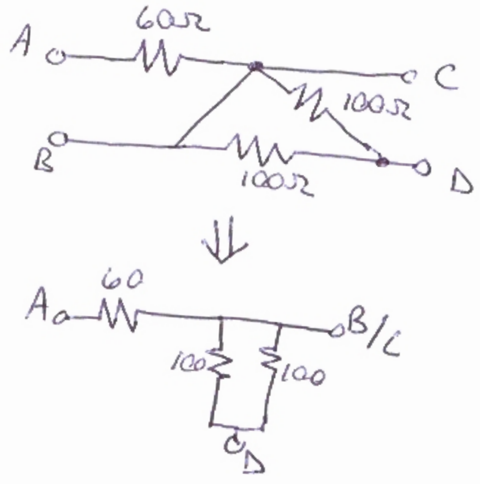
ENGR 210 Spring 05 HW #3 Solutions.

2-30



$$\boxed{R_{AB} = 60\Omega}$$

$$\boxed{R_{BC} = 0} \leftarrow \text{(B and C shorted together)}$$

$$\boxed{R_{AC} = 60\Omega}$$

$$R_{CD} = R_{BD} = 100 \,//\, 100 = \frac{100 \times 100}{100 + 100}$$

$$\boxed{R_{CD} = R_{BD} = 50\Omega}$$

$$R_{AD} = 60 + 100 \,//\, 100$$

$$\boxed{R_{AD} = 110\Omega}$$

2-34

$R_s = ?$

For "ideal" current source $R_s = \infty$
↳ open circuit

Real current sources have a finite resistance in parallel

$$V = I R_{EQ} \qquad R_{EQ} = R_s \,//\, 2k\Omega = \frac{1}{\frac{1}{R_s} + \frac{1}{2k}} = \frac{R_s (2k)}{R_s + 2k}$$

$$\frac{V}{I} = R_{EQ} = \frac{5V}{5mA} = 1000 = \frac{R_s (2000)}{R_s + 2000}$$

$$1000 R_s + 2 \times 10^6 = 2000 R_s$$

$$R_s = \frac{2 \times 10^6}{1000}$$

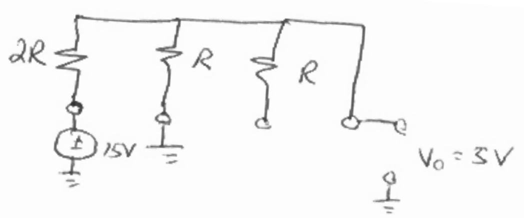
$$\boxed{R_s = 2k\Omega}$$

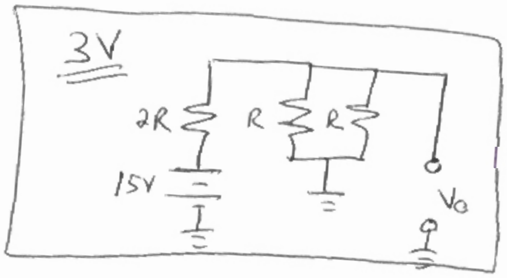
Normal "real" current sources have much bigger resistances ($> 1M\Omega$)

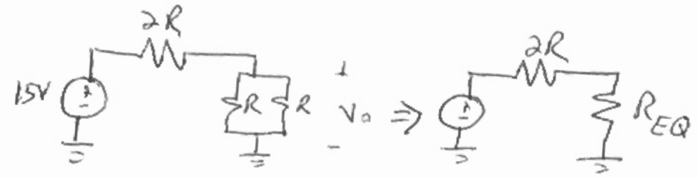
2-48

$V_s = 15V$

$V_o = 3V, 6V, 9V, 12V$



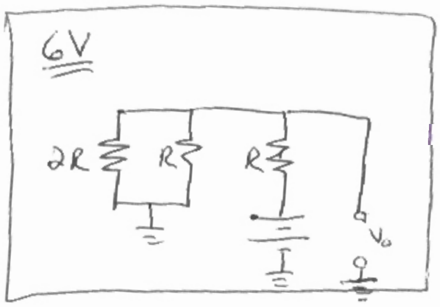


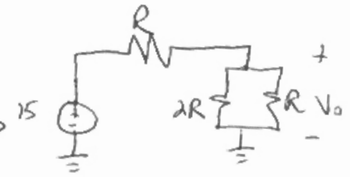


$R_{EQ_1} = R \parallel R = \frac{R \times R}{R+R}$

$= \frac{R}{2}$

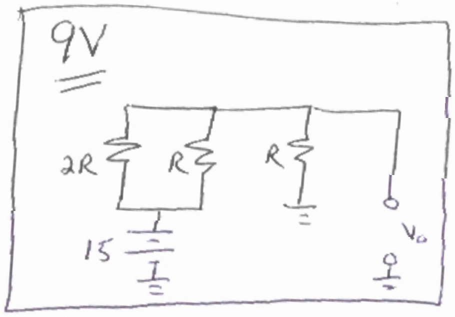
Voltage Divider $V_o = \frac{\frac{R}{2}(15)}{2R + \frac{R}{2}} = 3V$

