PHYS0104
Second Semester
35/36

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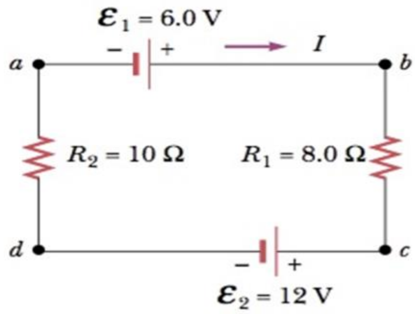
Sciences Faculty

Name: Solution **Student Id:** ....

Homework#2

1)
A single-loop circuit contains two resistors and two batteries, as shown in figure below. Answer the following questions:
1) Find the current in the circuit.
2) What power is delivered to each resistor?

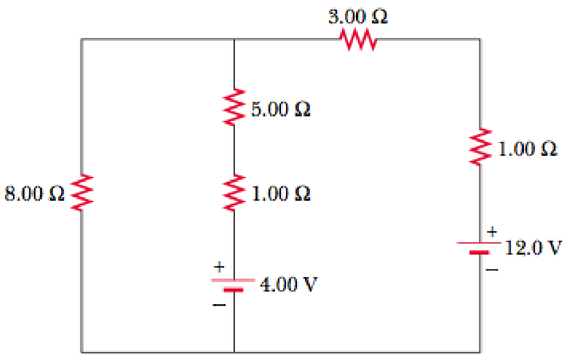


I = - .33 A
....

P1 = .87 w
P2 = 1.1 w

2)

Determine the current in each branch of the circuit shown in figure below.



We name currents I_1, I_2, and I_3 as shown.

From Kirchhoff's current rule, $I_3 = I_1 + I_2$.

Applying Kirchhoff's voltage rule to the loop containing I_2 and I_3,

$$12.0\text{ V} - (4.00)I_3 - (6.00)I_2 - 4.00\text{ V} = 0$$

$$8.00 = (4.00)I_3 + (6.00)I_2$$

Applying Kirchhoff's voltage rule to the loop containing I_1 and I_2,

$$-(6.00)I_2 - 4.00\text{ V} + (8.00)I_1 = 0 \qquad (8.00)I_1 = 4.00 + (6.00)I_2.$$

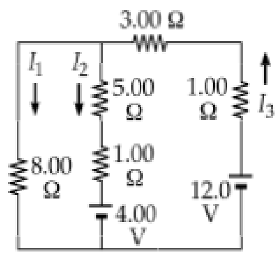


FIG. P28.21

Solving the above linear system, we proceed to the pair of simultaneous equations:

$$\begin{cases} 8 = 4I_1 + 4I_2 + 6I_2 \\ 8I_1 = 4 + 6I_2 \end{cases} \quad \text{or} \quad \begin{cases} 8 = 4I_1 + 10I_2 \\ I_2 = 1.33I_1 - 0.667 \end{cases}$$

and to the single equation $8 = 4I_1 + 13.3I_1 - 6.67$

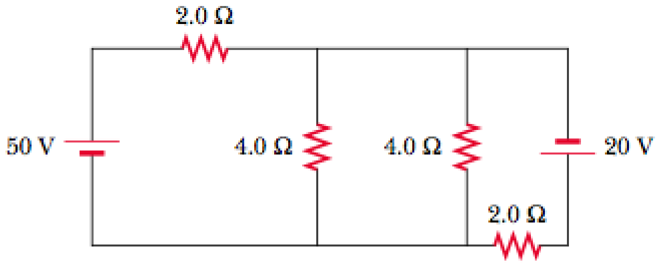
$$I_1 = \frac{14.7\text{ V}}{17.3\,\Omega} = 0.846\text{ A}. \quad \text{Then} \quad I_2 = 1.33(0.846\text{ A}) - 0.667$$

and $I_3 = I_1 + I_2$ give $\boxed{I_1 = 846\text{ mA},\ I_2 = 462\text{ mA},\ I_3 = 1.31\text{ A}}$.

