Name: _____ **Class:** _____ **Date:** _____ **ID: A**

Cp Phyisics web review ch 19-20 Circuits

Please do not write on my tests

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. A circuit has a continuous path through which charge can flow from a voltage source to a device that uses electrical energy. What is the name of this type of circuit?
a. a short circuit
b. a closed circuit
c. an open circuit
d. a circuit schematic

____ 2. If the potential difference across a pair of batteries used to power a flashlight is 6.0 V, what is the potential difference across the flashlight bulb?
a. 3.0 V
b. 6.0 V
c. 9.0 V
d. 12 V

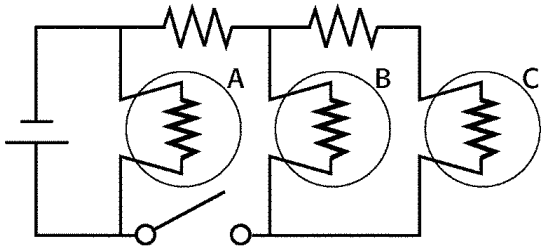
____ 3. Three resistors with values of R_1, R_2, and R_3 are connected in series. Which of the following expresses the total resistance, R_{eq}, of the three resistors?
a. $R_{eq} = R_1 + R_2 + R_3$
b. $R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)$
c. $R_{eq} = R_1 = R_2 = R_3$
d. $R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)^{-1}$

____ 4. Three resistors connected in parallel carry currents labeled I_1, I_2, and I_3. Which of the following expresses the total current I_t in the combined system?
a. $I_t = I_1 + I_2 + I_3$
b. $I_t = \left(\frac{1}{I_1} + \frac{1}{I_2} + \frac{1}{I_3} \right)$
c. $I_t = I_1 = I_2 = I_3$
d. $I_t = \left(\frac{1}{I_1} + \frac{1}{I_2} + \frac{1}{I_3} \right)^{-1}$

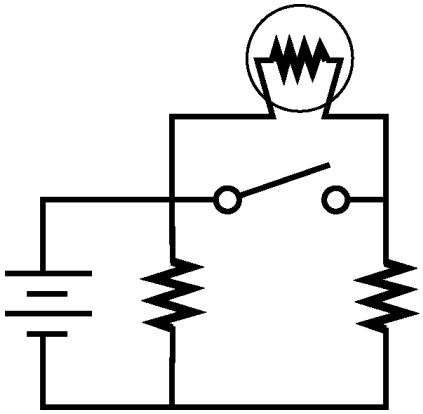
____ 5. Three resistors with values of R_1, R_2, and R_3 are connected in parallel. Which of the following expresses the total resistance, R_{eq}, of the three resistors?
a. $R_{eq} = R_1 + R_2 + R_3$
b. $R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)$
c. $R_{eq} = R_1 = R_2 = R_3$
d. $R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)^{-1}$

____ 6. Two resistors having the same resistance value are wired in parallel. How does the equivalent resistance compare to the resistance value of a single resistor?
a. The equivalent resistance is twice the value of a single resistor.
b. The equivalent resistance is the same as a single resistor.
c. The equivalent resistance is half the value of a single resistor.
d. The equivalent resistance is greater than that of a single resistor.

