PHYSICS 12

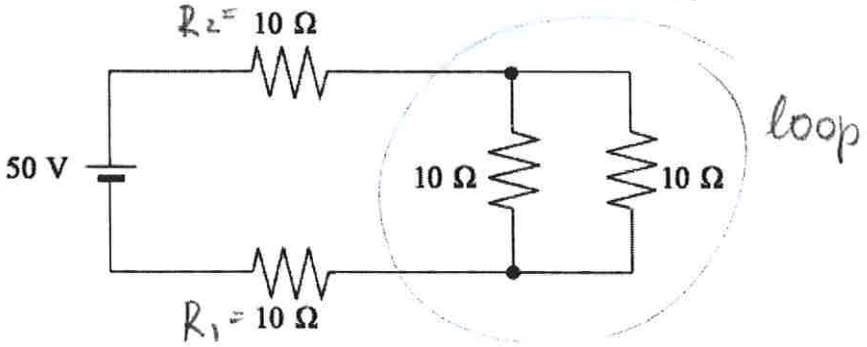
Answers

Ohm's Law, Resistance, Power and Kirchhoff's Laws

Examples

1.

In the following circuit, what current is drawn from the battery? I_{tot}



A. 1.3 A
B. 1.7 A
C. 2.0 A
D. 5.0 A

- $R_{eq} = R_1 + R_2 + R_{loop}$
  $= 10 + 10 + 5$
  $= 25\ \Omega$

- $I = \frac{V_{battery}}{R_{eq}}$

- $I = \frac{50}{25}$

$I = 2.0\ A$

- R_{loop}:

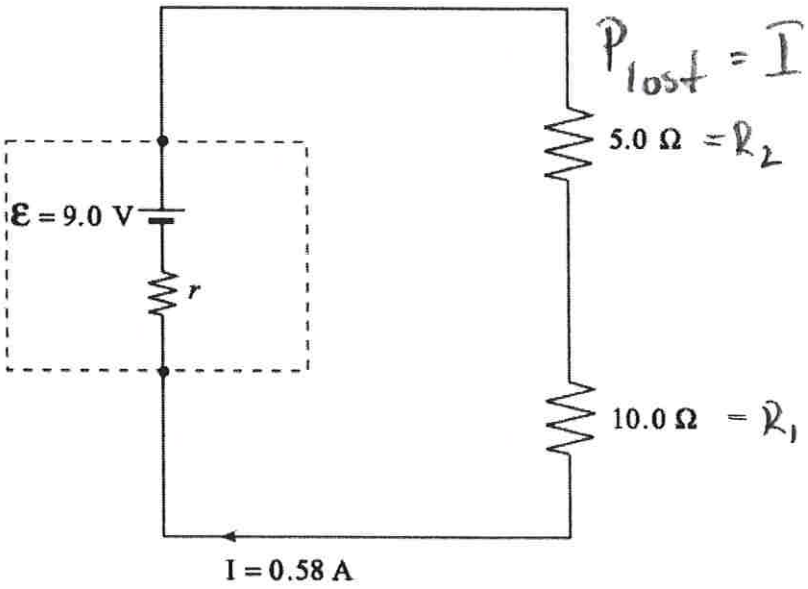
$\frac{1}{R_{loop}} = \frac{1}{10} + \frac{1}{10}$

$\frac{1}{R_{loop}} = \frac{2}{10}$

$R_{loop} = \frac{10}{2} = 5.0\ \Omega$

2.

. In the following circuit, what is the power loss in the battery? $P = IV$



A. 0 W
B. 0.17 W
C. 5.0 W
D. 5.2 W

- $V_{lost} = \mathcal{E} - V_{term}$

$V_{lost} = 9.0 - 8.7$

$= 0.3\ V$

- $V_{term} = \mathcal{E} - Ir$
- $V_{term} = I(R_1 + R_2)$

$= (0.58)(15.0)$

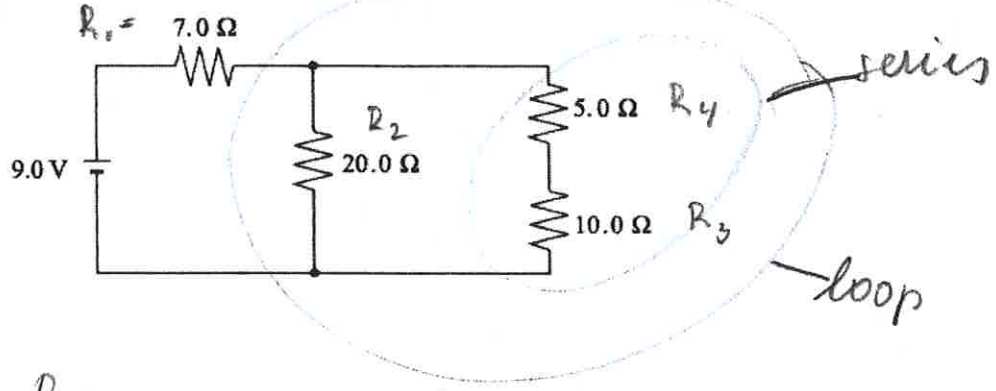
$= 8.7\ V$

- $P_{lost} = (0.58)(0.3)$

$= 0.174\ W$

3.

