EECS2200 Electric Circuits

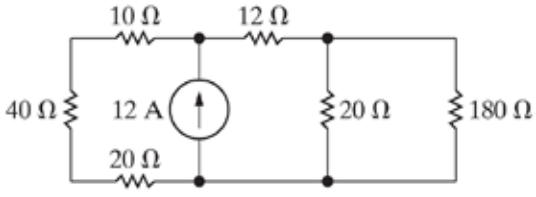
Chapter 3

Activities

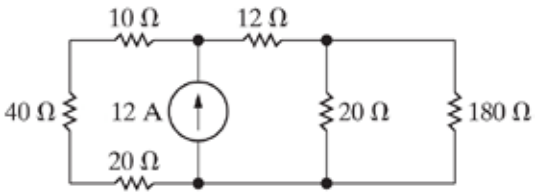
Activity 1

(1) Which of the resistors in the circuit below are connected in series?

(2) Find the equivalent resistance of the series-connected resistors.



Solution



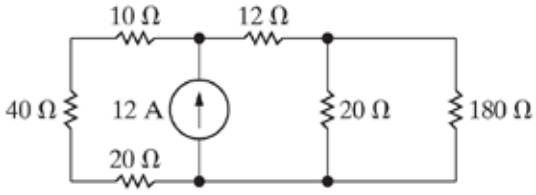
(1) 10 Ω and 40 Ω and 20 Ω.

(2) $R_{eq} = 10\Omega + 40\Omega + 20\Omega = 70\Omega$

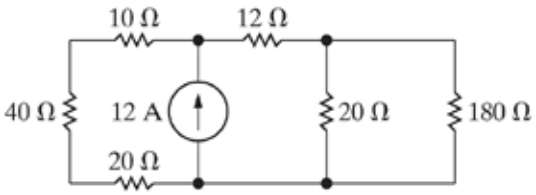
Activity 2

(1) Which of the resistors in the circuit below are connected in parallel?

(2) Find the equivalent resistance of the parallel-connected resistors.



Solution

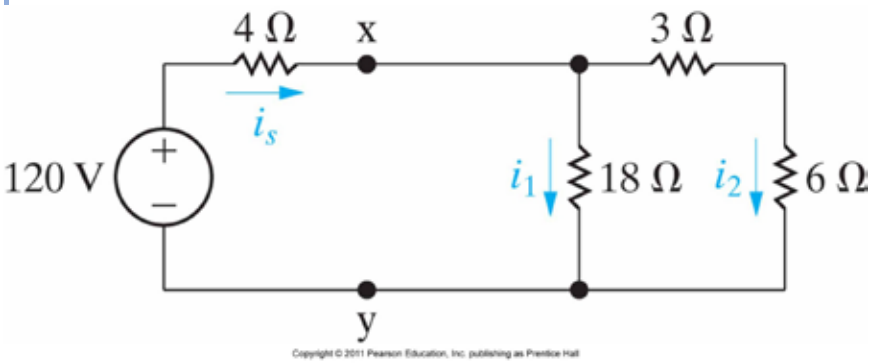


(1) 20 Ω and 180 Ω.

(2) $$\frac{1}{R_{eq}} = \frac{1}{20} + \frac{1}{180} = \frac{10}{180} = \frac{1}{18} \Rightarrow R_{eq} = 18\Omega$$

Activity 3

Find i_s, i_1, *and* i_2

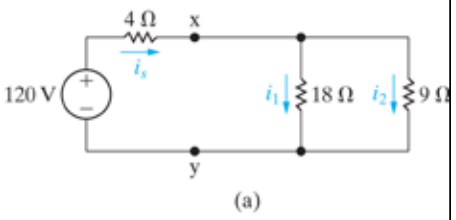


Solution

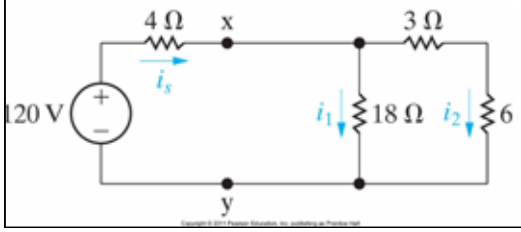
1. 3Ω and 6Ω are in series, R_{eq1}=9Ω.
2. R_{eq2} and 18Ω are in parallel,

