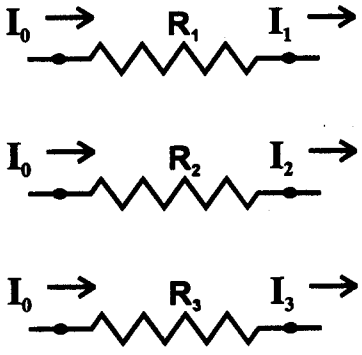
Chapter 5 Current and Resistance

In-Class Questions

Prerequisite Concepts:

- **Definitions of current, "voltage" [potential difference], resistance**
- **Positive charges flow through resistors in direction of decreasing potential**
- **Ohm's law: $I = \Delta V/R$**
- **Current is conserved as it flows through conductors and resistors**
- ***Assumption:* conducting wires are "ideal" ($R_{wire} = \Delta V_{wire} = 0$)**

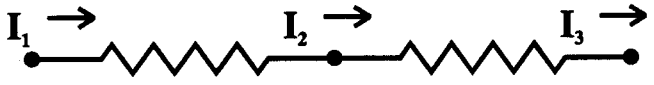
1. The same current I_0 enters each of the three resistors. The resistors have unequal magnitudes, and $R_3 > R_2 > R_1$. What will be the relationship among the magnitudes of the current *leaving* the three resistors?



A. $I_1 > I_2 > I_3$
B. $I_3 > I_2 > I_1$
C. $I_1 = I_2 = I_3$

2. Current is flowing through a set of two identical resistors connected by wires as shown. The magnitude of the current at three different points is indicated by I_1, I_2, and I_3. Which of these could be the relationship among I_1, I_2, and I_3?

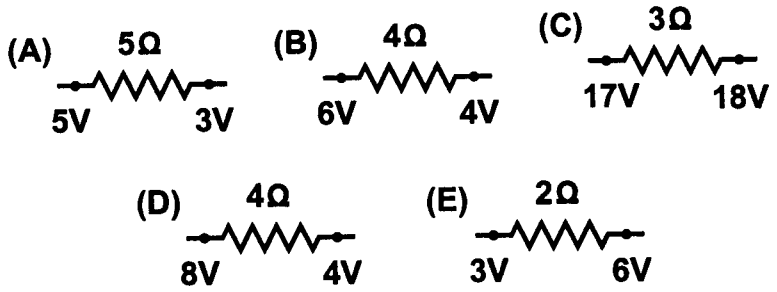
A. $I_2 = \frac{1}{2} I_1$; $I_3 = \frac{1}{2} I_2$
B. $I_2 = \frac{1}{2} I_1$; $I_3 = 0$
C. $(I_1 - I_2) = (I_2 - I_3) \neq 0$
D. $I_1 = I_2 = I_3$
E. $I_2 = \frac{1}{2} I_1$; $I_3 = I_1$



3. The current flows through the resistor in the direction shown. Which of the following is true:

A. The potential at A is the same as at B.
B. The potential at A is higher than that at B.
C. The potential at A is smaller than that at B.
D. There is not enough information to determine how the potentials at A and B compare.

4.

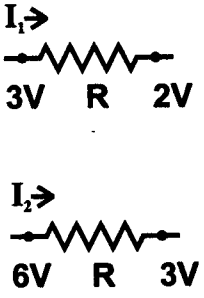


In the figure above five different resistors are shown, each with a conducting wire leading into it and leading out. The electric potential at both ends of each resistor is shown. Through which resistor will the current flow be greatest?

5. In this figure, current I_1 flows through the top resistor, and current I_2 flows through the bottom resistor. *Both resistors have the same value "R."* What is the ratio of I_1 to I_2?

