed

time/s

Copy and complete the new graph of potential difference against time showing the values of potential difference before and after switch S is closed.

**3**

6.   Electrically heated gloves are used by skiers and climbers to provide extra warmth.



(a)  Each glove has a heating element of resistance $3 \cdot 6\,\Omega$.

Two cells, each of e.m.f. $1 \cdot 5\,V$ and internal resistance $0 \cdot 20\,\Omega$, are used to operate the heating element.
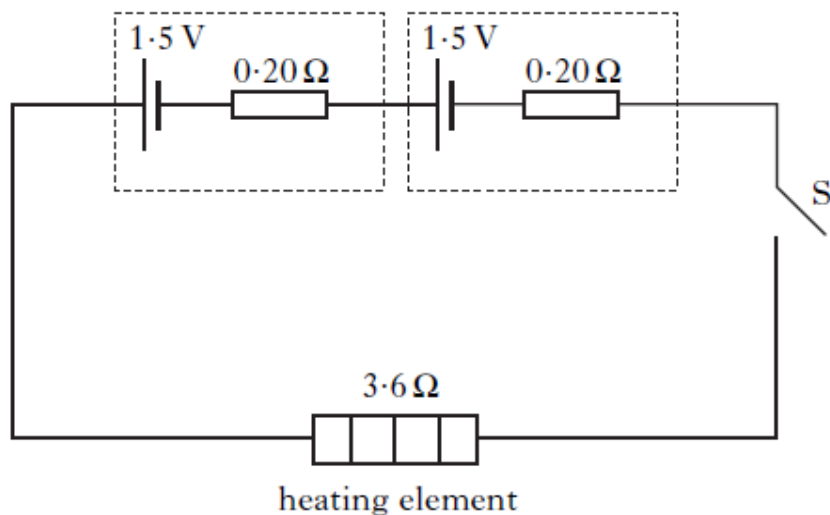


heating element

Switch S is closed.

   (i)   Determine the value of the total circuit resistance.                    1

   (ii)   Calculate the current in the heating element.                         3

   (iii)   Calculate the power output of the heating element.                   3

(b)  When in use, the internal resistance of each cell gradually increases.

What effect, if any, does this have on the power output of the heating element?

Justify your answer.                                                            2

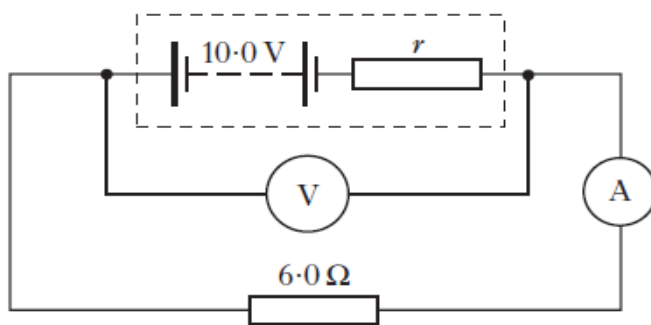7.  (a)  A supply of e.m.f. 10·0 V and internal resistance $r$ is connected in a circuit as shown in Figure 1.



Figure 1

The meters display the following readings.

Reading on ammeter  $= 1·25$ A

Reading on voltmeter $= 7·50$ V

  (i)  What is meant by an *e.m.f. of 10·0 V*?                                    1

  (ii)  Show that the internal resistance, $r$, of the supply is 2·0 Ω.           2

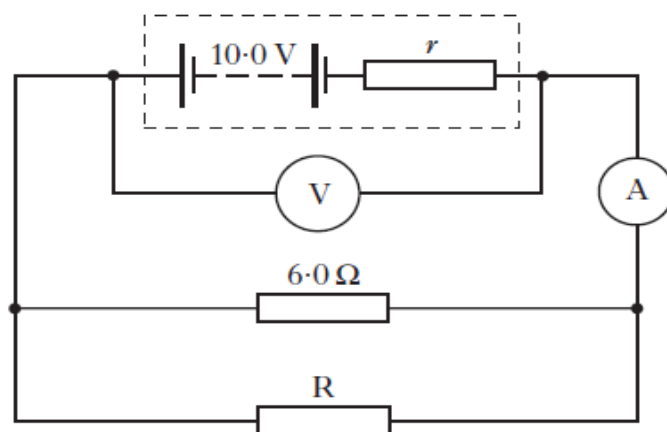(b)  A resistor R is connected to the circuit as shown in Figure 2.



Figure 2

The meters now display the following readings.

Reading on ammeter  $= 2·0$ A

Reading on voltmeter $= 6·0$ V

  (i)  Explain why the reading on the voltmeter has decreased.                    2

  (ii)  Calculate the resistance of resistor R.                                   3

**Total 30 Marks**