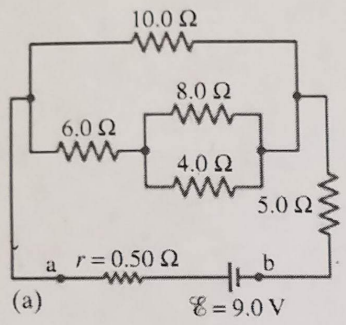
PHYSICS 122 WORKSHEET 5 2/19/2018

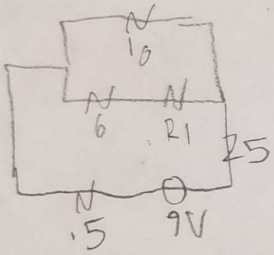
NAME: SECTION:

1.

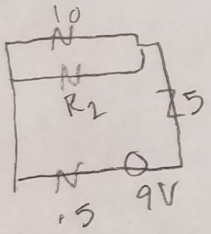


EXAMPLE 19–7 **Analyzing a circuit.** A 9.0-V battery whose internal resistance r is 0.50 Ω is connected in the circuit shown in Fig. 19–10a. (*a*) How much current is drawn from the battery? (*b*) What is the terminal voltage of the battery? (*c*) What is the current in the 6.0-Ω resistor?

APPROACH To find the current out of the battery, we first need to determine the equivalent resistance R_{eq} of the entire circuit, including r, which we do by identifying and isolating simple series or parallel combinations of resistors. Once we find I from Ohm's law, $I = \mathcal{E}/R_{eq}$, we get the terminal voltage using $V_{ab} = \mathcal{E} - Ir$. For (*c*) we apply Ohm's law to the 6.0-Ω resistor.

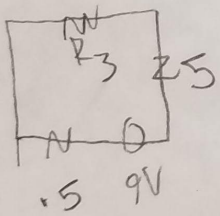


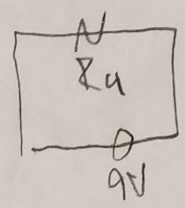
$$R_1 = \left[\frac{1}{8\Omega} + \frac{1}{4\Omega}\right]^{-1} = \left[\frac{3}{8\Omega}\right]^{-1} = 2.7\,\Omega$$



$$R_2 = 6\,\Omega + 2.7\,\Omega = 8.7\,\Omega$$

$$R_3 = \left[\frac{1}{10\Omega} + \frac{1}{8.7\Omega}\right]^{-1} = 4.8\,\Omega$$





$$R_4 = R_3 + 5\,\Omega + .5\,\Omega = 10.3\,\Omega$$

$$I = \frac{9\,V}{10.3\,\Omega} = 0.87\,A \quad (a)$$

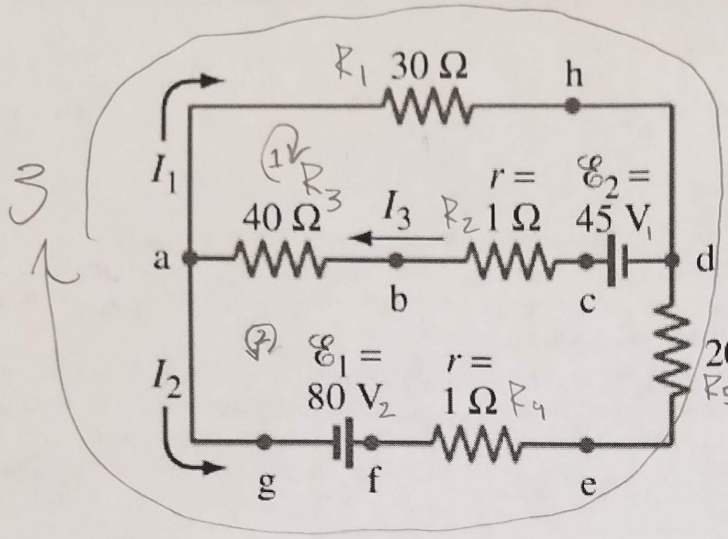
(b) $V_{Term\,ab} = 9\,V - I(0.5\,\Omega) = 8.6\,V$

(c) $I_{6\Omega} = \dfrac{9\,V - (0.87\,A)(0.5\,\Omega + 5\,\Omega)}{8.7\,\Omega}$

$= 0.49\,A$

Ex 19.8

2. Calculate I_1, I_2, I_3.



① $I_3 = I_1 + I_2$

$a \to b: \quad -(30\Omega) I_1 = V_{ba}$

$d \to c: \quad +45V = V_{cd}$

$c \to a: \quad -[(1+40)\Omega] I_3 = V_{ac}$

$\sum_{\text{loop 2}} V_{ij} = V_{ba} + V_{cd} + V_{ac} = 0$

$-30 I_1 + 45 - 41 I_3 = 0$

① $\sum_{l1} V_{ij} = V_{ba} + V_{cd} + V_{ac} = -R_1 I_1 + V_1 - (R_2+R_3) I_3 = 0$

② $\sum_{l2} V_{ij} = V_{ga} + V_{fg} + V_{ef} = 0 + V_2 - R_4 I_2 - R_5 I_2 + V_1 - (R_2+R_3) I_3$

② − ① $= R_1 I_1 - V_1 + V_1 + V_2 - I_2(R_4+R_5) = 0 \to I_2 = \frac{1}{R_4+R_5}[V_2 + R_1 I_1]$

① $I_3 = I_1 + I_2 = I_1 + \frac{1}{R_4+R_5} V_2 + \frac{R_1}{R_4+R_5} I_1 = \left(1 + \frac{R_1}{R_4+R_5}\right) I_1 + \frac{V_2}{R_4+R_5}$

① $= \frac{1}{R_2+R_3}[V_1 - R_1 I_1] = \frac{V_1}{R_2+R_3} - \frac{R_1 I_1}{R_2+R_3} \Rightarrow \frac{\frac{V_1}{R_2+R_3} - \frac{V_2}{R_4+R_5}}{1 + R_1\left(\frac{1}{R_2+R_3} + \frac{1}{R_4+R_5}\right)} = I_1$

③: $-I_1 \cdot R_1 + (R_5+R_4) I_2 - V_2 = 0 \to I_2 = \frac{1}{R_4+R_5}[V_2 + I_1 R_1]$

① : $I_3 = I_1 + I_2$

$V_{cd} = -(48\Omega) I_3 + 45 \to -34.2V$

$V_2 - I_2 R_4 =$