



2026 Sec 4 Physics Assignment 15A D.C Circuit (Sample Solutions)

Reminders:

1. Use subscripts for similar quantities belonging to different components, e.g. R_1 , R_2 .
2. Write down the **basic formulae** before substitution.
 - Component: $V = I R$
 - Entire circuit: e.m.f. = $I_{\text{main}} R_{\text{eff}}$
3. Show all key mathematical steps clearly.
4. **Redraw & rearrange** circuit components and wiring to **simplify** circuit diagrams
 - Note short-circuits, switches open/closed, junctions, etc.
5. **Evaluate your final answer!** (2 or 3 s.f.)

1 (a) Find resistance of the two resistors in parallel:
 $1/(1/10) + (1/10) = 5.0 \Omega$
Hence total resistance = $R_T = 3.0 + 5.0 = 8.0 \Omega$

(b) $I = V / R = 4.0 \text{ V} / 8.0 \Omega = 0.50 \text{ A}$

(wrong method: 4.0 V divided by 3.0Ω)

(c) Each resistor gets $0.50 \text{ A} \div 2 = 0.25 \text{ A}$ of current.
 $Q = I t = (0.25 \text{ A}) (2.0 \text{ s}) = 0.50 \text{ C}$

2 (a) Current through Resistor A = $2 \times 0.5 \text{ A} = 1.0 \text{ A}$
Same p.d. = $I_1 R_1 = I_2 R_2$

Note: Resistor A is connected in parallel to the path where point X lies.
Point X lies along a path with 2 resistors.
Therefore, the current through Resistor A will be twice that at X.

(b) Current through Resistor B = $0.5 \text{ A} + 1.0 \text{ A} = 1.5 \text{ A}$
Resistor B is in series with the battery, where the two paths (one with Resistor A and one with point X) converge.

3 (a) $I = V / R = 4.0 \text{ V} / 10 \Omega = 0.40 \text{ A}$

(b) 0 A since S acts as a short-circuit across the 4.0Ω

[Note: answer for question (b) is not $4.0 \text{ V} / 6.0 \Omega = 0.67 \text{ A}$, since question did not ask for current through that 6.0Ω resistor.]

- 4 (a) Find resistance of the two resistors 12Ω and 6.0Ω in parallel:
 $1/(1/12) + (1/6.0) = 4.0 \Omega$
 Find resistance of the two resistors 3.0Ω and 6.0Ω in parallel:
 $1/(1/3.0) + (1/6.0) = 2.0 \Omega$

Find resistance of the two resistors 4.0Ω and 2.0Ω in series:
 $R_T = 6.0 \Omega$

(b) $I = 12 / (4.0 + 2.0) = 2.0 \text{ A}$

(c) $I = 12 / (4.0 + 3.0) = 1.7 \text{ A}$

- 5 (a) $V_x = 12 / 2 = 6 \text{ V}; \quad V_y = 0 \text{ V}$

Why is $V_y = 0 \text{ V}$?

When there is no current, both terminals of the appliance are at the same electric potential, hence the potential difference across that appliance is zero.

- (b) same p.d. and resistance across each branch,
 so both have same current = 0.30 A
 hence new ammeter reading = $0.30 \text{ A} \times 2 = 0.60 \text{ A}$

OR

2 lamps in series: $R = 12 \text{ V} / 0.30 \text{ A} = 40 \Omega$

2 branches in parallel: effective resistance, $R_e = 40 / 2 = 20 \Omega$

Main current = e.m.f. / $R_e = 12 \text{ V} / 20 \Omega = 0.60 \text{ A}$

- 6 Rearrange the circuit to see that the 3 resistors are in parallel.
 $R_e = 5.0 \Omega / 3$
 e.m.f. = $I R_e = 3.0 \text{ A} \times 5.0 \Omega / 3 = 5.0 \text{ V}$

- 7 (a) In 2nd branch, current = $V / R = 12 \text{ V} / 5.0 \Omega = 2.4 \text{ A}$

- (b) In 1st branch, current = $5.0 \text{ A} - 2.4 \text{ A} = 2.6 \text{ A}$

$$R = V / I \quad \rightarrow \quad X + 3.0 \Omega = 12 \text{ V} / 2.6 \text{ A}$$

$$X = 1.62 \Omega = 1.6 \Omega \text{ (1.d.p.)}$$

- (c) All 3 branches are in parallel with the battery.

The current flowing through the 5.0Ω resistor is unchanged (still 2.4 A)
 as the voltage across the 5.0Ω is unchanged at 12 V even with the addition of the 2.0Ω resistor.

8 **Note:** May use potential divider method, treat resistance wire as 2 variable resistors in series as the jockey moves!

- The p.d. across the wire is proportional to its resistance when current through it is constant. $V = I R \quad \rightarrow \quad V \propto R$
- Resistance of that wire is proportional to its length.
- When S is **at A**, voltmeter reading is **zero** as the resistance across it is zero.
- As S moves from A towards B, the p.d. across the length of wire AS increases with increasing resistance, based on potential divider concept. Hence the voltmeter reading **V increases**.
- When S is **at B**, the **voltmeter reading is 4.0 V** as the voltmeter is across the maximum length of the resistance wire AB.

Need to specify the minimum and maximum voltmeter readings.

Language Notes:

- **DO NOT** write: *voltage flows through* a component
- You may write: current (flows) through a component
OR p.d. or voltage (established) across a component

9 (a) Let resistance of each lamp be R .

L_2 and L_3 are in parallel, so effective resistance is found to be $R/2$

Ratio of resistance of L_1 : L_2 and L_3 (in parallel)
 $= R : R/2$
 $= 2 : 1$

So ratio of p.d.s is also $= 2 : 1 = 4 \text{ V} : 2 \text{ V}$

$V_{L_2} = V_{L_3} = 2.0 \text{ V}$

Lamps L_2 and L_3 will be equally dim as the p.d. across each of them is lower than the rated value of 3.0 V.

$V_{L_1} = 4.0 \text{ V}$

Lamp L_1 will be brighter than normal as the p.d across it is higher than the rated value of 3.0 V.

Note:

- Rating of 3.0 V means when a p.d. of 3.0 V is applied across the lamp, it has normal brightness.
- Redraw the circuit and simplify if it helps you to understand the circuit better.
- Brightness is *not* directly proportional to current or p.d.: **NOT twice as bright!**

(b) The two lamps are **in series**.

$$V_{L1} = V_{L3} = 3.0 \text{ V}$$

Lamp L3 and lamp L1 will **both be operating at normal brightness** as the p.d. across each of them is equal to the rated value of 3.0 V.

Note:

When a lamp is removed, the wires next to it are NOT reconnected unless stated!

(c) The two lamps are **in parallel**.

$$V_{L2} = V_{L3} = 6.0 \text{ V}$$

Lamps L2 and L3 will **both be very bright** (and likely to fuse) as the p.d. across each of them is doubled the rated value of 3.0 V.

10 (a) $I = V / R_{\text{total}} = 0.020 \text{ A}$

(b)(i) $V = 6.0 \text{ V}$

(ii) $V = 3.0 \text{ V}$

(iii) $V = 0.0 \text{ V}$

Note: Brightness of lamp is not directly proportional to V or I .