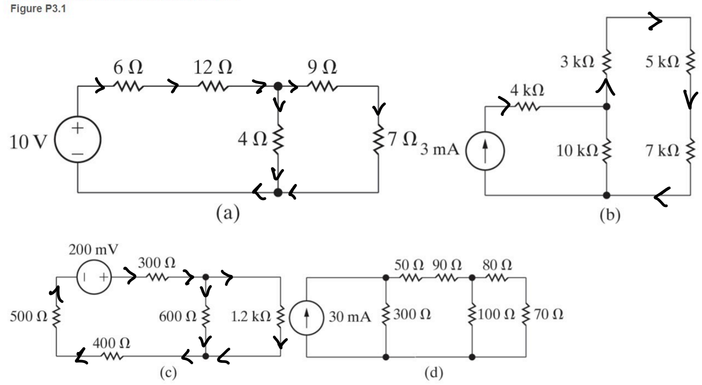
3.1 For each of the circuits shown in Fig. P 3.1,

Figure P3.1



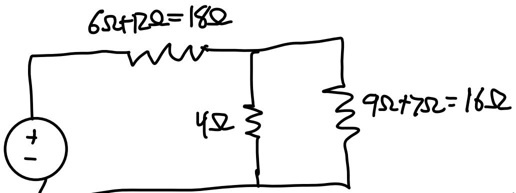
a) identify the resistors connected in series,
b) simplify the circuit by replacing the series-connected resistors with equivalent resistors.

Circuit(a)

a) resistors in series

$\boxed{6\Omega, 12\Omega \quad 9\Omega, 7\Omega}$

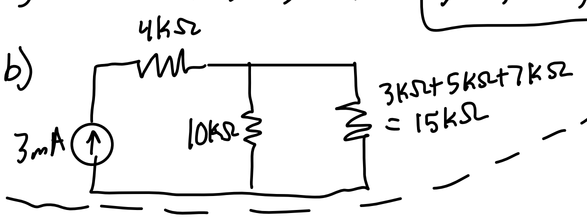
b)



Circuit(b)

a) The resitors in series are $\boxed{3k\Omega, 5k\Omega, 7k\Omega}$

b)

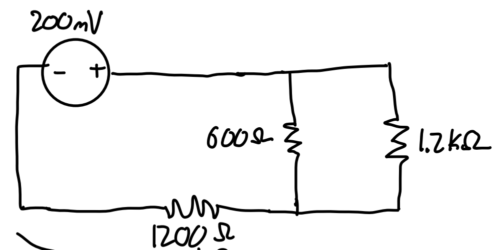


Circuit(c)

a) the resistors in series are:

$\boxed{300\Omega, 400\Omega, 500\Omega}$

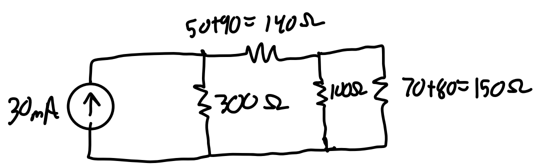
b)



Circuit(d): a) Resistors in parallel are:

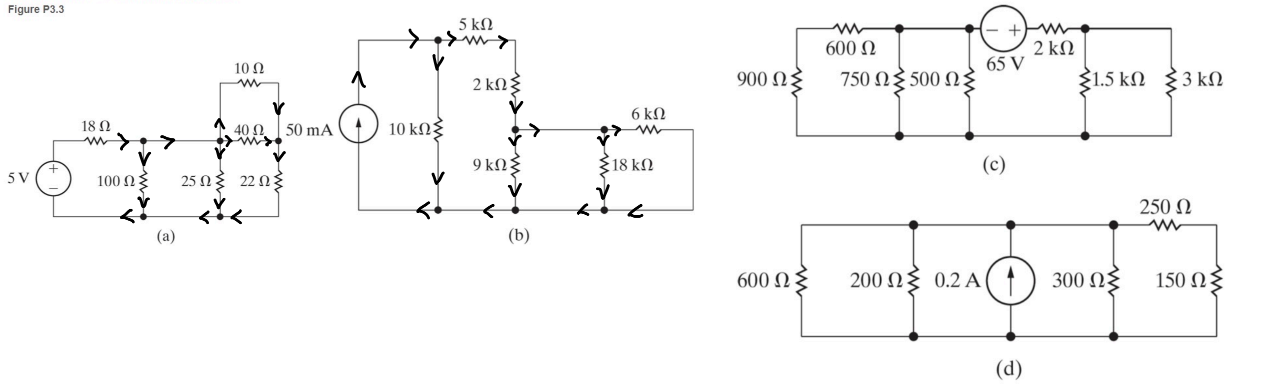
$\boxed{50\Omega, 90\Omega \quad 80\Omega, 70\Omega}$

b)



