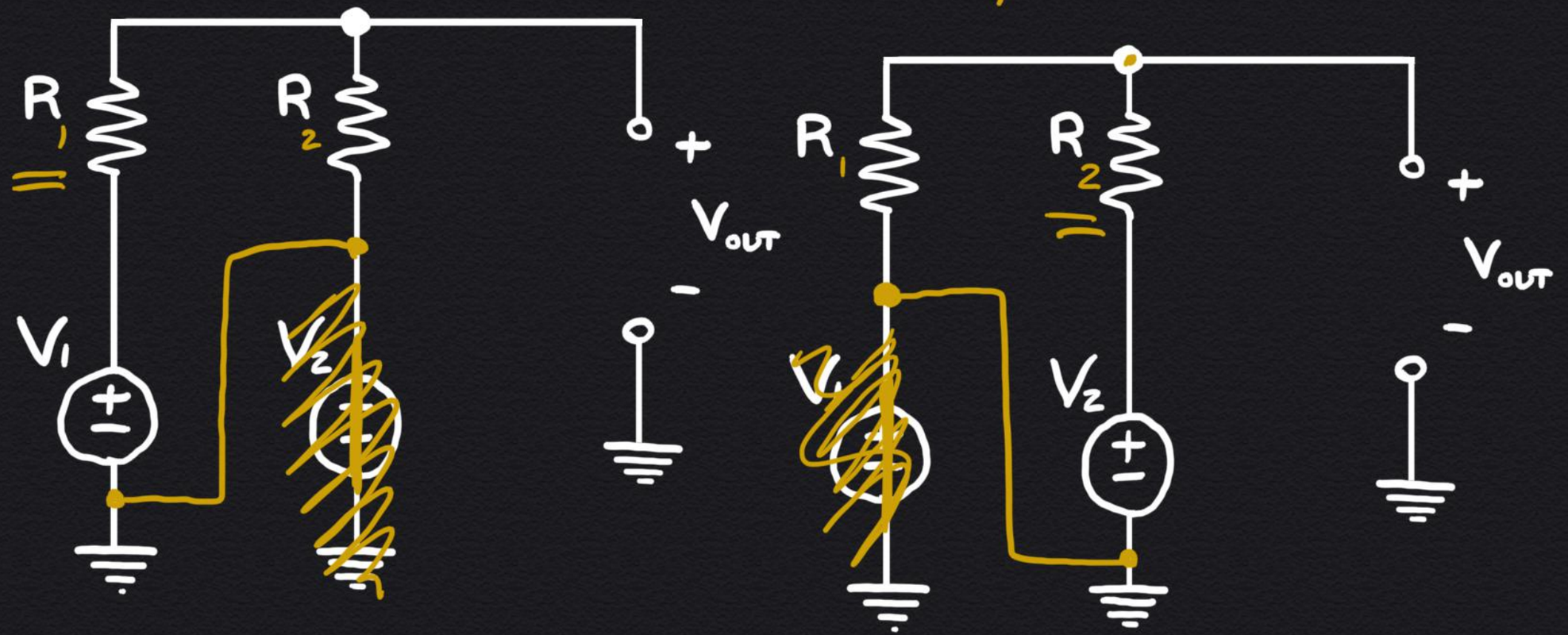
"Casual Pre-midterm Session"

- Super position:

$$V_{out} = V_1\left(\frac{R_2}{R_1+R_2}\right) + V_2\left(\frac{R_1}{R_1+R_2}\right)$$

(1) Dividers for Days:



