O Level Combined Physics Structured

Current and DC Circuits Test 1.0

Q1

Fig. 7.1 shows a battery, with an electromotive force of 6.0 V, connected to three resistors.

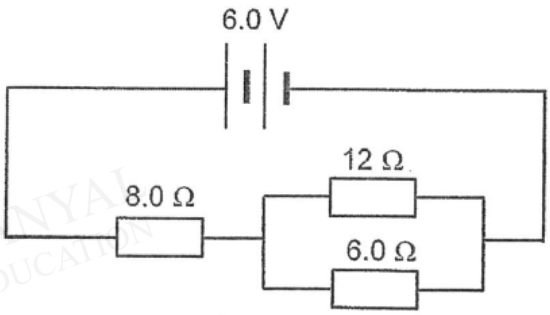


Fig. 7.1

(a) Calculate the effective resistance of the 12 Ω and 6.0 Ω resistors.

effective resistance = ...[2]

(b) Calculate the effective resistance of the circuit.

effective resistance = ...[1]

(c) Calculate the current that flows in the 8.0 Ω resistor.

current = ...[2]

(d) Determine the amount of charge that passes through the 8.0 Ω resistor in 5.0 minutes.

charge = ...[2]

(e) A light bulb of resistance 4.0 Ω is now added in parallel to the 6.0 Ω resistor. Explain what happens to the current that flows through the battery.

.....

.....

.....

.....[2]

Q2

Fig. 10 shows two 6 Ω resistors and a lamp of resistance 3 Ω, connected to a 12 V cell.

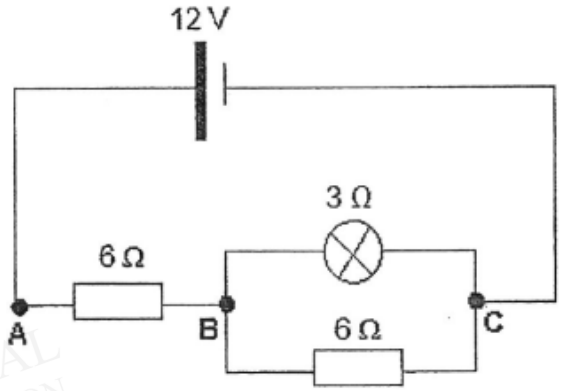


Fig. 10

(a) Calculate

(i) the total resistance of the circuit,

resistance = _____ Ω [2]

(ii) the potential difference across **B** and **C**.

potential difference = _____ V [2]

(b) Given that the power dissipated in the lamp is 3 W, calculate the cost of using the lamp for 12 hours per day for a week if it costs $0.20 per unit of electricity.

cost = $ _____ [2]

(c) Another lamp of resistance 3 Ω is connected across BC. State and explain what will happen to the current flowing through the battery. [2]

.....

.....

Q3

11 Fig. 11.1 shows four resistors and three switches that are connected to a cell of emf 12 V in a circuit. Two switches S_1 and S_2 are closed while S_3 is open.

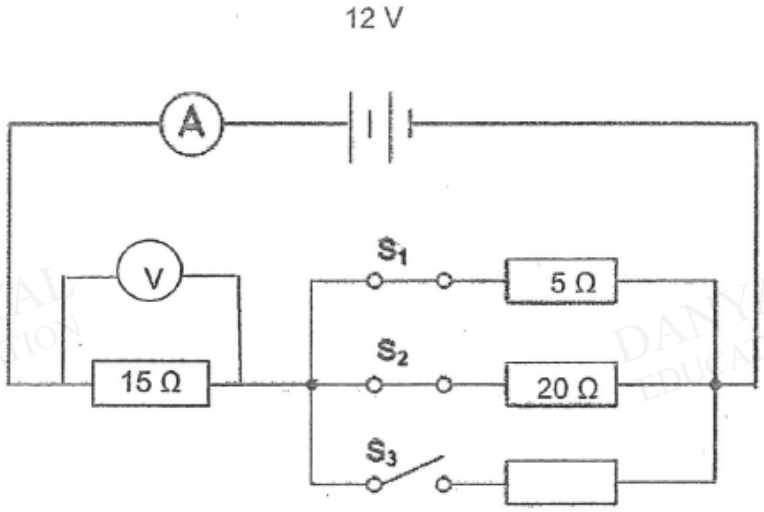


Fig 11.1

(a) Explain what is meant by "*emf of 12 V*."