3.3 For each of the circuits shown in Fig. P 3.3,

Figure P3.3



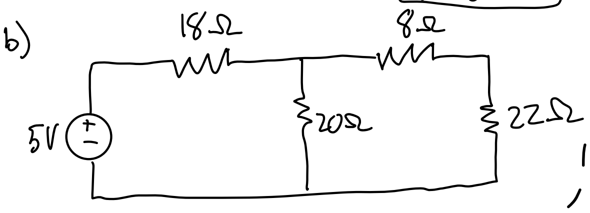
a) identify the resistors connected in parallel,
b) simplify the circuit by replacing the parallel-connected resistors with equivalent resistors.

$$R = \frac{R_1 R_2}{R_1 + R_2}, \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

3.3 cont

circuit (a) a) resistors in parallel: $\boxed{100\Omega, 25\Omega, 40\Omega, 10\Omega}$

b)



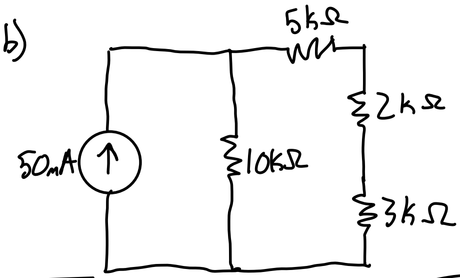
$R = \frac{2500}{125} = 20\Omega$

$R = \frac{400}{50} = 8\Omega$

Circuit (b) a) the parallel resistors are:

$\boxed{9k\Omega, 18k\Omega, 6k\Omega}$

b)



$\frac{1}{R} = \frac{1}{9} + \frac{1}{18} + \frac{1}{6}$

$\frac{1}{R} = \frac{2}{18} + \frac{1}{18} + \frac{3}{18} = \frac{1}{3}$

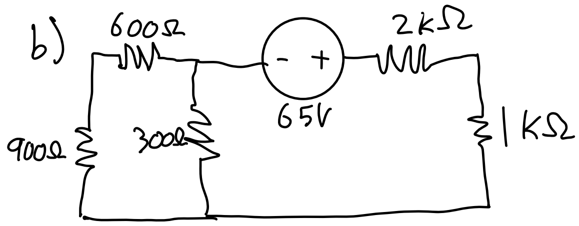
$R = 3$

Circuit (C) a) resistors in parallel

$R = \frac{(1.5)(3)}{4.5} = 1k\Omega$ $\boxed{1.5k\Omega, 3k\Omega, 500\Omega, 75\Omega}$

$R = 300\Omega$

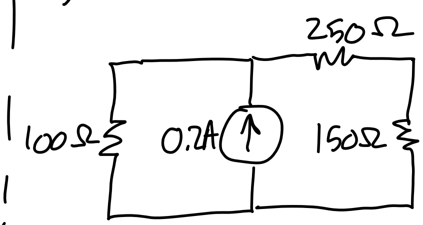
b)



Circuit (d) a) Resistors in parallel are:

$\boxed{200\Omega, 600\Omega, 300}$

b)



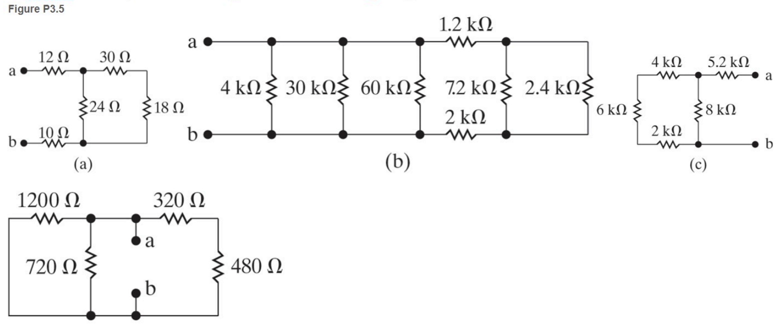
$\frac{1}{R} = \frac{1}{200} + \frac{1}{600} + \frac{1}{300}$