In the circuit shown below, determine the current through the 5.0 Ω resistor. **(7 marks)**



- $R_{eq} = R_1 + R_{loop}$

$R_{eq} = 7.0 + \frac{60}{7}$

$\doteq 15.5714\ \Omega$

- R_{loop}:

$\frac{1}{R_{loop}} = \frac{1}{R_2} + \frac{1}{R_3 + R_4}$

$= \frac{1}{20} + \frac{1}{15}$

$= \frac{3+4}{60}$

$= \frac{7}{60} \rightarrow R_{loop} = \frac{60}{7}\ \Omega$

- $I_{tot} = \frac{V}{R_{eq}}$

$= \frac{9.0}{15.5714}$

$= 0.577982\ldots\ A$

- $V_{loop} = V_{battery} - V_1$

$= 9.0 - (0.577982)(7.0)$

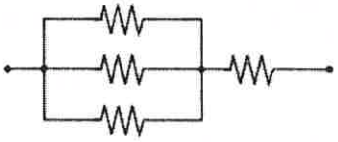
$\doteq 4.9541\ V$

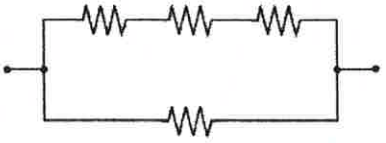
- $V_{loop} = V_{series} \rightarrow I_{series} = I_4 = \frac{V_{series}}{R_{series}} = \frac{4.9541}{(5+10)} = 0.33$

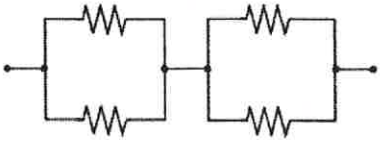
$I = \frac{V}{R}$ ⇒ large I ⇔ small R

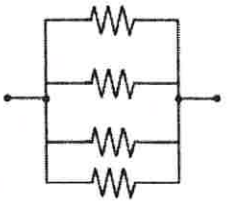
4.

. Which of the following arrangements would draw the largest current when connected to a potential difference? All resistors have the same value.

A. 

B. 

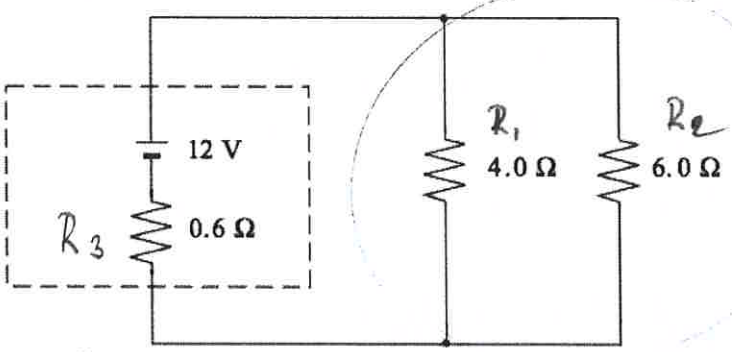
C. 

(D.) 

Resistors in parallel lower the R_{eq} !

5.

In the following circuit, what current flows through the 4.0 Ω resistor?



(A.) 2.4 A
B. 2.6 A
C. 3.0 A
D. 4.0 A

(5) • $V_{loop} = V_1 = V_2$

(2) • $R_{eq} = R_3 + R_{loop}$

$R_{eq} = 0.6 + \frac{12}{5}$

$= 3.0\ \Omega$

(1) • $\frac{1}{R_{loop}} = \frac{1}{4.0} + \frac{1}{6.0}$

$\frac{1}{R_{loop}} = \frac{3+2}{12}$

$R_{loop} = \frac{12}{5}\ \Omega$

(6) • $I_2 = \frac{V_2}{R_2}$

$= \frac{9.6}{4.0}$

$= 2.4\ A$

(3) • $I = \frac{V}{R_{eq}}$

$= \frac{12}{3.0}$

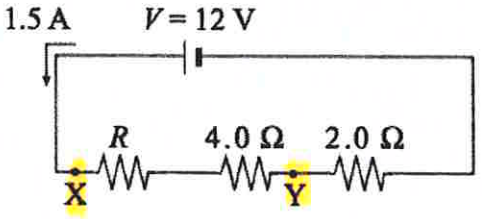
$= 4.0\ A$

(4) • $V_{loop} = V_{battery} - V_3$

$= 12.0 - (4.0)(0.6) = 9.6\ V$

6.

In the following circuit, what is the magnitude of the potential difference between X and Y?



A. 3.0 V
B. 6.0 V
C. 9.0 V
D. 12 V

- $R_{eq} = \frac{V}{I}$
  $= \frac{12}{1.5}$
  $= 8.0\,\Omega$

- $R_{eq} = R + 4.0 + 2.0$
  $\rightarrow R = 8.0 - 4.0 - 2.0$
  $= 2.0\,\Omega$

- $V_{XY} = I_{tot} \cdot R_{XY}$
  $= (1.5)(2.0+4.0)$
  $= 9.0\ V$