Homework 27.33

In Fig. 27-44, the current in resistance 6 is i_6 = *1.40 A* and the resistances are $R_1 = R_2 = R_3 = 2.00$ Ohms. $R_4 = 16.0$ Ohms, $R_5 = 8.00$ Ohms, and $R_6 = 4.00$ Ohms. What is the emf of the battery?

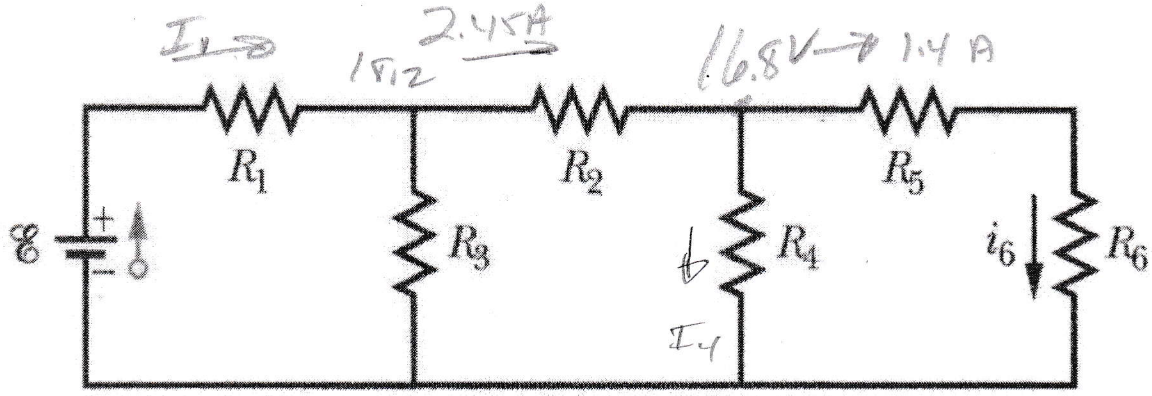


Figure 27.44

$I_4 = \frac{16.8}{16} = 1.05\ A$

$\frac{1.4}{2.45}$

$V_3 = 16.8 + 2 \times 2.45$

$= 18.2\ V$

$I_1 = 2.45 + \frac{18.2}{2}$

$2.45 + 9.1 = 11.55\ A$

$\mathcal{E} = 18.2 + 11.55 * 2$

$= 41.3\ V$

Ans 48.3 V

$V_4 = 1.4 * (8 + 4) = 1.4 * 12 = 16.8V$

$I_4 = \frac{16.8}{16} = 1.05\ A$

$I_2 = 1.05 + 1.4 = 2.45\ A$

$V_3 = 16.8 + 2 \times 2.45 = 21.7$

$I_3 = \frac{V_3}{R_3} = \frac{21.7}{2} = 10.85$

$I_1 = 10.85 + 2.45 = 13.3$

$\mathcal{E} = V_3 + 13.3 \times 2$

$\boxed{\mathcal{E} = 48.3V}$

Homework 27.36

In Fig. 27-47, E_1 = 6.00 V, E_2 = 12.0 V, R_1 = 100 Ohms, R_2 = 200 Ohms, and R_3 = 300 Ohms, One point on the circuit is grounded (V = 0). What are the (a) size and (b) direction (up or down) of the current through resistance 1, the (c) size and (d) direction (left or right) of the current through resistance 2, and the (e) size and (f) direction of the current through restance 3? (g) What is the electric potential at point A?

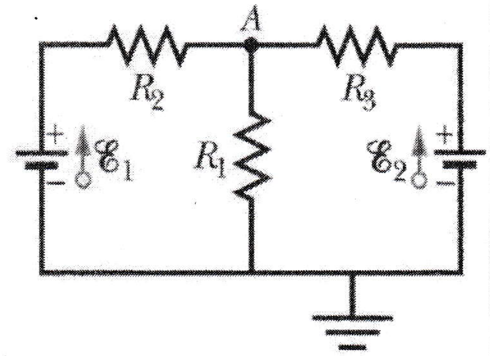
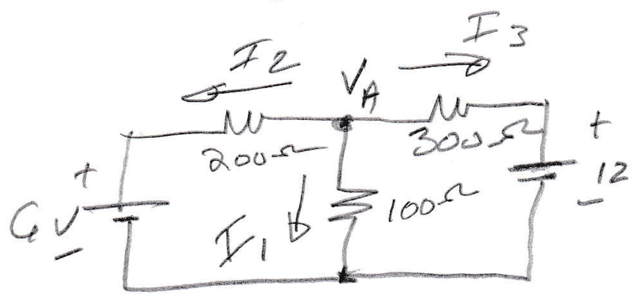


