# AP PHYSICS 1 & 2: DC CIRCUIT ANALYSIS

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.

Questions 1–4

$R_1 = 3.0\,\Omega$

$\Delta V = 12.0\,\text{V}$

$R_2 = 1.0\,\Omega$

$R_3 = 2.0\,\Omega$
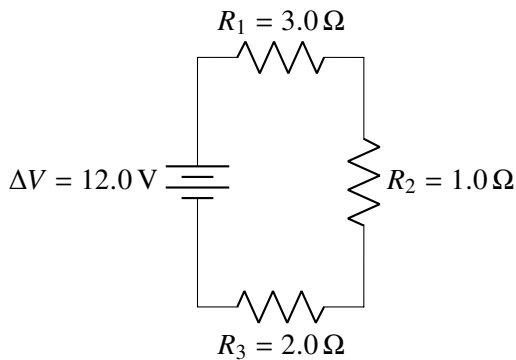
1. What is the current flowing through the circuit shown in the diagram?

   (A) 1 A
   (B) 2 A
   (C) 4 A
   (D) 6 A
   (E) 12 A

2. Which of the following statements is true about the circuit shown in the diagram?

   (A) The voltage drop is greatest across R_1, but R_1 has the least amount of current flowing through it.
   (B) The voltage drop is greatest across R_2, but R_2 has the least amount of current flowing through it.
   (C) The voltage drop is greatest across R_3, but R_3 has the least amount of current flowing through it.
   (D) The voltage drops and current are equal across all resistors.
   (E) The voltage drop is greatest across R_1, but the current is equal at all points in the circuit.

3. In this diagram, what is the power dissipated by all of the resistors in the circuit?

   (A) 2 W
   (B) 6 W
   (C) 12 W
   (D) 24 W
   (E) 48 W

4. In the diagram, what is the voltage drop across the third resistor (R_3)?

   (A) 2 V
   (B) 3 V
   (C) 4 V
   (D) 6 V
   (E) 12 V

5. Two identical resistors with resistance R are connected in series with a power supply with a potential difference of ΔV. Which expression represents the power output of the entire circuit?

   (A) $\dfrac{\Delta V^2}{4R}$
   (B) $\dfrac{\Delta V^2}{2R}$
   (C) $\dfrac{\Delta V^2}{R}$
   (D) $\dfrac{2(\Delta V)^2}{R}$
   (E) $2R(\Delta V)^2$

6. Two identical resistors with resistance R are connected in parallel with a power supply with a potential difference of ΔV. Which expression represents the rate that the circuit transfers energy to a single resistor?

   (A) $\dfrac{\Delta V^2}{4R}$
   (B) $\dfrac{\Delta V^2}{2R}$
   (C) $\dfrac{\Delta V^2}{R}$
   (D) $\dfrac{2(\Delta V)^2}{R}$
   (E) $2R(\Delta V)^2$

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Questions 7–10
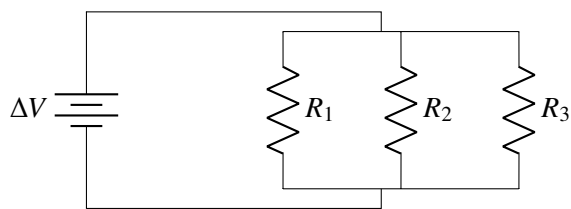
$$\Delta V = 12.0\,\text{V}, R_1 = 10.0\,\Omega,$$
$$R_2 = 6.0\,\Omega, R_3 = 8.0\,\Omega$$

7. 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) $I_1 < I_2 < I_3$

8. 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) $24\,\Omega$

9. 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

10. 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

11. 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.

GO ON TO THE NEXT PAGE.

AP PHYSICS 1 & 2: DC CIRCUIT ANALYSIS
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.
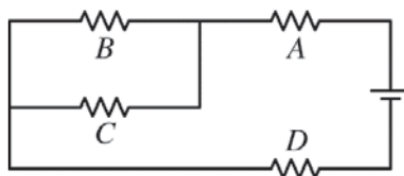

1. (Suggested time 13 minutes) A circuit contains a battery and four identical resistors arranged as shown in the diagram above.

   (a) Rank the magnitude of the potential difference across each resistor from greatest to least. If any resistors have potential differences with the same magnitude, state that explicitly. Briefly explain your reasoning.

   Ranking:

   Brief explanation:

   Resistor B is now removed from the circuit, and there is no connection between the wires that were attached to it. The new circuit diagram is shown below.
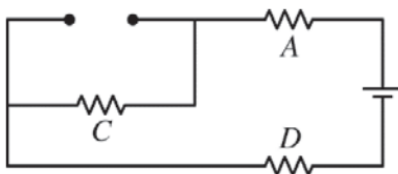
   (b) When resistor B is removed, does the current through resistor A increase, decrease, or remain the same?

   ____ Increase   ____ Decrease   ____ Remain the same

   Briefly explain your reasoning.

   (c) When resistor B is removed, does the current through resistor C increase, decrease, or remain the same?

   ____ Increase   ____ Decrease   ____ Remain the same

   Briefly explain your reasoning.

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