I_1/I_2 =

A. 1
B. 2
C. 3
D. 1/2
E. 1/3
F. 2/3

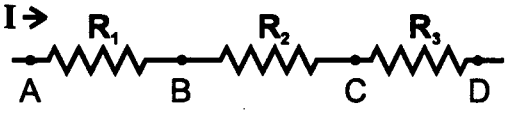


6. If the potential at point A *doubles* (i.e., $V_A \rightarrow 2V_A$), but I and R *remain constant*, then what must happen to V_B?

A. $V_B \rightarrow 4V_B$
B. $V_B \rightarrow 2V_B$
C. $V_B \rightarrow 0.5\ V_B$
D. $V_B \rightarrow [V_A + V_B]$
E. V_B doesn't change
F. not enough information to determine what happens to V_B

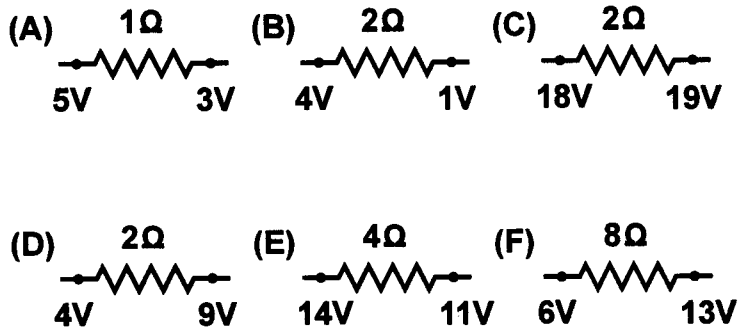
7. Using the notation $\Delta V_{AB} \equiv V_A - V_B$, etc., which of the following relationships must hold for the potential difference between points A and D:

A. $\Delta V_{AD} > \Delta V_{AB} + \Delta V_{BC} + \Delta V_{CD}$
B. $\Delta V_{AD} = \Delta V_{AB} + \Delta V_{BC} + \Delta V_{CD}$
C. $\Delta V_{AD} < \Delta V_{AB} + \Delta V_{BC} + \Delta V_{CD}$
D. not enough information given to answer this



In-Class Exercises

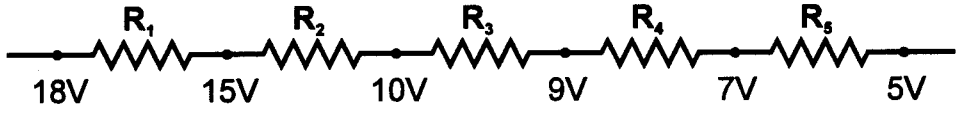
1. In this figure six different resistors are shown, each with a conducting wire leading into it and leading out. The electric potential at both ends of each resistor is shown.



Draw an arrow below each resistor, indicating the direction of current flow through the resistor. Rank the magnitudes of the current flows starting with largest magnitude; if two or more are the same, put an "equals" sign ["="] between them; e.g., [I_A, I_B = I_C, I_D, I_E, I_F] means: I_A is largest, I_F is smallest, and I_B is equal to I_C, but is larger than I_D, etc.]:

Ranking: (largest)_____(smallest)

2. In this figure, current is flowing through a set of five resistors connected to each other by conducting wires. The electric potential is indicated at several points marked by dots.



Rank the magnitudes of the resistances starting with largest magnitude; if two or more are the same, put an "equals" sign ["="] between them; e.g., [R_1, R_2 = R_3, R_4, R_5] means: R_1 is largest, R_5 is smallest, and R_2 is equal to R_3, but is larger than R_4]:

Ranking: (largest)_____(smallest)

3. A 5-A current is flowing through the set of resistors shown. The point "E" where the electric potential is 0 volts is indicated. Write down the electric potential at the following points:

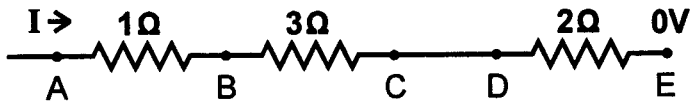
A: _____

B: _____

C: _____

D: _____

E: 0 volts



What is ΔV_{AE}, the magnitude of the potential difference between points A and E?
ΔV_{AE} = _____

4. If the set of resistors in #3 above were replaced by a single resistor, and the same 5-A current were to flow, what would the value R of that resistor have to be in order to maintain the same potential difference between points A and E?