Figure 27-47

answer

Node METHOD



$$I_1 + I_2 + I_3 = 0$$

$$\frac{V_A}{100} + \frac{V_A - 6}{200} + \frac{V_A - 12}{300} = 0$$

$$V_A\left[1 + \frac{1}{2} + \frac{1}{3}\right] = 3 + 4 = 7$$

$$V_A = 3.82V \qquad I_1 = \frac{V_A}{100} = 38.2\text{ mA} \qquad I_2 = \frac{V_A - 6}{200} = -10.9\text{ mA}$$

$$I_3 = \frac{V_A - 12}{300} = 27.3\text{ mA}$$

a) 38.2 mA

b) down

c) 10.9 mA

d) RIGHT

e) 27.3 mA

f) Left

g) 3.82 V

Homework 27.39

In Fig. 27-50, two batteries with an emf, $E = 12.0\ V$ and an internal resistance r = 0.300 Ohms are connected in parallel across a resistance R. (a) For what value of R is the power dissipation rate in the resistor a maximum? (b) What is that maximum?

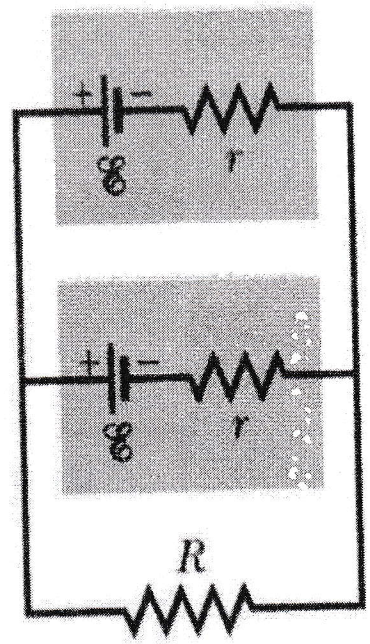
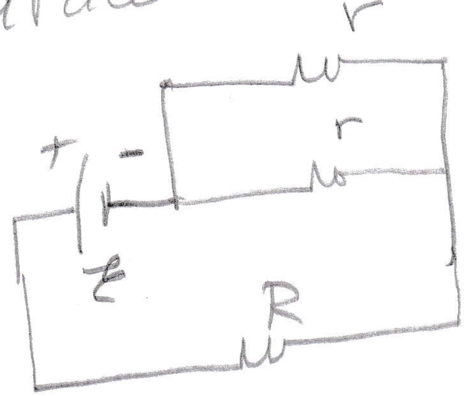
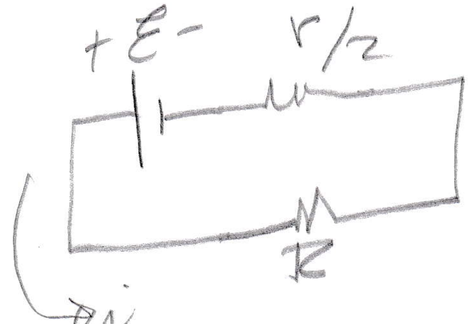


Figure 27-50

Redraw





or

Power is Max when LOAD (R) = internal resistance

$$\boxed{R = \frac{r}{2}}$$

$$i = \frac{\mathcal{E}}{R + \frac{r}{2}}$$

$$p = i^2 R = \frac{\mathcal{E}^2 R}{\left(R + \frac{r}{2}\right)^2}$$

Max P when

$$\frac{d}{dR}\left(\frac{R}{\left(R + \frac{r}{2}\right)^2}\right) = 0$$

$$0 = \frac{1}{\left(R + \frac{r}{2}\right)^2} - \frac{2R}{\left(R + \frac{r}{2}\right)^3}$$

$$1 - \frac{2R}{R + \frac{r}{2}} = 0$$

$$R + \frac{r}{2} - 2R = 0$$

a) $$\boxed{R = \frac{r}{2} = 0.15\ \Omega}$$

b) $$P = i^2 R$$

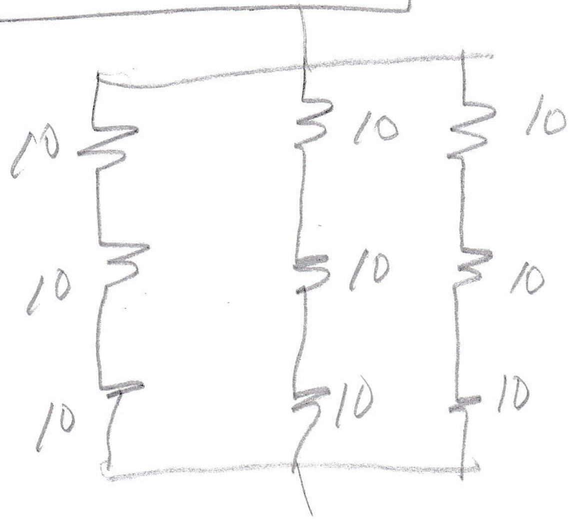
$$= \left(\frac{12}{.3}\right)^2 * 0.15$$