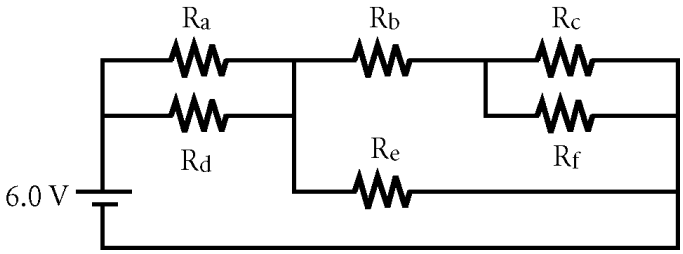
Short Answer



7. Which bulb or bulbs will have a current in the schematic diagram shown above?



8. In the circuit shown above, what will happen when the switch is closed? Explain.



9. In the circuit shown above, which resistors, if any, have equal voltages across them?

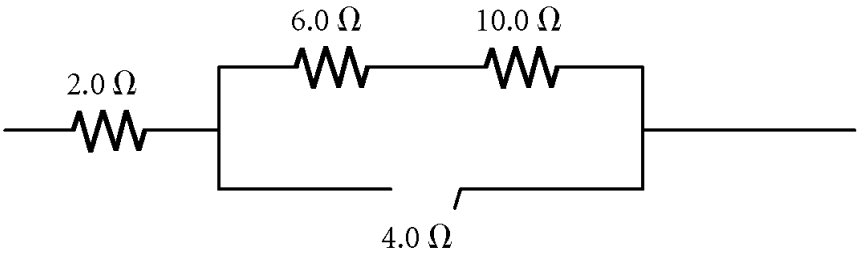
Problem

10. Three resistors with values of 18 Ω, 26 Ω, 9 Ω, respectively, are connected in series. What is their equivalent resistance?
11. Three resistors with values of 12 Ω, 38 Ω, 125 Ω, respectively, are connected in series. What is their equivalent resistance?
12. A current of 0.20 A passes through a 3.0 Ω resistor. The resistor is connected in series with a 6.0 V battery and an unknown resistor. What is the resistance value of the unknown resistor?

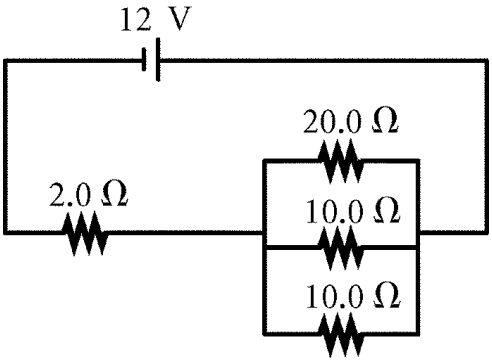
13. Three resistors are wired in series with a 22.0 V battery. The resistances are 22.5 Ω, 33.6 Ω, and 9.9 Ω. What is the voltage across the 9.9 Ω resistor?

14. Three resistors with values of 16 Ω, 19 Ω, 26 Ω, respectively, are connected in parallel. What is their equivalent resistance?

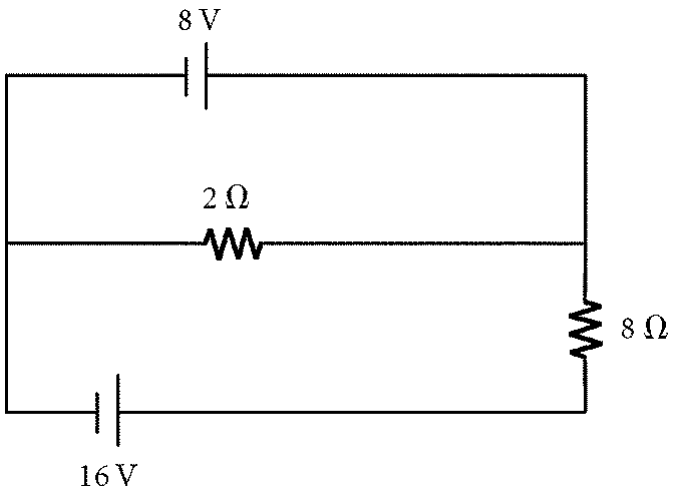
15. Four resistors are wired in parallel with a 2.50 V battery. The total circuit current is 1.85 A, and three of the resistors have resistances of 2.70 Ω, 8.20 Ω, and 12.6 Ω. What is the resistance of the fourth resistor?



