



## 2022 Sec 4 Physics Assignment 15A D.C Circuit - Answers

### 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:  $V = IR$
  - 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!

- 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)  $I = V / R = 0.50 \text{ A}$
- (c)  $Q = I t = 0.50 \text{ C}$
- 2 (a)  $I = 1.0 \text{ A}$   
(b)  $I = 0.50 \text{ A}$
- 3 (a) Find resistance of the two resistors  $12 \Omega$  and  $6.0 \Omega$  in parallel:  
 $1/(1/12) + (1/6.0) = 4.0 \Omega$   
Find resistance of the two resistors  $3.0 \Omega$  and  $6.0 \Omega$  in parallel:  
 $1/(1/3.0) + (1/6.0) = 2.0 \Omega$
- (b) Find resistance of the two resistors  $4.0 \Omega$  and  $2.0 \Omega$  in parallel:  
 $I = 12 / (4.0 + 2.0) = 2.0 \text{ A}$
- (c)  $I = 12 / (4.0 + 3.0) = 1.7 \text{ A}$
- (d)  $I = 12 / (6.0 + 3.0) = 1.3 \text{ A}$
- 4 (a)  $V_X = 12/2 = 6 \text{ V}$ ,  $V_Y = 0 \text{ V}$   
(b)  $0.60 \text{ A}$
- 5 (a)  $R = 5 + \frac{3}{4} = 5.75 \Omega = 5.8 \Omega$   
(b)  $1.04 \text{ A}$
- 6  $5.0 \text{ V}$

7 (a) 2.4 A (b)

1.62  $\Omega$

(c) The current flowing through the 5  $\Omega$  resistor is unchanged (still 2.4 A) as the voltage across the 5  $\Omega$  is unchanged at 12 V even with the addition of the 2  $\Omega$  resistor.

8 (a) 0.40 A

(b) 0 A Current in 4  $\Omega$  resistor

9 **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.
- 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. 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.

- 10 (a) Let resistance of each lamp be  $r$ .  
 $L_2$  and  $L_3$  are in parallel, so effective resistance is found as  
 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  $2 : 1 = 4V : 2V$

$V_{L2} = V_{L3} = 2.0 V$ ; 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  $3.0 V$ .

$V_{L1} = 4.0 V$ ; 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 not directly proportional to current or p.d.: **NOT twice as bright!**

- (b) The two lamps are in series.

$V_{L1} = V_{L3} = 3.0 V$ ; Lamp  $L_3$  and lamp  $L_1$  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.

$V_{L2} = V_{L3} = 6.0 V$ ; Lamps  $L_2$  and  $L_3$  will both be very bright (and likely to fuse) as the p.d. across each of them is doubled the rated value of  $3.0 V$ .

- 11 (a)  $V = 6.0 V$ ,  $I = V / R_{total} =$   
 (b)  $V = 3.0 V$ , same  $I = 0.020 A$   
 (c)  $V = 0.0 V$ , same  $I = 0.020 A$

**Note:** Brightness of lamp is not directly proportional to  $V$  or  $I^2$