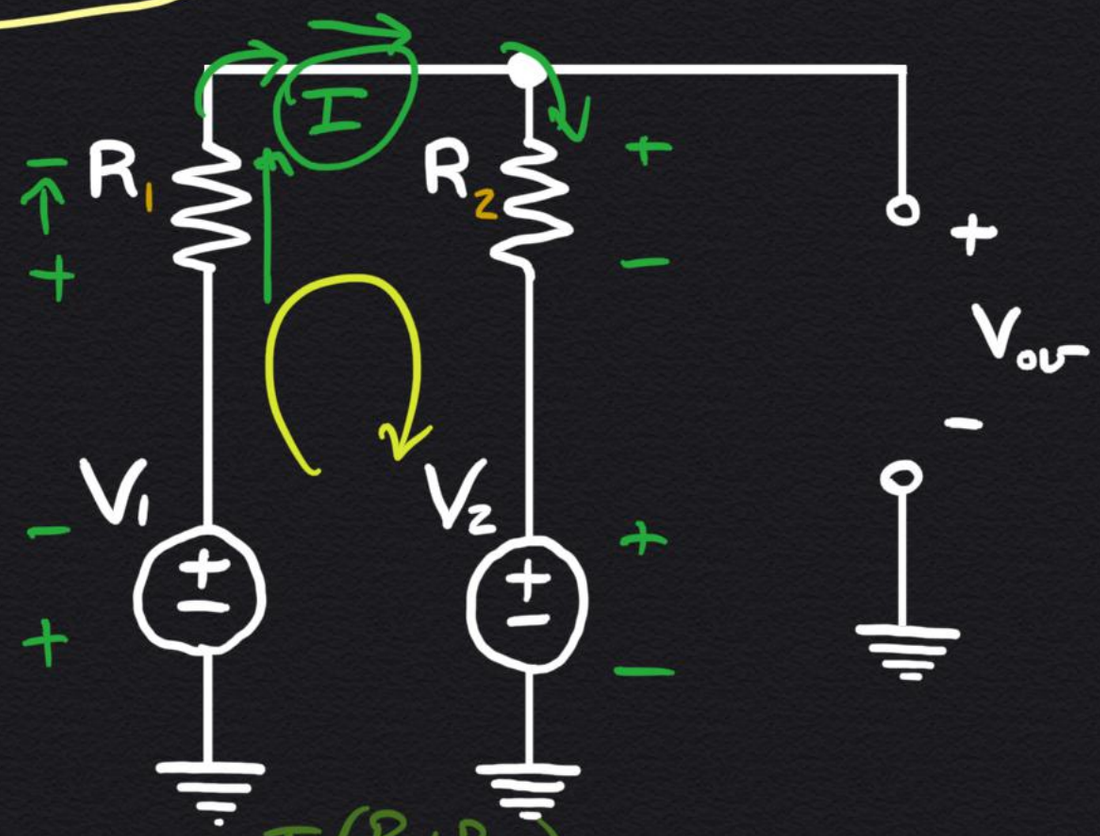
a] Find V_{out}:

$$V_{out} = \frac{1}{2} V_1 + \frac{1}{2} V_2$$

b] Can you identify new resistors for the circuit so that $V_{out} = \frac{1}{3} V_1 + \frac{2}{3} V_2$?

$$V_{out} = V_1 \left(\frac{R_2}{R_1+R_2}\right) + V_2 \left(\frac{R_1}{R_1+R_2}\right)$$

$1/3$ $\qquad$ $2/3$



$$\begin{cases} R_1 + R_2 = 3k\Omega \\ R_1 = 2k\Omega \\ R_2 = 1k\Omega \end{cases}$$

Technically any values work provided $R_1 = 2R_2$!!
(2 unknowns, but each eqn is identical to each other)

$$\left[I = \frac{V_1 - V_2}{(R_1+R_2)} \right]$$

* Green is NVA approach:

$$V_{out} = V_1 - I R_1 = V_1 \left(1 - \frac{R_1}{R_1+R_2}\right) + V_2 \left(\frac{R_1}{R_1+R_2}\right)$$