16. What is the equivalent resistance for the resistors in the figure shown above?

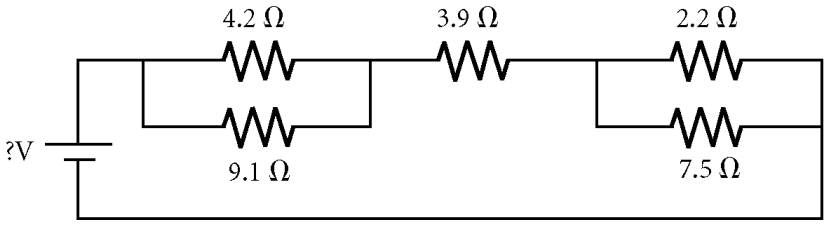


17. How much current is in one of the 10 Ω resistors in the diagram shown above?

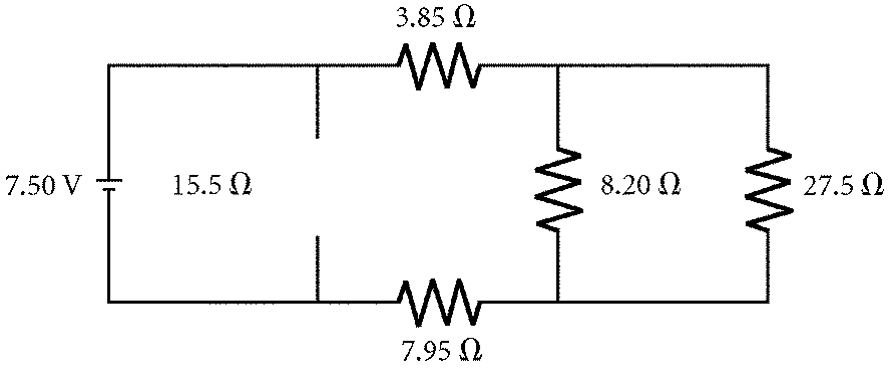


18. What is the current in the 8 Ω resistor in the circuit shown in the figure above?

19. What is the current in the 2 Ω resistor in the circuit shown in the figure above?



20. In the circuit shown above, the current in the 3.9 Ω resistor is 0.27 A. What is the voltage of the battery?



21. What is the current through the 8.20 Ω resistor in the circuit shown above?

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Answer Section

MULTIPLE CHOICE

1. B
2. B
3. A
4. A
5. D
6. C

SHORT ANSWER

7. Bulb A has a current, but B and C do not because the switch is open.
8. The lamp will go out, or the lamp will get dimmer. The resistance through the switch is lower than the filament of the lamp.
9. The voltage across R_a is equal to the voltage across R_d, and the voltage across R_c is equal to the voltage across R_f.

PROBLEM

10. 53 Ω

    Given
    $R_1 = 18\ \Omega$
    $R_2 = 26\ \Omega$
    $R_3 = 9\ \Omega$

    Solution
    $R_{eq} = R_1 + R_2 + R_3 = 18\ \Omega + 26\ \Omega + 9\ \Omega = 53\ \Omega$
11. 175 Ω

    Given
    $R_1 = 12\ \Omega$
    $R_2 = 38\ \Omega$
    $R_3 = 125\ \Omega$

    Solution
    $R_{eq} = R_1 + R_2 + R_3 = 12\ \Omega + 38\ \Omega + 125\ \Omega = 175\ \Omega$

12. 27 Ω

Given
$I_{R1} = 0.20$ A
$R_1 = 3.0\ \Omega$
$\Delta V_{batt} = 6.0$ V

Solution
$\Delta V_{R1} = R_1 \times I_1 = 3.0\ \Omega \times 0.20\text{ A} = 0.60$ V
$\Delta V_{R2} = \Delta V_{batt} - \Delta V_{R1} = 6.0\text{ V} - 0.60\text{ V} = 5.4$ V
$I_{R2} = I_{R1} = 0.20$ A

$$R_2 = \frac{V_{R2}}{I_{R2}} = \frac{5.4\text{ V}}{0.20\text{ A}} = 27\ \Omega$$

13. 3.3 V

Given
$V_{batt} = 22.0$ V
$R_1 = 22.5\ \Omega$
$R_2 = 33.6\ \Omega$
$R_3 = 9.9\ \Omega$

Solution
$$R_{eq} = R_1 + R_2 + R_3 = 22.5\ \Omega + 33.6\ \Omega + 9.9\ \Omega = 66.0\ \Omega$$

$$I = \frac{V_{batt}}{R_{eq}} = \frac{22.0\text{ V}}{66.0\ \Omega} = 0.333\text{ A}$$

$$V_{R3} = I(R_3) = (0.333\text{ A})(9.9\ \Omega) = 3.3\text{ V}$$

14. 6.5 Ω

Given
$R_1 = 16\ \Omega$
$R_2 = 19\ \Omega$
$R_3 = 26\ \Omega$

Solution
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{16\ \Omega} + \frac{1}{19\ \Omega} + \frac{1}{26\ \Omega}$$

$$\frac{1}{R_{eq}} = \frac{0.062}{1\ \Omega} + \frac{0.053}{1\ \Omega} + \frac{0.038}{1\ \Omega} = \frac{0.153}{1\ \Omega}$$

$$R_{eq} = \frac{1\ \Omega}{0.153} = 6.5\ \Omega$$

15. 5.94 Ω

Given
$\Delta V_{batt} = 2.50$ V
$I_{total} = 1.85$ A
$R_1 = 2.70$ Ω
$R_2 = 8.20$ Ω
$R_3 = 12.6$ Ω