$\frac{1}{R} = \frac{1}{100}$

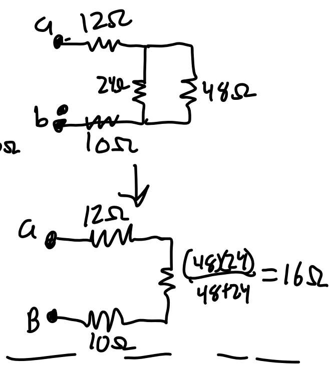
$R = 100\Omega$

3.5 PSPICE MULTISIM Find the equivalent resistance R_{ab} for each of the circuits in Fig. P 3.5.

Figure P3.5



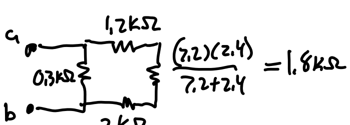
circuit (a)



$R_{ab} = 12\Omega + 16\Omega + 10\Omega$

$\boxed{R_{ab} = 38\Omega}$

Circuit b



$\frac{(7.2)(2.4)}{7.2+2.4} = 1.8k\Omega$

$\frac{1}{R} = \frac{1}{4} + \frac{1}{30} + \frac{1}{60}$

$\frac{1}{R} = \frac{15}{60} + \frac{2}{60} + \frac{1}{60}$

$R = 0.3\ k\Omega$

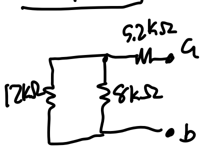
$\boxed{R_{ab} = 2k\Omega}$

$\frac{1}{R_{ab}} = \frac{1}{4} + \frac{1}{30} + \frac{1}{60} + \frac{1}{5}$

$\frac{1}{R_{ab}} = \frac{15}{60} + \frac{2}{60} + \frac{1}{60} + \frac{12}{60}$

$\frac{1}{R_{ab}} = \frac{1}{2}$

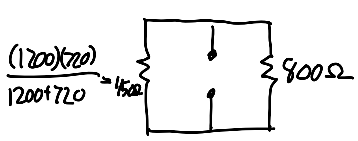
circuit (C)



$R_{ab} = \frac{(12)(8)}{20} + 5.2$

$\boxed{R_{ab} = 10k\Omega}$

Circuit d



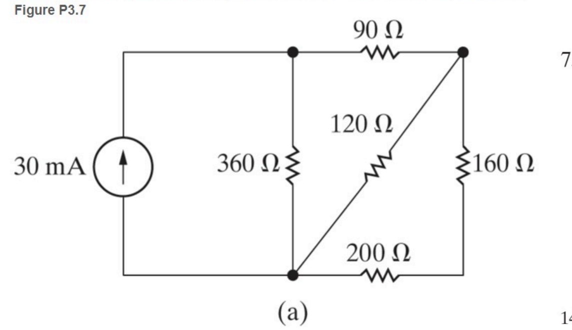
$R_{ab} = \frac{(450)(800)}{450+800}$

$\boxed{R_{ab} = 288\Omega}$

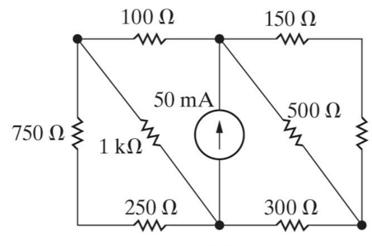
3.7 PSPICE MULTISIM

a) In the circuits in Fig. P 3.7 (a)–(d), find the equivalent resistance seen by the source.