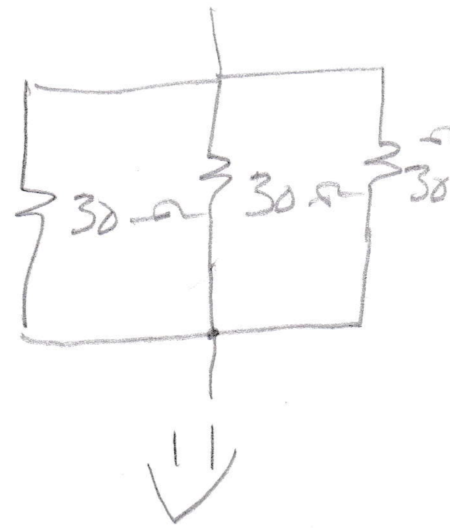
$$P = 240 \text{ Watts}$$

Homework 27.43

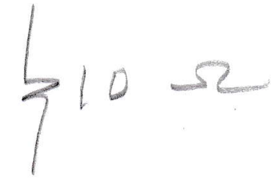
You are given a number of 10 Ohm resistors, each capable of dissipating only 1.0 W without being distroyed. What is the minimum number of such resistors that you need to combine in series or in parallel to make a 10 Ohm resistance capable of dissipating at least 5.0 W?

$\boxed{\text{9 Resistors}}$





$$\frac{1}{30} + \frac{1}{30} + \frac{1}{30} = \frac{1}{10}$$



EACH RESISTOR dissipates the Same power

Max power = 9 Watts > 5.0 watts

Homework 27.55

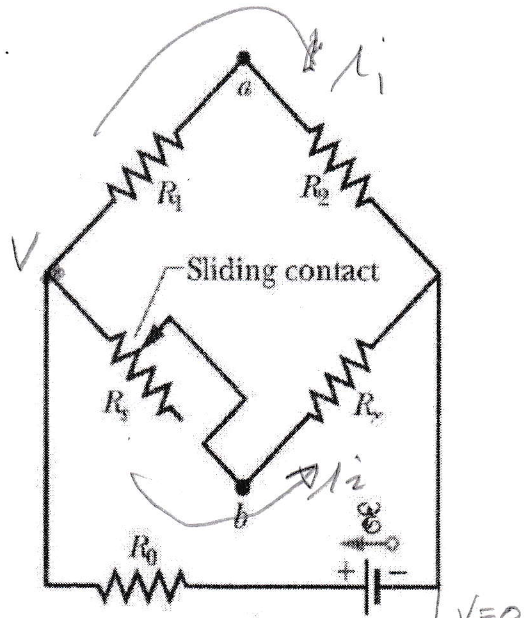


Figure 27-61

In Fig. 27.61, R_s is to be adjusted in value by moving the sliding contact across it until points a and b are brought to the same potential. (One tests for this condition by momentarily connecting a sensitive ammeter between a and b; if these points are at the same potential, the ammeter will not deflect.) Show that when this adjustment is made, the following relation holds: $R_x = R_s R_2 / R_1$. An unknown resistance (R_x) can be measured in terms of a standard (R_s) using this device , which is called a Wheatstone bridge,erms of a standard (R_s)

$$i_1 = \frac{V}{R_1+R_2}$$

$$i_2 = \frac{V}{R_s+R_x}$$

$$V_a = R_2 i_1 = \frac{V R_2}{R_1+R_2}$$

$$V_b = R_x i_2 = \frac{V R_x}{R_s+R_x}$$

$$V_a = V_b$$

$$\frac{\cancel{V} R_2}{R_1+R_2} = \frac{\cancel{V} R_x}{R_s+R_x}$$

$$\frac{R_2}{R_1+R_2} = \frac{R_x}{R_s+R_x}$$

$$R_2 R_s + \cancel{R_2 R_x} = R_x R_1 + \cancel{R_x R_2}$$

$$R_2 R_s = R_x R_1$$

$$\boxed{R_x = \frac{R_2}{R_1} R_s}$$