Solution

$$I_{R1} = \frac{\Delta V_{batt}}{R_1} = \frac{2.50\text{ V}}{2.70\,\Omega} = 0.926\text{ A}$$

$$I_{R2} = \frac{\Delta V_{batt}}{R_2} = \frac{2.50\text{ V}}{8.20\,\Omega} = 0.305\text{ A}$$

$$I_{R3} = \frac{\Delta V_{batt}}{R_3} = \frac{2.50\text{ V}}{12.6\,\Omega} = 0.198\text{ A}$$

$I_{R4} = I_{total} - (I_{R1} + I_{R2} + I_{R3}) = 1.85\text{ A} - (0.926\text{ A} + 0.305\text{ A} + 0.198\text{ A})$
$I_{R4} = 1.85\text{ A} - 1.429\text{ A} = 0.421\text{ A}$

$$R_4 = \frac{\Delta V_{batt}}{I_{R4}} = \frac{2.50\text{ V}}{0.421\text{ A}} = 5.94\,\Omega$$

16. 5.2 Ω

Given
$R_1 = 2.0$ Ω
$R_2 = 6.0$ Ω
$R_3 = 10.0$ Ω
$R_4 = 4.0$ Ω

Solution
$R_{2,3} = R_2 + R_3 = 6.0\ \Omega + 10.0\ \Omega = 16.0\ \Omega$

$$\frac{1}{R_{2,3,4}} = \frac{1}{R_{2,3}} + \frac{1}{R_4} = \frac{1}{16.0\,\Omega} + \frac{1}{4.0\,\Omega} = \frac{0.0625}{1\,\Omega} + \frac{0.25}{1\,\Omega} = \frac{0.3125}{1\,\Omega}$$

$$R_{2,3,4} = \frac{1\,\Omega}{0.3125} = 3.2\,\Omega$$

$$R_{eq} = R_{1,2,3,4} = R_4 + R_{2,3,4} = 2.0\,\Omega + 3.2\,\Omega = 5.2\,\Omega$$

17. 0.80 A

Given
$R_1 = 2.0\ \Omega$
$R_2 = 20.0\ \Omega$
$R_3 = 10.0\ \Omega$
$R_4 = 10.0\ \Omega$
$\Delta V_{batt} = 12\ \text{V}$
$I_{R3} = I_{R4}$

Solution

$$\frac{1}{R_{2,3,4}} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{20.0\ \Omega} + \frac{1}{10.0\ \Omega} + \frac{1}{10.0\ \Omega}$$

$$\frac{1}{R_{2,3,4}} = \frac{1}{20.0\ \Omega} + \frac{2}{20.0\ \Omega} + \frac{2}{20.0\ \Omega} = \frac{5}{20.0\ \Omega}$$

$$R_{2,3,4} = \frac{20.0\ \Omega}{5} = 4.00\ \Omega$$

$$R_{eq} = R_1 + R_{2,3,4} = 2.0\ \Omega + 4.00\ \Omega = 6.0\ \Omega$$

$$I_{tot} = \frac{\Delta V_{batt}}{R_{eq}} = \frac{12\ \text{V}}{6.0\ \Omega} = 2.0\ \text{A}$$

$$\Delta V_3 = \Delta V_4 = R_{2,3,4} \times I_{tot} = 4.00\ \Omega \times 2.0\ \text{A} = 8.0\ \text{V}$$

$$I_{R3} = I_{R4} = \frac{\Delta V_3}{R_3} = \frac{\Delta V_4}{R_4} = \frac{8.0\ \text{V}}{10.0\ \Omega} = 0.80\ \text{A}$$