$\frac{R_2}{R_1+R_2}$

$$V_1 - I R_1 - I R_2 - V_2 = 0$$

$I(R_1+R_2)$

$$V_1 - V_2 = I(R_1+R_2)$$

~OR~

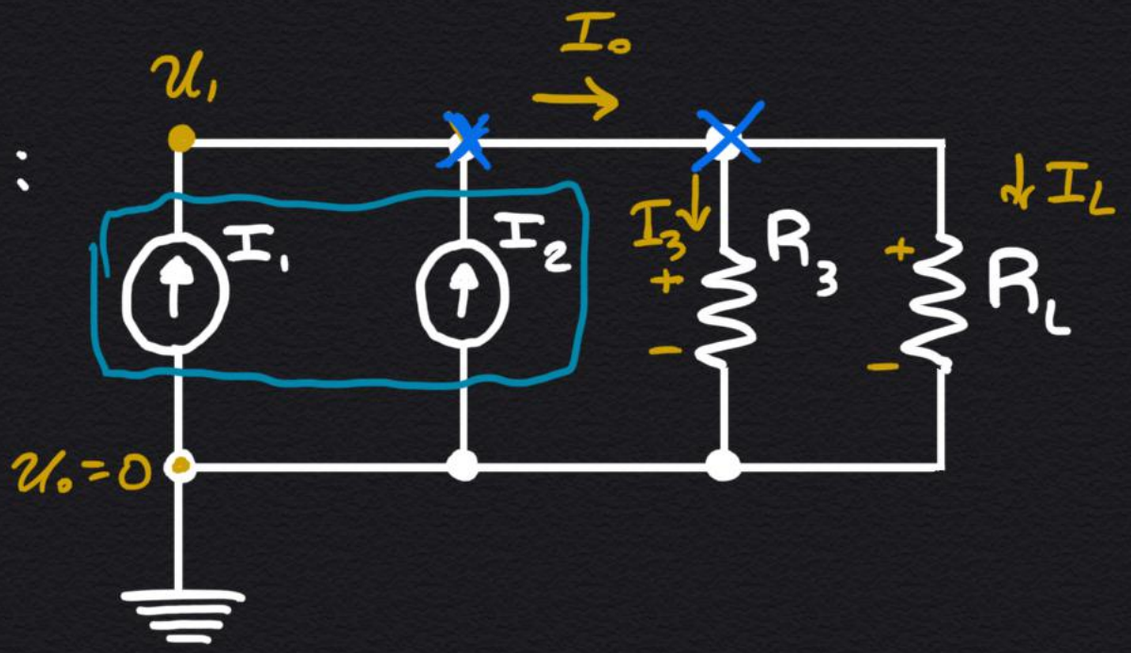
$$V_{out} = V_2 - I R_2 = V_1 \left(\frac{R_1}{R_1+R_2}\right) + V_2 \left(1 - \frac{R_1}{R_1+R_2}\right)$$

$\frac{R_2}{R_1+R_2}$

c) Consider this new circuit:

