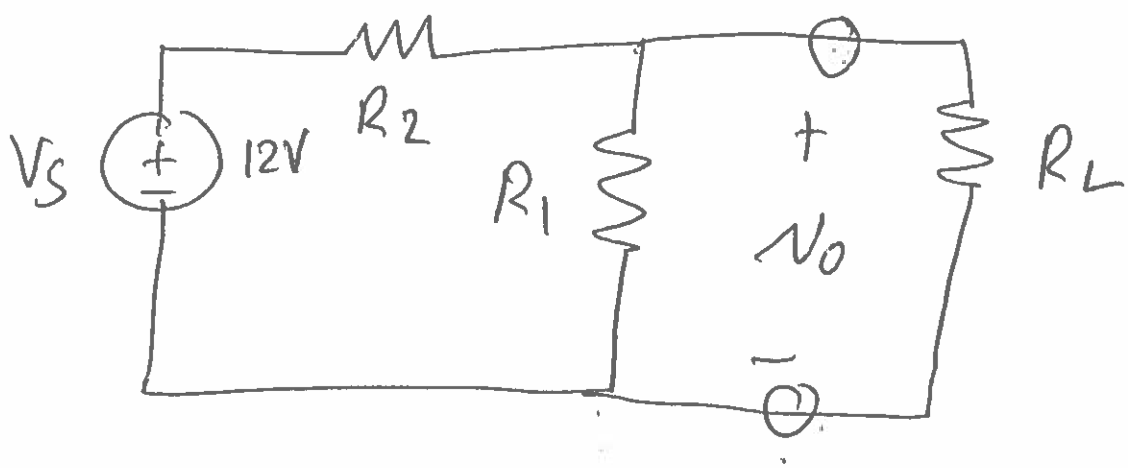
DP 3-2.



$R_L = 200\Omega \pm 5\% \Rightarrow 190\Omega \leq R_L \leq 210\Omega$

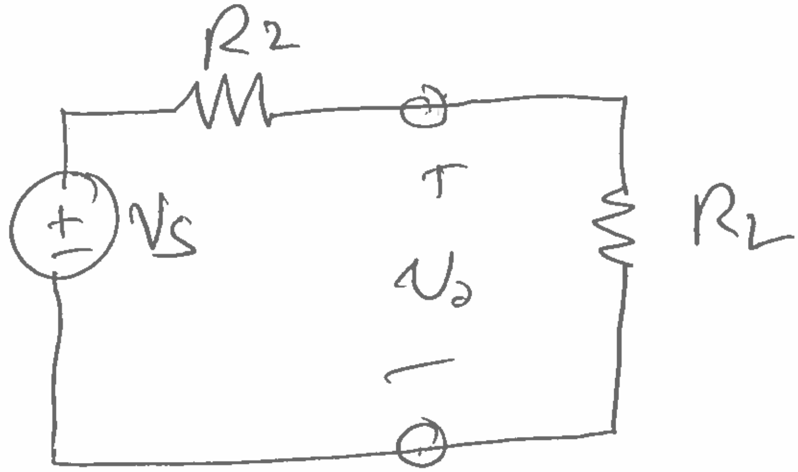
$V_s = 12V \pm 1\%$ Provide 5W

Design circuit using 5% $\frac{1}{8}$W resistors R_1 and R_2 so that $V_o = 4V \pm 10\%$

5% $\frac{1}{8}$W 100Ω would have resistance between 95Ω and 105Ω and can safely dissipate $\frac{1}{8}$W $= 0.125$W

Let's simplify by making $R_1 = \infty$

Open circuit Use No R_1



R_2 Should be 400Ω

Then $V_O = \dfrac{V_S R_L}{R_2 + R_L}$

$$V_O = \frac{(12V)(200\Omega)}{400\Omega + 200\Omega} = \frac{200\Omega}{600\Omega}(12V)$$

$$= 4V \checkmark$$

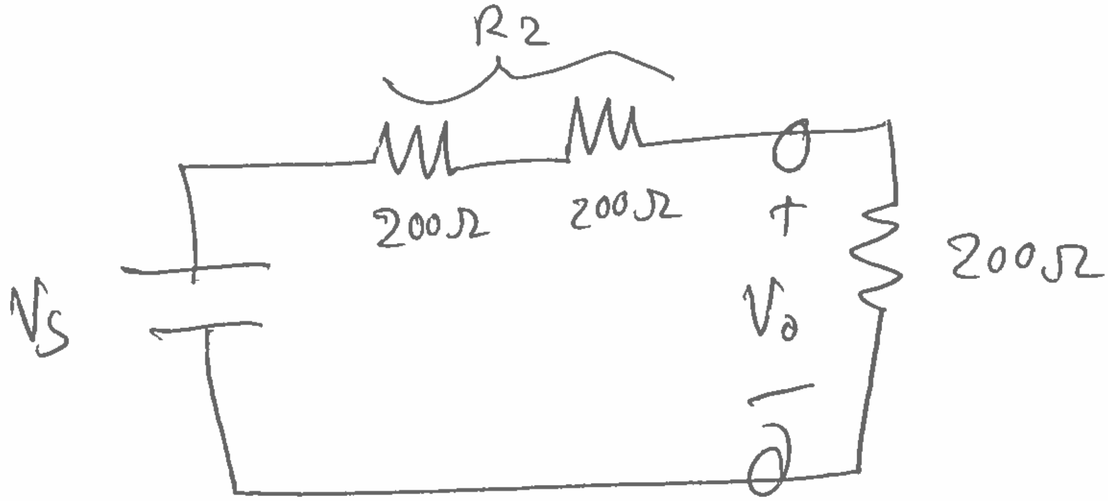
$P_{R2} \Rightarrow \quad i = \dfrac{V_{TOT}}{R_{TOT}} = \dfrac{12V}{600\Omega} = .02A$