18. 1 A

Given
$R_1 = 2\ \Omega$
$R_2 = 8\ \Omega$
$V_1 = 8\ \text{V}$
$V_2 = 16\ \text{V}$

Solution
Because one side of R_2 is connected to the 16 V battery and the other side is connected to the 8 V battery, the voltage across R_2 must be the difference between the battery voltages.
$V_{R2} = V_2 - V_1 = 16\ \text{V} - 8\ \text{V} = 8\ \text{V}$

$$I_{R2} = \frac{V_{R2}}{R_2} = \frac{8\ \text{V}}{8\ \Omega} = 1\ \text{A}$$

19. 4 A

Given
$R_1 = 2\ \Omega$
$R_2 = 8\ \Omega$
$V_1 = 8$ V
$V_2 = 16$ V

Solution
The voltage across R_1 must be equal to 8 V, because R_1 is connected directly across the 8 V battery.

$$I_{R1} = \frac{V_1}{R_1} = \frac{8\text{ V}}{2\ \Omega} = 4\text{ A}$$

20. 2.3 V

Given
$R_1 = 4.2\ \Omega$
$R_2 = 9.1\ \Omega$
$R_3 = 3.9\ \Omega$
$R_4 = 2.2\ \Omega$
$R_5 = 7.5\ \Omega$
$I_{R3} = 0.27$ A

Solution

$$\frac{1}{R_{1,2}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4.2\ \Omega} + \frac{1}{9.1\ \Omega} = \frac{0.24}{1\ \Omega} + \frac{0.11}{1\ \Omega} = \frac{0.35}{1\ \Omega}$$

$$R_{1,2} = \frac{1\ \Omega}{0.35} = 2.9\ \Omega$$

$$\frac{1}{R_{4,5}} = \frac{1}{R_4} + \frac{1}{R_5} = \frac{1}{2.2\ \Omega} + \frac{1}{7.5\ \Omega} = \frac{0.45}{1\ \Omega} + \frac{0.13}{1\ \Omega} = \frac{0.58}{1\ \Omega}$$

$$R_{4,5} = \frac{1\ \Omega}{0.58} = 1.7\ \Omega$$

$R_{eq} = R_{1,2} + R_3 + R_{4,5} = 2.9\ \Omega + 3.9\ \Omega + 1.7\ \Omega = 8.5\ \Omega$
$I_{ckt} = I_{R3}$
$\Delta V_{batt} = (R_{eq})(I_{ckt}) = (8.5\ \Omega)(0.27\text{ A}) = 2.3$ V

21. 0.320 A

Given
$\Delta V = 7.50$ V
$R_1 = 15.5\ \Omega$
$R_2 = 3.85\ \Omega$
$R_3 = 7.95\ \Omega$
$R_4 = 8.20\ \Omega$
$R_5 = 27.5\ \Omega$

Solution
Find R_{eq} for R_4 and R_5:

$$\frac{1}{R_{4,5}} = \frac{1}{R_4} + \frac{1}{R_5} = \frac{1}{8.20\,\Omega} + \frac{1}{27.5\,\Omega} = \frac{0.122}{1\,\Omega} + \frac{0.036}{1\,\Omega} = \frac{0.158}{1\,\Omega}$$

$$R_{4,5} = \frac{1\,\Omega}{0.158} = 6.33\,\Omega$$

R_1 is not used for the calculations as it is simply in parallel with the remainder of the circuit. Find the equivalent resistance for the part of the circuit that includes R_4:
$R_{eq} = R_2 + R_3 + R_{4,5} = 3.85\ \Omega + 7.95\ \Omega + 6.33\ \Omega = 18.13\ \Omega$
Find the current through this resistance:

$$I_{ckt} = \frac{\Delta V}{R_{eq}} = \frac{7.50\,\text{V}}{18.13\,\Omega} = 0.414\,\text{A}$$

Use this current to find the voltage across $R_{4,5}$:
$\Delta V_{R4,5} = (I_{ckt})(R_{4,5}) = (0.414\,\text{A})(6.33\,\Omega) = 2.62\,\text{V}$
Find the current through R_4:

$$I_{R4} = \frac{\Delta V_{R4,5}}{R_4} = \frac{2.62\,\text{V}}{8.20\,\Omega} = 0.320\,\text{A}$$