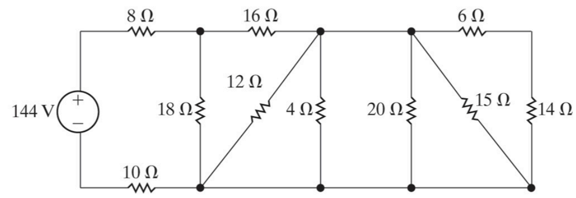
Figure P3.7



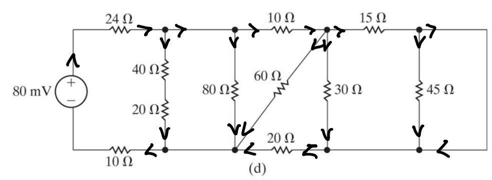
(a)



(b)



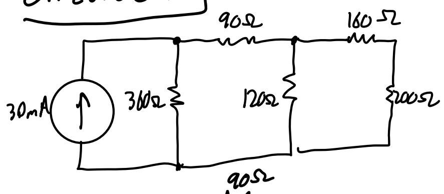
(c)

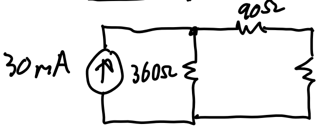


(d)

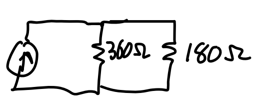
b) For each circuit find the power delivered by the source.

Circuit (a)





$\frac{(120)(160+200)}{120+160+200} = 90\Omega$

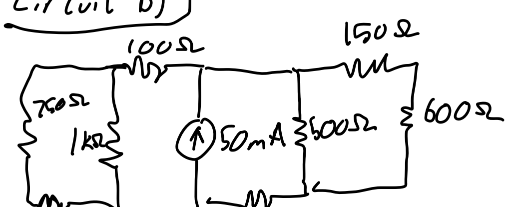


$R = \frac{(360)(180)}{360+180} \Rightarrow \boxed{R = 120\Omega}$ a)

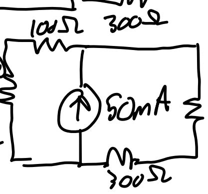
b) $P = I^2R \Rightarrow P = (30mA)^2\, 120\Omega$

$\boxed{P = 108\,mW}$

Circuit B)



$\frac{(1000)(250+750)}{1000+750+250} = 500\Omega$



$\frac{500(150+600)}{500+150+600} = 300\Omega$

$R = \frac{(300+300)(500+100)}{300+300+500+100}$

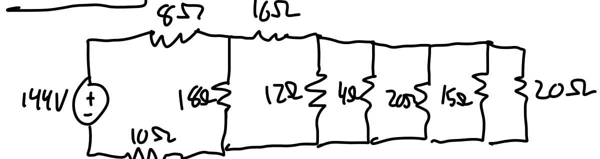
$\boxed{R = 300\Omega}$

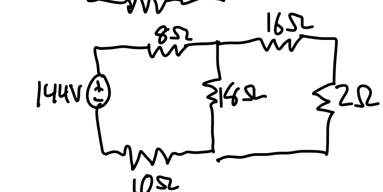
$P = I^2R$

$P = (50mA)^2(300\Omega)$

$\boxed{P = 750\,mW}$

Circuit c

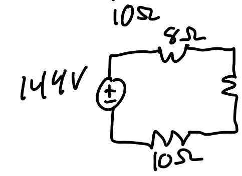




$\frac{1}{R} = \frac{1}{12}+\frac{1}{4}+\frac{1}{20}+\frac{1}{15}+\frac{1}{20}$

$\frac{1}{R} = \frac{5}{60}+\frac{15}{60}+\frac{3}{60}+\frac{4}{60}+\frac{3}{60}$

$\frac{1}{R} = \frac{1}{2}$



$\frac{(18)(18)}{36} \to 9\Omega$

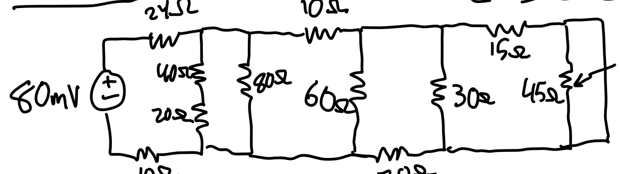
$R = 8+9+10$

$\boxed{R = 27\Omega}$

$P = \frac{V^2}{R} = \frac{144^2}{27}$

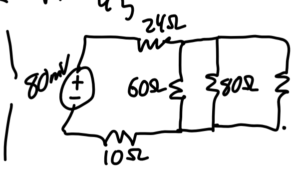
$\boxed{P = 768\,W}$

Circuit (d)