.....

..... [1]

(b) Calculate the total resistance of the circuit and hence the ammeter reading.

total resistance = ...Ω
ammeter reading = ... A [3]

(c) Calculate the amount of charges flowing through the cell per minute. Indicate the units clearly.

charge = ...
unit = ... [2]

(d) Hence calculate the energy used by the cell in a minute.

energy = ... J [1]

(e) S_3 is now closed.

Predict and explain whether the voltmeter reading will increase, decrease or stay constant.

.....

.....

.....

..... [2]

(f) The 15 Ω resistor is an ohmic resistor. A potential difference (p.d) of 0 – 12 V is applied across it.

Sketch in Fig 11.2 below how the current I/A will change as the p.d V/V across it changes from 0-12 V. Show the V and I values clearly when a p.d of 12 V is applied across it.

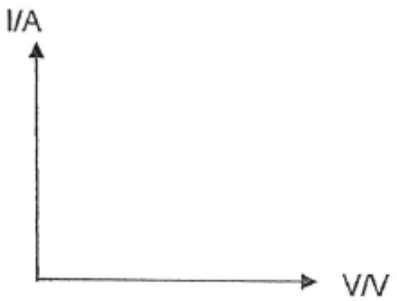


Fig 11.2

[1]

Q4

Fig. 9.1 shows an electric circuit in which the internal resistance of the battery is negligible. When a filament lamp is connected to the battery of e.m.f of 4.0 V, the current in the circuit is 2.0 A.

The energy dissipated in the filament lamp is 64 J. The resistance of the filament lamp is 2.0 Ω.

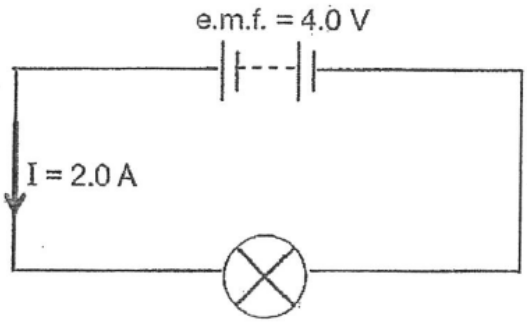


Fig. 9.1

(a) Explain what is meant by *e.m.f.*.

.....

.....[1]

(b) Calculate the amount of charge flowing through the filament lamp.

charge = ... [1]

(c) An identical filament lamp is connected in parallel to the filament lamp.

Calculate

(i) the effective resistance of the circuit,

resistance = ... [1]

(ii) the current drawn from the battery,

current = ... [1]

(iii) the total power dissipated from the lamps.

power = ... [1]

Q5

Fig. 10 shows an electrical circuit containing a 12 V power supply and a number of resistors.

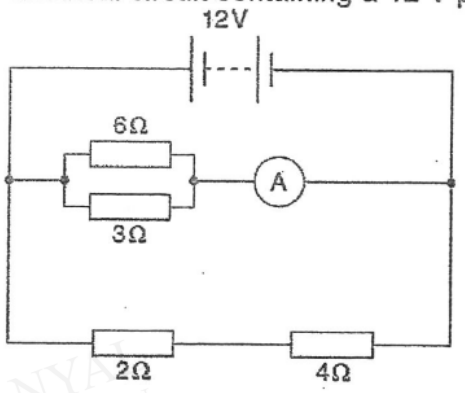


Fig. 10

a) Calculate the combined resistance of the 3 Ω and 6 Ω resistors in parallel. [2]

combined resistance = ... Ω

b) Calculate the reading of the ammeter in **Fig. 10**. [2]

reading = ... A

c) Determine the potential difference across the 4 Ω resistor. [2]

potential difference = ... V

Answers

Current and DC Circuits Test 1.0

Q1

(a) $R_{eff} = (\frac{1}{12} + \frac{1}{6.0})^{-1}$ C1

$= 4.0\ \Omega$ A1

(b) effective resistance of circuit = 8.0 + 4.0 = 12 Ω Allow ECF from **(a)** A1

(c) $I = \frac{V}{R} = \frac{6.0}{12}$ Allow ECF from **(b)** C1

$= 0.50$ A A1

(d) $Q = It$

$= 0.50 \times 5.0 \times 60$ Allow ECF from **(c)** C1

$= 150$ C A1

(e) Current passing through the battery is larger B1

As the total resistance of the circuit has decreased B1

Q2

Fig. 10 shows two 6 Ω resistors and a lamp of resistance 3 Ω, connected to a 12 V cell.

