ANSWERS

1

(a) p.d. across X = 12.0 – 4.0 = 8.0 V
I = V/R = 4.0/3.0 = 1.33 A
Hence, resistance of X = 8.0/1.33 = 6.0 Ω

OR using potential divider method:
(X + 3)/3 = 12/4 or X/3 = (12-4)/4
X = 6.0 Ω

(b) Total current = (4.0/3.0 + 12.0/5.0) or (12.0/9.0 + 12.0/5.0)
= 3.73 ≈ 3.7 A

OR effective resistance: 1/R = 1/9.0 + 1/5.0, R = 3.214 Ω
Total current = V/R = 12.0/3.214 = 3.73 ≈ 3.7 A

(c) When S is opened,
the voltmeter reading would remain the same
the ammeter reading would decrease (to 12/9 = 1.33 A)

2

(a) 1/R = 1/6 + 1/12 = ¼ , R = 4 Ω
Effective resistance R_{eff} = 4 + 6 = 10 Ω

(b) Current through the 6.0 Ω resistor, I = V / R_{eff} = 12 / 10 = 1.2 A
Ratio of resistance = 12 : 6 = 2 : 1
Current reading on ammeter = 1/3 x 1.2 = 0.4 A

OR p.d. across resistors in parallel = 4 / (4+6) x 12.0 = 4.8 V
Current reading on ammeter = V / R = 4.8 / 12 = 0.4 A

3

(a) Across DB: $1/R_1$ = 1/5 + 1/6
R_1 = 2.727 Ω

Top loop of AB: R_2 = 2 + 2.727 = 4.727 Ω

Therefore, across AB:
$1/R_{eff}$ = 1/4.727 + ¼

Therefore, R_{eff} = 2.17 Ω (3 s.f.)

4

(a) The current flows through a conductor is directly proportional to the potential difference across it when physical conditions/ temperature are kept constant.

(b) The resistance of the lamp increases with increasing potential difference.

(c) From the graph:
When the current in the circuit is 3 A, the voltages across the lamp and resistor are 4.5 V and 9.0 V respectively.

Hence the potential difference across the battery is 4.5 + 9.0 = 13.5 V

5

(a) The copper wire causes a short circuit. The light bulb would not light up (or would go off).

(b) The second light bulb is connected in parallel, causing the effective resistance across AB decreases, so the p.d. across AB decreases. The original light bulb would become dimmer (or would become less bright).

(c) The net e.m.f. of the cells become zero. The light bulb would not light up (or would go off).

6

(a) (ammeter connected in series with resistor C)
(voltmeter connected parallel to resistor C)

(b) (i) I_A = 6.0V / 6.0 Ω = 1.0 A
(ii) I_2 = 0.50 A

(c) (i) V_2 = (0.50 A) x (4.0 Ω) = 2.0 V
(ii) 4.0 V
(iii) 2.0 V

(d) The wires used may have internal resistance, causing the overall resistance of the entire circuit to go up, reducing the current flowing through the circuit.
OR
There may be poor contact at some points in the circuit, causing apparently higher resistance.

(e) The wires used to connect resistors $\mathbf{B_1}$ and $\mathbf{B_2}$ may have particularly high internal resistance.

Resistors $\mathbf{B_1}$ and $\mathbf{B_2}$ may have higher resistance than stated.
Resistor **A** may have lower resistance than stated.

7

(a) I = 2.5 A – 1.0 A = 1.5 A

(b) V = IR = 1.0 A x 6.0 Ω = 6.0 V

(c) V = 9.0 V – 6.0 V = 3.0 V

(d) When *S* is opened, the effective resistance of the circuit increases and **current through the bulb decreases.**
Since $P = I^2R$ and at constant R, $P \propto I^2$, the **bulb is dimmer** as **power** dissipated in it **decreases** when current through the bulb decreases.

OR When *S* is opened, effective resistance of the fixed resistors increases. Hence, the p.d. across the 6.0 Ω resistor increases and the **p.d. across the bulb decreases**.
Since $P = V^2/R$ and at constant R, $P \propto V^2$, the **bulb is dimmer** as **power** dissipated in it **decreases** when p.d. across the bulb decreases.