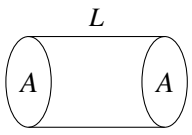
Student #: _____ Student Name: _____

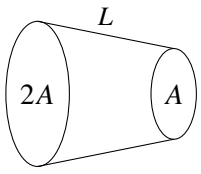
# AP PHYSICS C CLASS 20: CIRCUIT ANALYSIS, PART 1

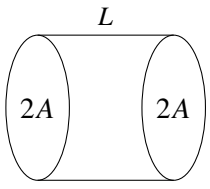
**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and place the letter of your choice in the corresponding box on the student answer sheet.

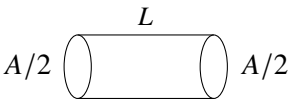
**Note:** To simplify calculations, you may use $g = 10\,\text{m/s}^2$ in all problems.

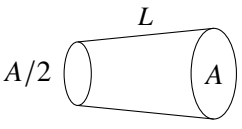
1. Five resistors are made of the same material. Which of the following has the highest resistance?

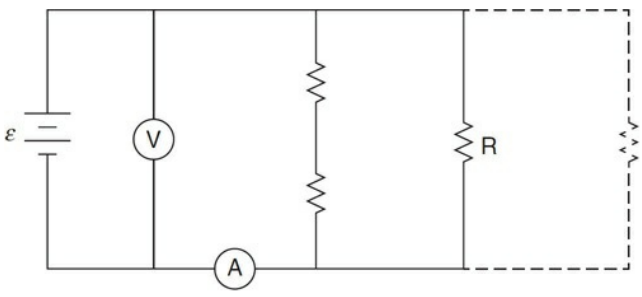
(A) 


(B) 


(C) 


(D) 


(E) 

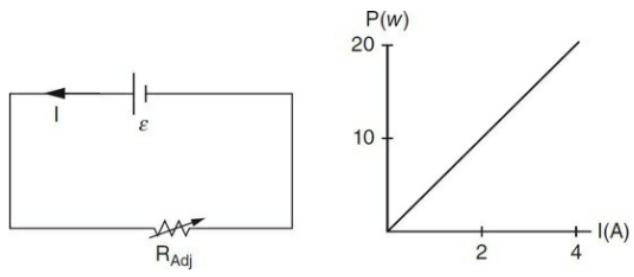




2. In the circuit shown, what effect would adding another resistor in parallel with the resistor labeled $R$ have?
   (A) The reading on the voltmeter would increase.
   (B) The reading on the ammeter would increase.
   (C) The reading on the voltmeter would decrease.
   (D) The reading on the ammeter would decrease.
   (E) The reading on the ammeter would not change.

3. The current flowing in a wire as a function of time is given by the equation $I = 4t^3$. The charge that passes through the wire from 0 s to 2 s is
   (A) 2 C
   (B) 4 C
   (C) 8 C
   (D) 16 C
   (E) 24 C

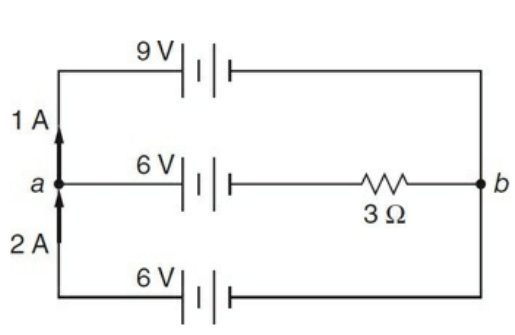
4. Which of the following statements best summarizes a series circuit with three different resistances?
   (A) In all parts of the circuit, the resistances are different, the voltage drops are the same, and the current is different.
   (B) In all parts of the circuit, the resistances are the same, the voltage drops are the same, and the current is different.
   (C) In all parts of the circuit, the resistances are different, the voltage drops are different, and the current is the same.
   (D) In all parts of the circuit, the resistances are different, the voltage drops are the same, and the current is the same.
   (E) In all parts of the circuit, the resistances are the same, the voltage drops are the same, and the current is the same.

**Questions 5–6** An adjustable resistor is connected to a battery of emf  in a simple circuit. A graph of power vs. current in the battery is shown in the figure.



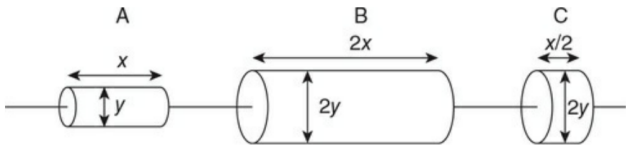

5. The emf $\mathcal{E}$ of the battery is most nearly
   (A) 5 V
   (B) 10 V
   (C) 20 V
   (D) 40 V
   (E) 60 V

6. What is the resistance of the adjustable resistor when the power in the circuit is 10 watts?
   (A) 1.25 Ω
   (B) 1.5 Ω
   (C) 2.5 Ω
   (D) 5.0 Ω
   (E) 0 Ω




7. There are three batteries in the circuit shown above. There may be other resistances not shown on the diagram. The potential difference between points $a$ and $b$ is
   (A) 3 V
   (B) 6 V
   (C) 9 V
   (D) 12 V
   (E) 18 V