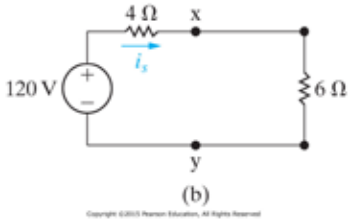
$$\frac{1}{R_{eq2}} = \frac{1}{9} + \frac{1}{18} = \frac{3}{18} = \frac{1}{6}$$

$$\therefore R_{eq2} = 6\Omega$$



(a)





(b)

Solution

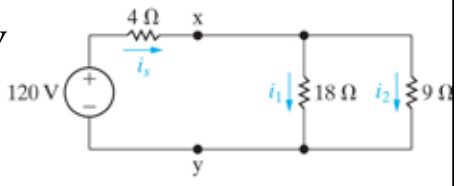
3.

$$i_s = \frac{120V}{4\Omega + 6\Omega} = 12A$$

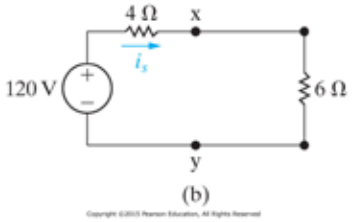
$$v_{xy} = i_s 6\Omega = 12 * 6 = 72V$$

$$i_1 = \frac{72V}{18\Omega} = 4A$$

$$i_2 = \frac{72V}{9\Omega} = 8A$$



(a)



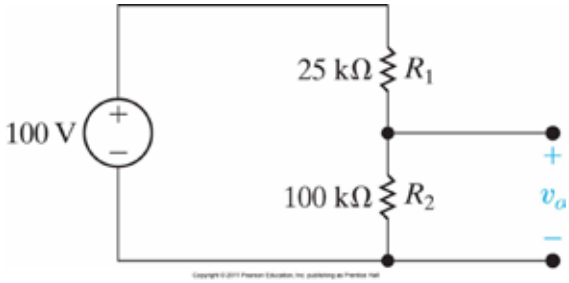
(b)

Activity 4

Find v_0

(1) if the load is 10Ω

(2) If the load is 10 M Ω



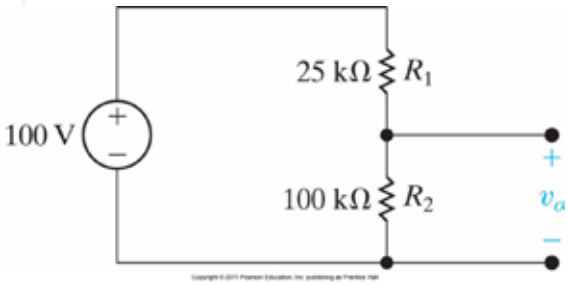
Solution

v_o without load

$$\because R_1 = 25k\Omega, R_2 = 100k\Omega, v_s = 100V$$

$$\therefore v_o = \frac{R_2}{R_1 + R_2} v_s = \frac{100k}{25k + 100k} 100$$

$$v_o = \frac{100k \times 100}{25k + 100k} = \frac{10000}{125} = 80V$$

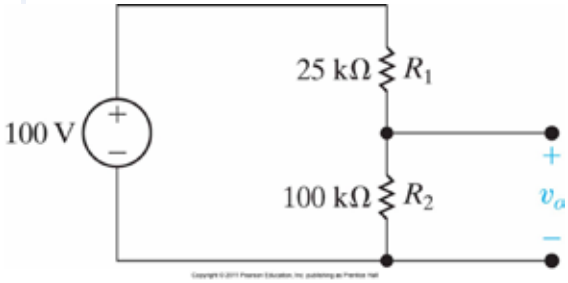


Solution

(1) $\because R_1 = 25k\Omega, R_2 = 100k\Omega, R_L = 10\Omega, v_s = 100V$

$$\therefore v_o = \frac{R_2}{R_1(1+R_2/R_L)+R_2} v_s = \frac{100k}{25k(1+100k/10)+100k} 100$$

$$v_o = \frac{100k \times 100}{25k \times 10k + 100k} = \frac{10000}{350} = 28.57V$$