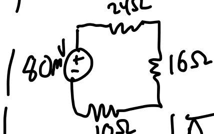


short so $30\Omega \parallel 15\Omega$

$R = \frac{(30)(15)}{45} = 10\Omega$ $\quad R = \frac{(30)(60)}{90} = 20\Omega$



$\frac{1}{R} = \frac{1}{60}+\frac{1}{80}+\frac{1}{30} = \frac{1}{16}$



$\boxed{R = 50\Omega}$

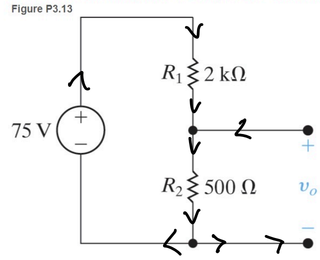
$P = \frac{V^2}{R} = \frac{(80mV)^2}{50\Omega}$

$\boxed{P = 128\,\mu W}$

3.13 DESIGN PROBLEM PSPICE MULTISIM

a) Calculate the no-load voltage v_0 for the voltage-divider circuit shown in Fig. P 3.13.

Figure P3.13



b) Calculate the power dissipated in R_1 and R_2.

c) Assume that only 1 W resistors are available. The no-load voltage is to be the same as in (a). Specify the smallest ohmic values of R_1 and R_2.

a) $V_o = \frac{500}{500+2000}(75) = 15V$

$\boxed{V_o = 15V}$

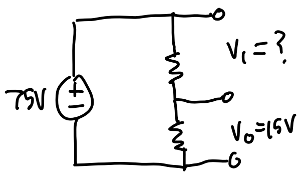
b) $P_1 = I^2R_1 \quad P_2 = I^2R_2$

$R_{eq} = 2500\Omega \quad V = 75V$

$I = \frac{70}{2500} = 30mA$

$\boxed{\begin{array}{l} P_1 = (30mA)^2(2000) = 1.8W \\ P_2 = (30mA)^2(500) = 0.45W \end{array}}$

c)



$i_{R_1} = \frac{V_1}{R_1} = \frac{60}{R_1}$

$\left(\frac{60}{R_1}\right)^2 R_1 \leq 1W$

$\left(\frac{3600}{R_1^2}\right) R_1 \leq 1W$

$\boxed{R_1 \geq 3600\Omega}$

So smalles value is:

$\boxed{R_1 = 3600\Omega}$

$75 = (3600)(I) + R_2(I)$

$75 = (3600 + R_2)I$

$I = \frac{75}{3600+R_2}$ -①

$I = \frac{75-15}{R} = \frac{60}{3600} = \frac{1}{60}A$ -②

equat ①+2

$\frac{75}{3600+R_2} = \frac{1}{60}$

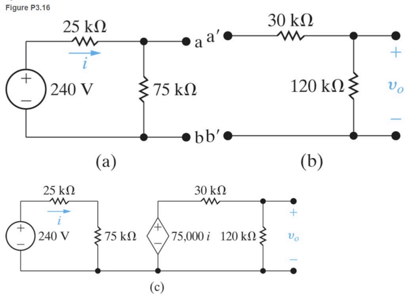
$3600 + R_2 = 75 \times 60$

$\boxed{R_2 = 900\Omega}$

3.16 PSPICE MULTISIM

a) The voltage divider in Fig. P3.16(a) is loaded with the voltage divider shown in Fig. P3.16(b); that is, a is connected to a', and b is connected to b'. Find v_o.