$P_{R2} = i^2 R_2 = (.02A)^2(400\Omega) = 0.16W > .125W$

make 400Ω by 2 200Ω resistors

$P_{200\Omega} = i^2 R = (.02A)^2 (200\Omega) = 0.08W$

$< 0.125W$



$P_{200\Omega} = .08W \times 2 = 0.16W$

$P_{200\Omega} = .08W \qquad = 0.08W$

$0.24W < 5W$

is V_o $4V \pm 10\%$ $3.6V \Leftrightarrow 4.4V$

Largest $V_o \Rightarrow R_L$ is $R_L + 5\%$ $- 210\Omega$

$R_{200\Omega} = 190\Omega \quad R_{200} - 5\%$

$V_s = 12V + 1\%$ ~~12.2V~~ $12.1V$

$$V_o = \frac{V_S \; R_L}{R_L + R_2}$$

$$V_o = \frac{(12.12V)(210\Omega)}{(210\Omega + 2(190\Omega))} = \frac{12.12V\,(210\Omega)}{590\Omega}$$

$$V_o = 4.314V < 4.4V \checkmark$$

Smallest V_o $\quad R_L = R_L - 5\% \Rightarrow 190\Omega$

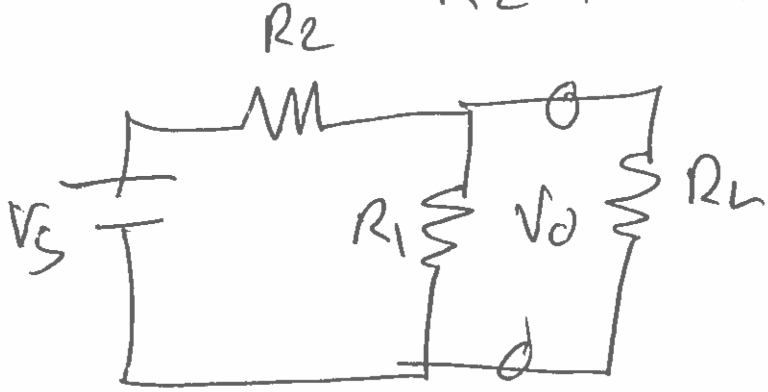
$$R_{200\Omega} = R_{200} + 5\% \Rightarrow 210\Omega$$

$$V_s = V_s - 1\% = 11.88V$$

$$V_o = \frac{(11.88V)(190\Omega)}{190\Omega + 2(210\Omega)} = \frac{(11.88V)(190\Omega)}{610\Omega}$$

$$V_o = 3.70V > 3.6V \checkmark$$

$$V_0 = \frac{V_S \, R_{eff}}{R_2 + R_{eff}}$$



$$R_{eff} = \frac{R_L R_1}{R_L + R_1}$$

$$V_0 = \frac{V_S \, R_L R_1}{(R_L + R_1)\left(R_2 + \frac{R_L R_1}{R_L + R_1}\right)}$$

Complex D.C. circuits

Two Basic circuit types

1. Planar — circuit can be drawn on a plane without any wire crossovers.

2. non-planar — circuit is more 3d wires have to crossover or "Leave" the plane.

2 Techniques

(A) Node Voltages — can do either circuit
Usually mostly constant current sources.

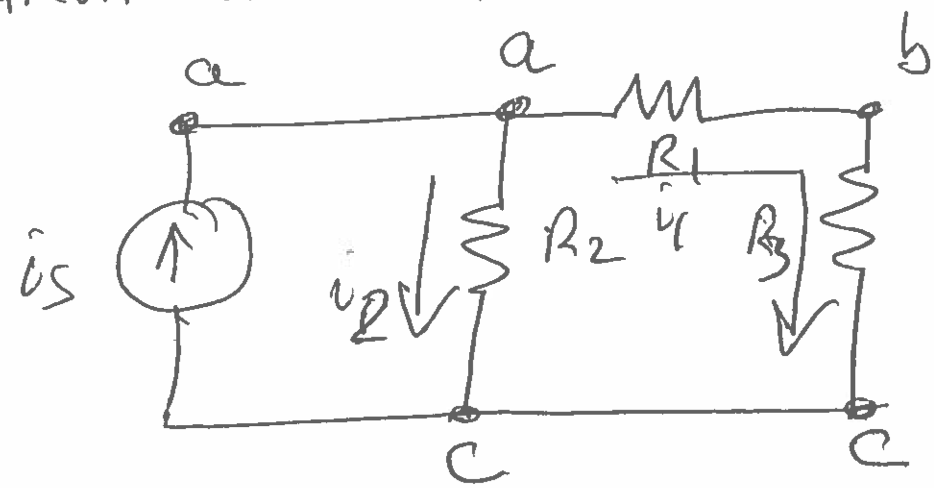
(B) Mesh currents — can only do planar
Usually mostly constant voltage sources.

In reality both are specialized ways of doing Kirchhoff equations.

But you do less thinking and they are very easy to put into MATLAB.

Voltage Nodes are points between two or more circuit elements.

Consider



$V_c = 0 \Rightarrow$ Ground point

at a $\quad i_s = i_1 + i_2$

$$i_1 = \frac{V_a - V_b}{R_1} = \frac{V_b}{R_3} \qquad i_2 = \frac{V_a}{R_2}$$