All currents are in the directions indicated by the arrows in the circuit diagram.

3)

Calculate the power delivered to each resistor shown in figure below.



We apply Kirchhoff's rules to the second diagram.

$50.0 - 2.00 I_1 - 2.00 I_2 = 0$ (1)

$20.0 - 2.00 I_3 + 2.00 I_2 = 0$ (2)

$I_1 = I_2 + I_3$ (3)

Substitute (3) into (1), and solve for I_1, I_2, and I_3

$I_1 = 20.0\ \text{A};\ I_2 = 5.00\ \text{A};\ I_3 = 15.0\ \text{A}.$

Then apply $\mathcal{P} = I^2 R$ to each resistor:

$(2.00\ \Omega)_1$: $\mathcal{P} = I_1^2 (2.00\ \Omega) = (20.0\ \text{A})^2 (2.00\ \Omega) = \boxed{800\ \text{W}}$

$(4.00\ \Omega)$: $\mathcal{P} = \left(\frac{5.00}{2}\ \text{A}\right)^2 (4.00\ \Omega) = \boxed{25.0\ \text{W}}$

(Half of I_2 goes through each)

$(2.00\ \Omega)_3$: $\mathcal{P} = I_3^2 (2.00\ \Omega) = (15.0\ \text{A})^2 (2.00\ \Omega) = \boxed{450\ \text{W}}$.

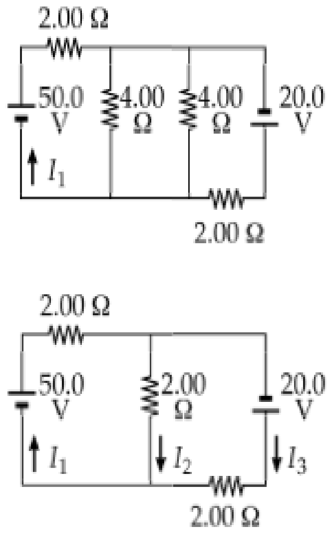
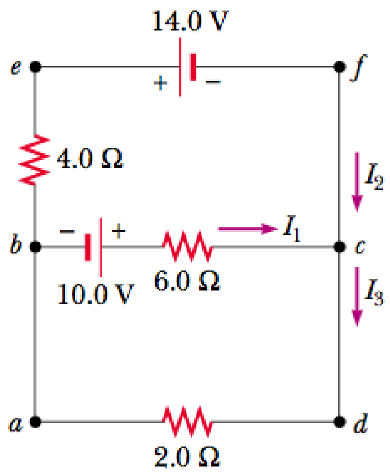


FIG. P28.30

4)
Find the currents I_1, I_2, and I_3 in the circuit shown in figure below.



Answer:

(1) $I_1 + I_2 = I_3$

(2) *abcda* $10.0\text{ V} - (6.0\ \Omega)I_1 - (2.0\ \Omega)I_3 = 0$

(3) *befcb* $-14.0\text{ V} + (6.0\ \Omega)I_1 - 10.0\text{ V} - (4.0\ \Omega)\ I_2 = 0$

$10.0\text{ V} - (6.0\ \Omega)I_1 - (2.0\ \Omega)\ (I_1 + I_2) = 0$

(4) $10.0\text{ V} = (8.0\ \Omega)I_1 + (2.0\ \Omega)I_2$

(5) $-12.0\text{ V} = -(3.0\ \Omega)I_1 + (2.0\ \Omega)I_2$

$22.0\text{ V} = (11.0\ \Omega)I_1$

$I_1 = 2.0\text{ A}$

$$(2.0\ \Omega)I_2 = (3.0\ \Omega)I_1 - 12.0\text{ V}$$
$$= (3.0\ \Omega)(2.0\text{ A}) - 12.0\text{ V} = -6.0\text{ V}$$

$I_2 = -3.0\text{ A}$

$I_3 = I_1 + I_2 = -1.0\text{ A}$