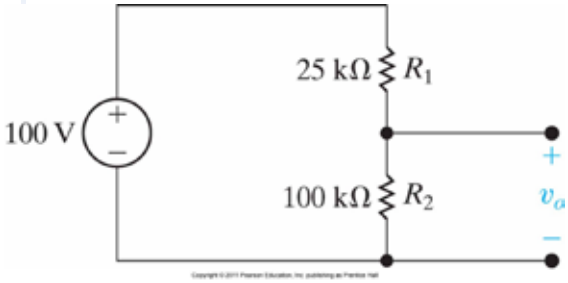


Solution

(2) $\because R_1 = 25k\Omega, R_2 = 100k\Omega, R_L = 10M\Omega, v_s = 100V$

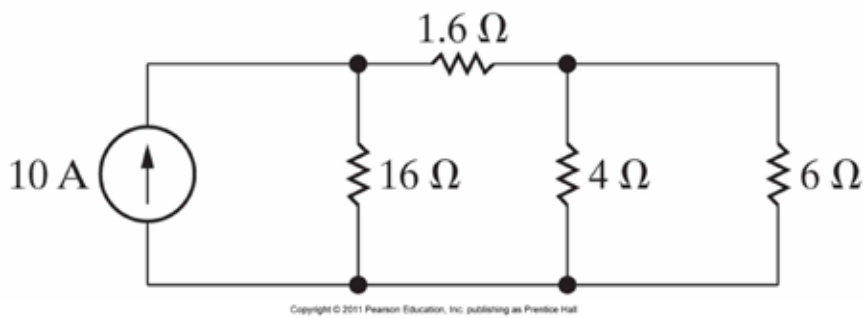
$$\therefore v_o = \frac{R_2}{R_1(1+R_2/R_L)+R_2} v_s = \frac{100k}{25k(1+100k/10M)+100k} 100$$

$$v_o = \frac{100k \times 100}{25k + 100k} = \frac{10000}{125} = 80V$$



Activity 5

Find the power dissipated in the 6 Ω resistor.



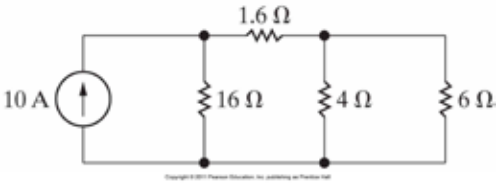
Solution

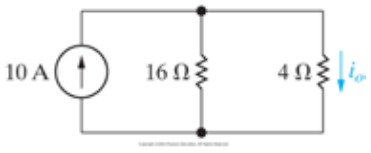
Find the power dissipated in the 6 Ω resistor.

$$R_{eq} = 4\Omega // 6\Omega = \frac{4\times 6}{4+6} = 2.4\Omega, i_0 = \frac{16\Omega}{16\Omega + 4\Omega} 10A = 8A$$

$$i_6 = \frac{4\Omega}{4\Omega + 6\Omega} 8A = 3.2A$$

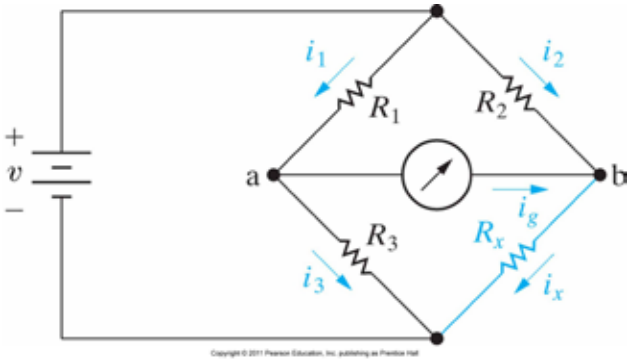
$$p_6 = i_6^2 R_6 3.2^2 \times 6 = 61.44W$$





Activity 6

Find Rx in a balanced Wheatstone bridge (i_g = 0). Assume R_1, R_2, and R_3 are known.