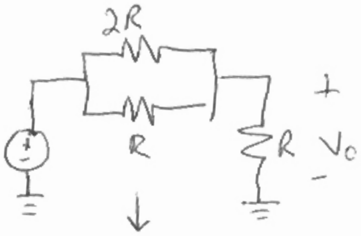




$R_{EQ_2} = \frac{R(2R)}{R+2R} = \frac{2}{3}R$

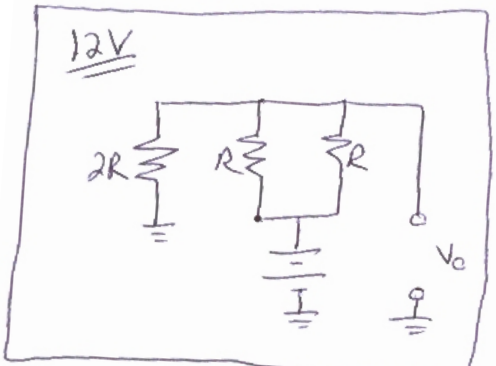
$V_o = \frac{\frac{2}{3}R \ (15V)}{\frac{2}{3}R + R} = 6V$

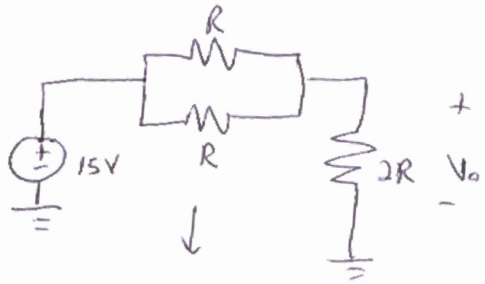




Same as $R_{EQ_2} = \frac{2}{3}R$

$V_o = \frac{R \ (15V)}{R + \frac{2}{3}R} = 9V$





Same as $R_{EQ_1} = \frac{R}{2}$

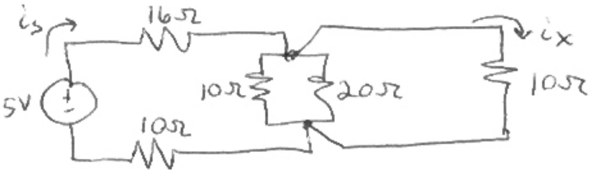
$V_o = \frac{2R(15V)}{2R + \frac{R}{2}} = 12V$

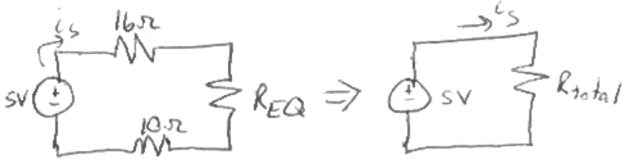
2-52

$i_s = ?$

$i_x = ?$

$$R_{EQ} = \frac{1}{\frac{1}{10} + \frac{1}{20} + \frac{1}{10}} = 4\Omega$$





$$R_{total} = 16 + 4 + 10 = 30\Omega$$

$$V_s = i_s R_{total}$$

$$i_s = \frac{5V}{30\Omega} = \frac{1}{6} A$$

$$\boxed{i_s = \frac{1}{6} A \text{ or } 0.167 A}$$

Current Divider (using original ckt)

$$i_x = \frac{G_x}{G_1 + G_2 + G_3} i_s$$

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

$$i_x = \frac{\frac{1}{10}}{\frac{1}{10} + \frac{1}{20} + \frac{1}{10}} i_s$$

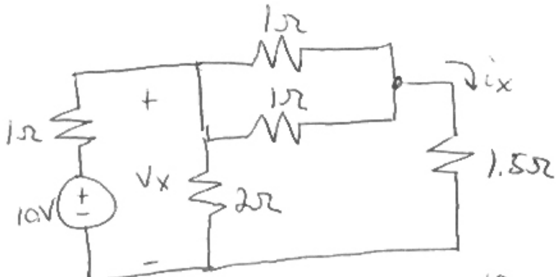
$$\boxed{i_x = \frac{2}{30} A \text{ or } 0.067 A}$$

2-53

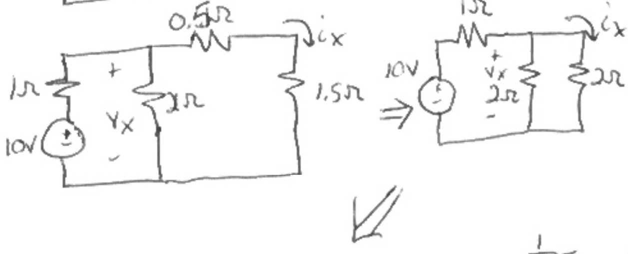
$V_x = ?$

$i_x = ?$

$$1\Omega \parallel 1\Omega = \frac{(1\Omega)(1\Omega)}{1\Omega + 1\Omega} = \frac{1}{2}\Omega = 0.5\Omega$$

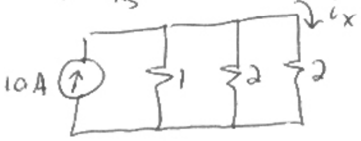


$$0.5\Omega + 1.5\Omega = 2\Omega$$



Source Transformation

$$i_s = \frac{V_s}{R_s} = \frac{10V}{1\Omega} = 10A$$



$$i_x = \frac{\frac{1}{2}}{\frac{1}{2} + \frac{1}{2} + \frac{1}{1}} (10) = \frac{10}{4} = \boxed{2.5A}$$

$$2 \parallel 2 = \frac{1}{\frac{1}{2} + \frac{1}{2}} = 1\Omega$$

$$V_x = \frac{1\,(10V)}{1+1} = \frac{10}{2}$$

$$\boxed{V_x = 5V}$$