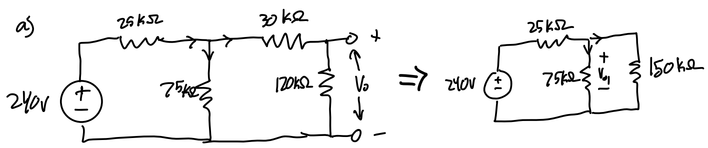
Figure P3.16



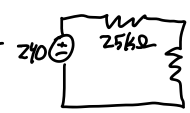
b) Now assume the voltage divider in Fig. P3.16(b) is connected to the voltage divider in Fig. P3.16(a) by means of a current-controlled voltage source as shown in Fig. P3.16(c). Find v_o.

c) What effect does adding the dependent-voltage source have on the operation of the voltage divider that is connected to the 240 V source?

a)



$R = \frac{(150k\Omega)(75k\Omega)}{150k\Omega + 75k\Omega} = 50k\Omega$



$V_{o1} = 240 \times \frac{50k\Omega}{50k\Omega + 25k\Omega}$

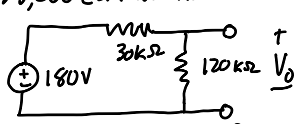
$V_{o1} = 80 \times 2 = 160V$

$V_o = 160 \times \frac{120k\Omega}{150k\Omega} = 32 \times 4$

$\boxed{V_o = 128V}$

b) $i = \frac{240V}{100k\Omega} = 2.4mA$

$75{,}000(2.4 \times 10^{-3}A) = 180V$



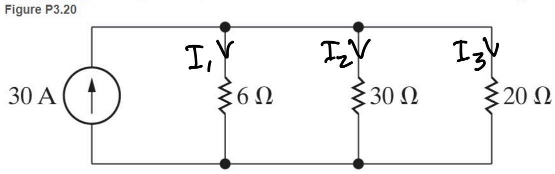
$V_o = 180V \times \frac{120k\Omega}{(120+30)k\Omega}$

$\boxed{V_o = 144V}$

c) adding the dependent voltage source removes some of the load on the 75,000i voltage voltage divider, i.e. it would have the same voltage as in the left side of the circuit

3.20 PSPICE MULTISIM Find the power dissipated in the 30 Ω resistor in the current-divider circuit in **Fig. P3.20**.

Figure P3.20



$$R_{eq} = \frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{30} + \frac{1}{20}$$

$$\frac{1}{R_{eq}} = \frac{1}{4} \Rightarrow R_{eq} = 4$$

$$I_2 = \left(\frac{R_{eq}}{30\Omega}\right) \times 30A = \frac{4}{30} \times 30 = 4A$$

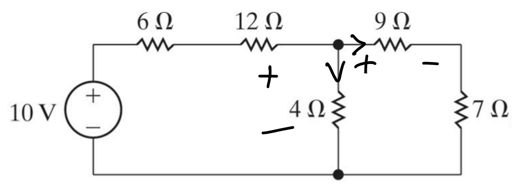
$$P_2 = (I_2)^2 R_2 = (4A)^2 \times 30\Omega$$

$$\boxed{P_2 = 480\,W}$$

3.23 Look at the circuit in **Fig. P3.1**(a).

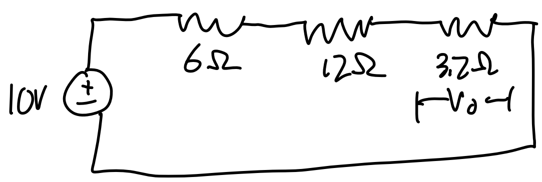
a) Use voltage division to find the voltage across the 4 Ω resistor, positive at the top.

b) Use the result from part (a) and voltage division to find the voltage across the 9 Ω resistor, positive on the left.



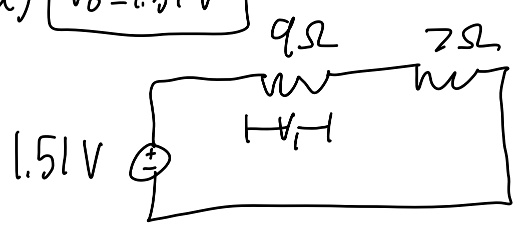
(a)

$$R = \frac{4\,(9+7)}{4+9+7} = 3.2\Omega$$



$$V_o = 10V\left[\frac{3.2}{3.2+6+12}\right]$$

a) $\boxed{V_o = 1.51\,V}$



$$V_1 = 1.51V\left[\frac{9}{9+7}\right]$$

b) $\boxed{V_1 = 0.85\,V}$