R = _____ *[Note: This is the "equivalent resistance" R_{equiv} of that set of resistors]*
Compared to the *sum* of the magnitudes of the individual resistors, is this larger, smaller, or the same?_____

5. A 3-A current is flowing through the set of resistors shown. The point "C" where the electric potential is 9 volts is indicated. Write down the electric potential at the following points:

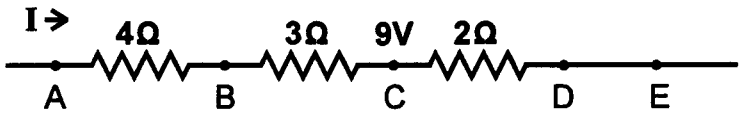
A: _____

B: _____

C: 9 volts

D: _____

E: _____



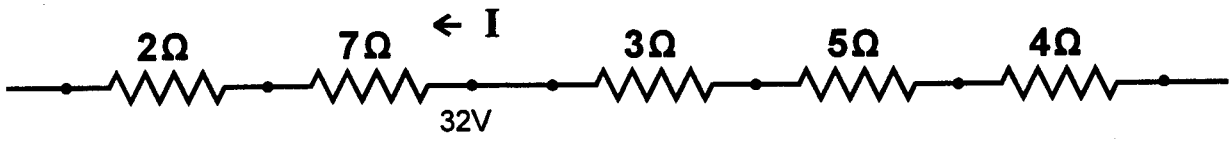
What is the potential difference between points A and E?
ΔV_{AE} = _____

6. If the set of resistors in #5 above were replaced by a single resistor, and the same 3-A current were to flow, what would the value R of that resistor have to be in order to maintain the same potential difference between points A and E?

R = _____
Compared to the *sum* of the magnitudes of the individual resistors, is this larger, smaller, or the same?_____

Homework Exercises

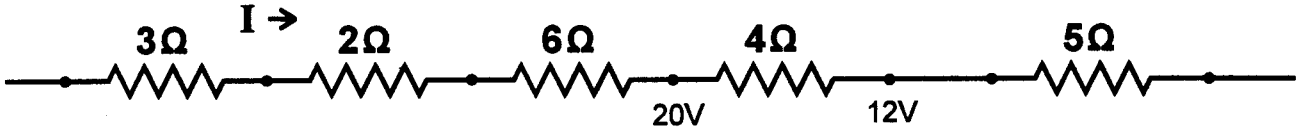
1.



In this figure, a current of 3 A is flowing in the direction shown, and the point at which the potential equals 32 V is indicated. On the figure, write the value of the potential at all points indicated by large dots. Find the equivalent resistance of the set of resistors.

R_{equiv} = _____

2.

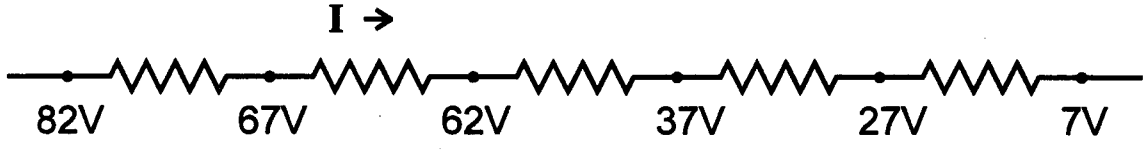


In this figure, an unknown current is flowing in the direction shown. Find the value of the current, and write the value of the potential on the figure at all points indicated by large dots. Find the equivalent resistance of the set of resistors.

I = _____

R_{equiv} = _____

3.



In this figure, a current of 5 A is flowing in the direction shown. On the figure, write down the value of all of the resistors. Find the equivalent resistance of the set of resistors.

R_{equiv} = _____