- Selet R_3 & R_L such that

$$I_L = \frac{2}{5}(I_1 + I_2)$$

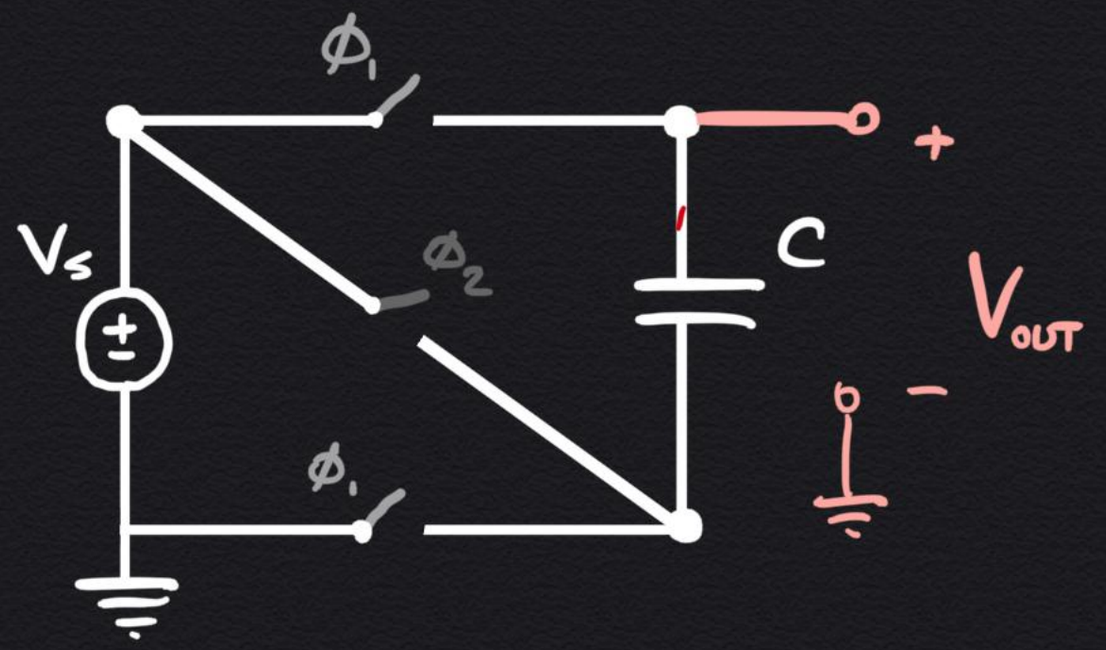


$$u_1 = (I_1 + I_2)\left(\frac{R_L R_3}{R_L + R_3}\right) \Leftarrow (I_1 + I_2) = I_L + I_3 = u_1\left(\frac{R_3}{R_L R_3} + \frac{R_L}{R_3 R_L}\right)$$

$\frac{u_1}{R_L}$ $\quad$ $\frac{u_1}{R_3}$ $\quad$ $\frac{R_3 + R_L}{R_3 R_L}$

$$I_L = \frac{u_1}{R_L} = (I_1 + I_2)\left(\frac{R_3}{R_3 + R_L}\right)$$

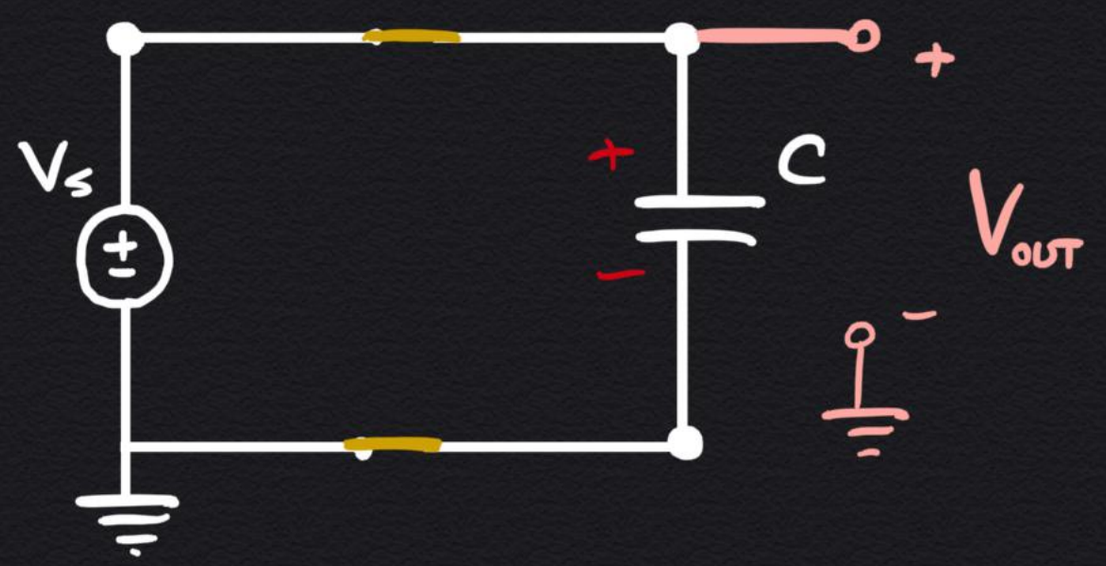
(2) Voltage Booster: [$V_S = 5V$]



a] Identify Q and V_{OUT} in phase 1 (ϕ_1):

$V_{OUT} = V_S$

$Q^{(1)} = C V_S$



b] Determine V_{out} in phase 2 (ϕ_2):

$$Q^{(2)} = CV \rightarrow V_c = \frac{Q^{(2)}}{C}$$

$$V_{out} = V_s + V_c$$

$$= V_s + \frac{1}{C}(CV_s)$$

$$= 2V_s = 10\,V$$