

Physics 222

Quiz 6 – Circuits, Form: A

Name: _____

Date: _____

Questions 1–9: A 1.5 V AA battery is connected to two light bulbs of different resistances that are in series with one another. Bulb 1 has a resistance of $10\ \Omega$ and bulb 2 has a resistance of $20\ \Omega$. A circuit diagram is shown in Figure 1.

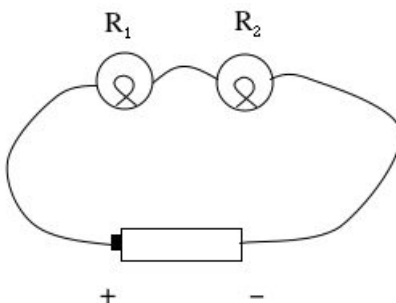


Figure 1:

1. Suppose the bulbs have filaments (small wires) that have the same length and same conductivity. Which bulb has a filament of larger radius?
 - (a) bulb 1
 - (b) bulb 2
 - (c) neither, because their filaments have the same cross sectional area and thus the same radius
2. Through which filament is the drift velocity (i.e. drift speed) the greatest?
 - (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the drift velocity through each bulb is the same
3. In which filament is the electric field the greatest?
 - (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the electric field in each bulb is the same
4. Across which bulb is the potential difference the greatest?
 - (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the potential difference across each bulb is the same
5. Through which bulb is the current the greatest?
 - (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the current through each bulb is the same

6. Which bulb dissipates (or absorbs) the greatest amount of energy in one second (i.e. power)?
- (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the current through each bulb is the same
7. Which bulb will glow brighter?
- (a) bulb 1
 - (b) bulb 2
 - (c) neither, because the potential difference across each bulb is the same
8. What is the current through the battery?
- (a) zero
 - (b) 0.225 amp
 - (c) 0.15 amp
 - (d) 0.10 amp
 - (e) 0.05 amp
9. If the two bulbs were instead connected in parallel, the current through the battery would be
- (a) greater.
 - (b) less.
 - (c) the same as when they were connected in series.

Questions 10–13: An uncharged capacitor is connected to a bulb and a 1.5 volt AA battery. After it is completely charged, the battery is removed from the circuit and the bulb is connected directly to the capacitor. The circuits are shown in Figure 2.

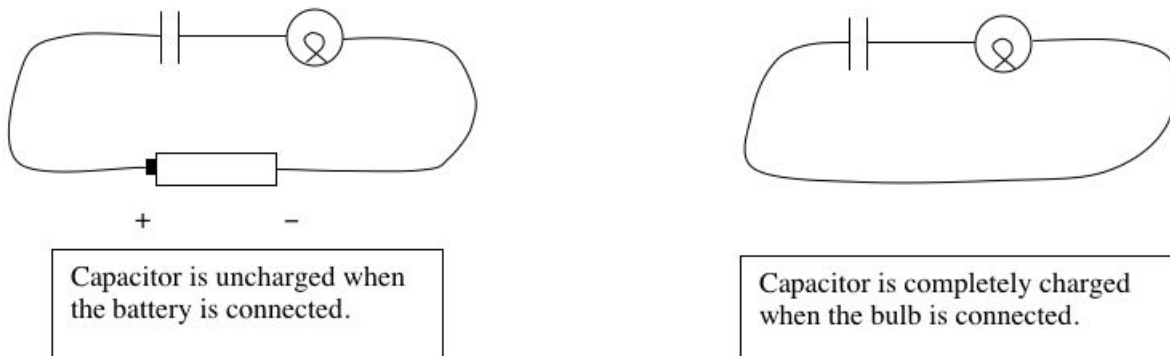


Figure 2:

10. Just after connecting the battery to the uncharged capacitor and bulb, the current is
- (a) nearly zero; there is very little current through the bulb, battery, and capacitor.
 - (b) much less than its maximum value and the bulb is dim.
 - (c) nearly its maximum value and the bulb is very bright.

11. The current in the wire is due to the net electric field in the wire. This net electric is primarily due to two sources: (1) surface charge on the wire; and (2)
- (a) the potential difference across the battery
 - (b) the drift velocity of mobile charge carriers
 - (c) fringe field due to the charge on the capacitor
12. As the capacitor discharges, in what direction do electrons flow through the bulb (i.e. direction of electron current)?
- (a) to the left
 - (b) to the right
 - (c) no current flows through the bulb because electrons cannot travel across the capacitor plates
13. As the capacitor discharges, the bulb is initially very bright. It then dims. Eventually, the current through the capacitor, wires, and bulb is zero. The best way to explain this is that
- (a) the bulb uses up charge as charge flows through the bulb; the bulb converts charge to light and thermal energy.
 - (b) the bulb dissipates (or absorbs) electric potential energy as charge flows through the bulb; the bulb converts this energy to light energy (photons) and thermal energy.
 - (c) the capacitor initially has a net positive charge (total charge including both plates); this charge is lost as it flows to the other side of the plate; it's mostly lost in the wires and bulb.

Questions 14–20: A 9-V battery is connected to three resistors as shown in Figure 3.

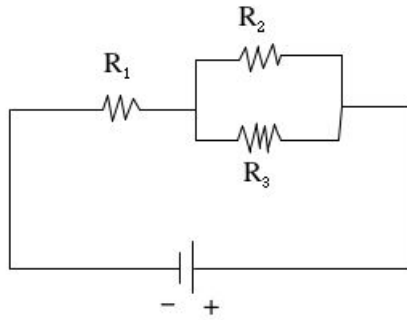


Figure 3:

The resistors are $R_1 = 1000 \ \Omega$, $R_2 = 500 \ \Omega$, $R_3 = 1000 \ \Omega$.

14. What is the equivalent resistance of the three resistors?
15. What is the current through the battery?

16. What is the potential difference across R_1 ?

17. What is the potential difference across R_2 and R_3 ?

18. What is the current through R_1 ?

19. What is the current through R_2 ?

20. What is the current through R_3 ?

Answer Key for Exam A

1. (a)

8. (e)

2. (b)

9. (a)

3. (b)

10. (c)

4. (b)

11. (c)

5. (c)

12. (b)

6. (b)

13. (b)

7. (b)

14. $(1/500 + 1/1000)^{-1} + 1000 = 1333 \Omega$

15. $9/1333 = 0.00675 \text{ amp}$

16. $0.00675(1000) = 6.75 \text{ volt}$

17. Apply KVL: $9 - 6.75 = 2.25 \text{ volt}$

18. same as the battery, 0.00675 amp

19. $2.25/500 = 0.0045 \text{ amp}$

20. Apply KCL: $0.00675 - 0.0045 = 0.00225 \text{ amp}$