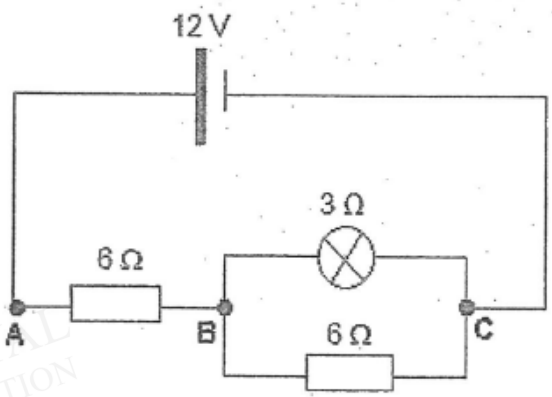


Fig. 10

(a) Calculate

(i) the total resistance of the circuit,

$\frac{1}{R} = \frac{1}{R^1} + \frac{1}{R^2}$ $\frac{1}{R} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

R = 2 Ω [M1]

R_T = 6 ÷ 2

= **8.0 Ω** [A1]

resistance = _____ Ω [2]

(ii) the potential difference across **B** and **C**.

Current through the circuit, I = V / R

= 12 / 8

= 1.5 A [M1]

V_{BC} = IR

= (1.5) (2)

= **3.0 V** [A1]

potential difference = _____ V [2]

(b) Given that the power dissipated in the lamp is 3 W, calculate the cost of using the lamp for 12 hours per day for a week if it costs $0.20 per unit of electricity.

E = Pt

$= (\frac{3}{1000})$ (12 x 7)

= 0.252 kWh [M1]

Cost = 0.252 x 0.20

= **$0.05** [A1: minus 1 mark for wrong / missing units]

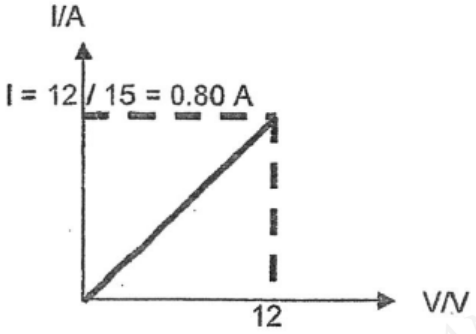
cost = $ _____ [2]

(c) Another lamp of resistance 3 Ω is connected across BC. State and explain what will happen to the current flowing through the battery. [2]

The current will increase [B1]

as the total resistance of the circuit decreases, as I = V/R. [B1]

Q3

11a)	The work needed to move a unit charge across the circuit	1
b)	$R = 15 + (\frac{1}{5} + \frac{1}{20})^{-1} = 15 + 4 = 19\ \Omega$ Ammeter reading = 12/19 = 0.632 A	2 1
c)	Q =It = (0.632)(1 X 60) = 37.9 Coulombs	1 1
d)	E = VQ = 12(37.9) = 455 J	1
e)	When switch is closed, a resistor is added in parallel and the <u>total R decreases</u>. The <u>total current increases.</u> <u>Voltmeter reading increases</u> as V = IR.	1 1
f)		1

Q4

a e.m.f. is the work done by a source in driving a unit charge around a complete circuit (or the energy released per unit charge)

b Q = E/V or W/V
= 64 /4.0
= <u>16 C</u>

ci 1/ R = 1/2 +1/2
R = <u>1.0 Ω</u>

cii I = V/ R
= 4.0 / 1.0
= <u>4.0 A</u>

ciii $P = I^2R$
$= (4.0)^2 \times 1$

= <u>16 W</u>

Q5

a) $1/R = 1/R_1 + 1/R_2 \rightarrow 1/R = 1/3 + 1/6$ [1] $\rightarrow R = 2\ \Omega$

b) $V = IR \rightarrow 12 = I\,(2) \rightarrow I = 6A$

c) $V = IR \rightarrow 12 = I\,(6) \rightarrow I = 2A$ [1]

$V = IR = 2 \times 4 = 8V$ [1]