Solution

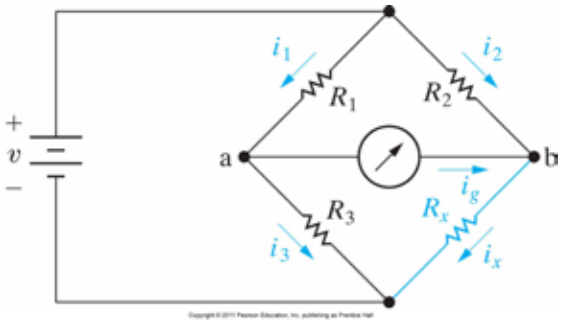
$\because i_g = 0 \Rightarrow v_{ab} = 0$

$KCL: i_1 = i_3, i_2 = i_x$

$KVL: i_3 R_3 = i_x R_x, i_1 R_1 = i_2 R_2$

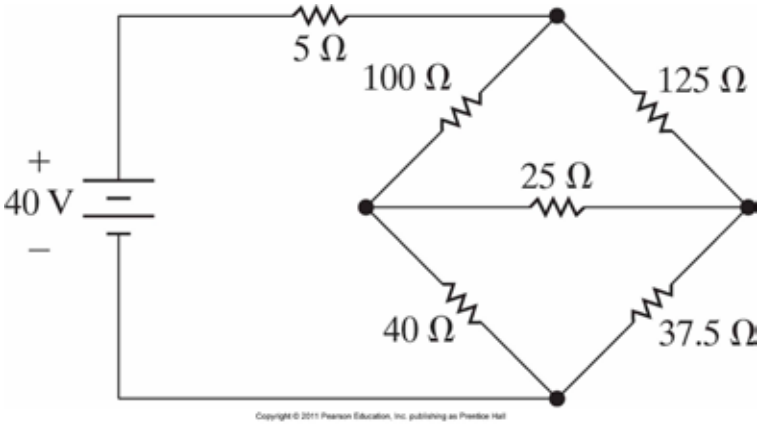
$\Rightarrow i_1 R_3 = i_2 R_x = \dfrac{R_1}{R_2} i_1 R_x$

$\therefore R_x = \dfrac{R_2}{R_1} R_3$



Activity 7

Find the current and power supplied by the 40V source .



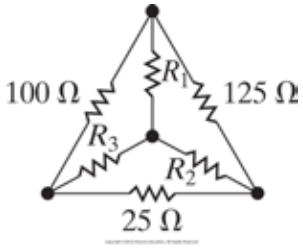
Solution

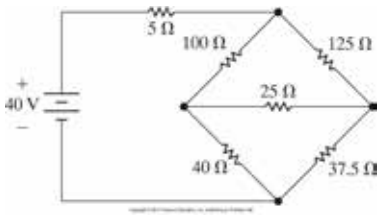
1. Replace upper Δ with a Y equivalent.
2. Find R_1, R_2, and R_3

$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c} = \frac{100 \times 125}{250} = 50\Omega,$$

$$R_2 = \frac{R_c R_a}{R_a + R_b + R_c} = \frac{125 \times 25}{250} = 12.5\Omega,$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c} = \frac{100 \times 25}{250} = 10\Omega$$





Solution

3. Put Y into the circuit, and find the R_{eq}

$$R_{eq} = 5\Omega + 50\Omega + (10\Omega + 40\Omega) // (12.5\Omega + 37.5\Omega)$$

$$= 55\Omega + 50\Omega // 50\Omega = 55\Omega + 25\Omega = 80\Omega$$

$$\therefore i = \frac{40V}{80\Omega} = 0.5A$$

$$p = vi = 40V \times 0.5A = 20W$$