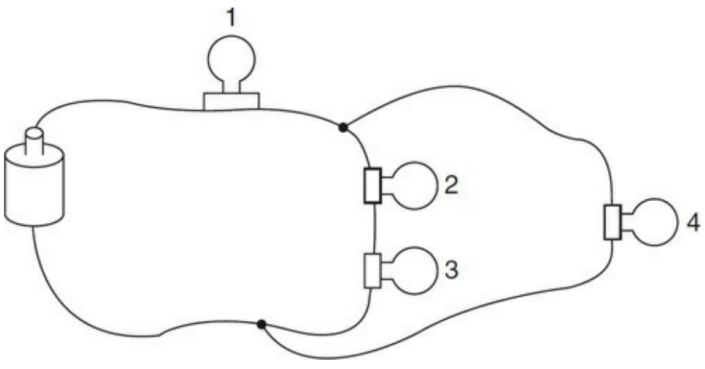
**Questions 8–9**




8. Which is the correct ranking of the currents for the resistors?
   (A) $I_A = I_B = I_C$
   (B) $I_A > I_B > I_C$
   (C) $I_C > I_A = I_B$
   (D) $I_C > I_B > I_A$
   (E) $I_C < I_B < I_A$

9. Which is the correct ranking of the potential differences of the resistors?
   (A) $V_A = V_B = V_C$
   (B) $V_A > V_B > V_C$
   (C) $V_A = V_B > V_C$
   (D) $V_C > V_B > V_A$
   (E) $V_C < V_B < V_A$

**Questions 10–11** Four identical light bulbs are connected to a battery as shown.



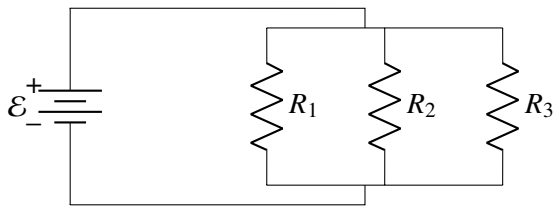

10. Which bulb will burn the brightest?

(A) 1
(B) 2
(C) 3
(D) 4
(E) All will emit the same brightness.

11. If bulb 4 is removed, how will the brightness of each of the bulbs change, if at all?

(A) Bulb 2 will be less bright.
(B) Bulb 2 will be brighter.
(C) Bulb 3 will not change its brightness.
(D) Bulb 1 will not give off light.
(E) None of the bulbs will change their brightness.

**Questions 12–15**




$\mathcal{E} = 12\,\text{V}$, $R_1 = 10\,\Omega$,
$R_2 = 6\,\Omega$, $R_3 = 8\,\Omega$

12. For the circuit in the diagram, which of the following expressions will describe the amount of current flowing through the resistors?

(A) $I_1 = I_2 = I_3$
(B) $I_3 > I_2 > I_1$
(C) $I_1 > I_2 < I_3$
(D) $I_2 > I_1 > I_3$
(E) $I_1 < I_2 < I_3$

13. For the circuit in the diagram, what is the equivalent resistance?

(A) $0.040\,\Omega$
(B) $0.40\,\Omega$
(C) $1.0\,\Omega$
(D) $2.6\,\Omega$
(E) $24\,\Omega$

14. For the circuit in the diagram, what is the total current?

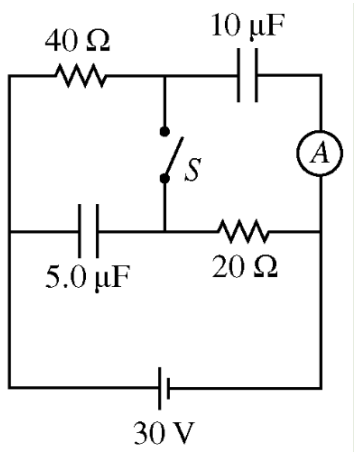
(A) 0.5 A
(B) 4.6 A
(C) 12 A
(D) 30 A
(E) 300 A

15. For the circuit in the diagram, the third resistor ($R_3$) dissipates how much energy each second?

(A) 12 W
(B) 14 W
(C) 46 W
(D) 212 W
(E) 300 W

**AP PHYSICS C CLASS C: ELECTRIC CIRCUITS**
**SECTION II**
**5 Questions**

**Directions:** Answer all questions. The parts within a question may not have equal weight. All final numerical answers should include appropriate units. Credit depends on the quality of your solutions and explanations, so you should show your work. Credit also depends on demonstrating that you know which physical principles would be appropriate to apply in a particular situation. Therefore, you should clearly indicate which part of a question your work is for.




1. In the circuit illustrated above, switch *S* is initially open and the battery has been connected for a long time.
   (a) What is the steady-state current through the ammeter?
   (b) Calculate the charge on the 10 μF capacitor.
   (c) Calculate the energy stored in the 5.0 μF capacitor.

   The switch is now closed, and the circuit comes to a new steady state.
   (d) Calculate the steady-state current through the battery.
   (e) Calculate the final charge on the 5.0 μF capacitor.
   (f) Calculate the energy dissipated as heat in the 40 Ω resistor in one minute once the circuit has reached steady state.