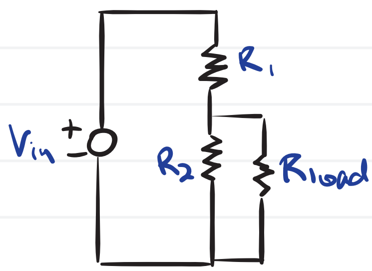
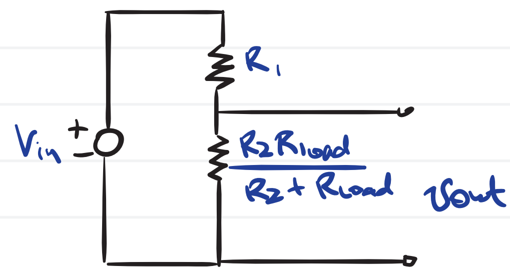
HH 1.10

a. Voltage divider: $v_{out} = \frac{R_2}{R_1+R_2} V_{in} = \frac{1}{2}(30) = 15\text{ V}$ //

b.



→ parallel →



Now a voltage divider.

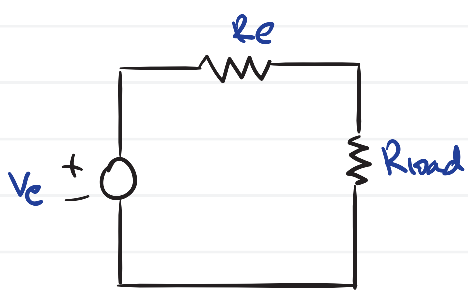
$$v_{out} = \frac{\frac{R_2 R_{load}}{R_2 + R_{load}}}{\frac{R_2 R_{load}}{R_2 + R_{load}} + R_1} V_{in} = \frac{R_2 R_{load}}{R_2 R_{load} + R_1 R_2 + R_1 R_{load}} V_{in}$$

$$= \frac{100\text{ K}}{100\text{ K} + 100\text{ K} + 100\text{ K}}(30) = 10\text{ V}$$ //

c. Thévenin eq.: $R_e = \frac{R_1 R_2}{R_1 + R_2} = 5\text{ k}\Omega$ //

$V_e = \frac{R_2}{R_1 + R_2} V_{in} = 15\text{ V}$ (voltage div.) //

d.



Voltage divider: $v_{out} = \frac{R_{load}}{R_{load} + R_e} V_e$

$= \frac{10}{10+5}(15)$

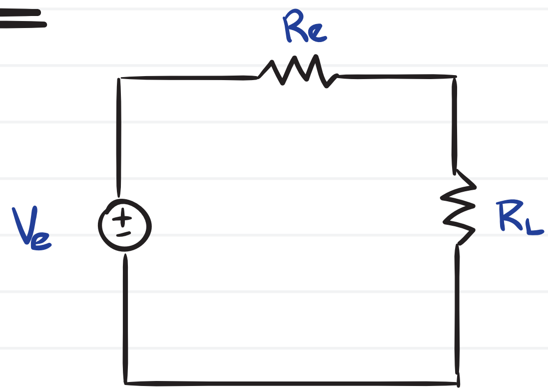
$= 10\text{ V}$ //

e. $P_{R_1} = v_{R_1}^2 / R_1 = \left(\frac{R_1}{R_1+R_2} V_s\right)^2 / R_1 = 15^2/(10 \cdot 10^3) = 22.5\text{ mW}$ //

$P_{R_2} = v_{R_2}^2 / R_2 = v_{out}^2 / R_2 = 10^2/(10 \cdot 10^3) = 10\text{ mW}$ //

$P_{Rload} = v_{out}^2 / R_{load} = 10\text{mW}$ //

HH 1.11



We want to maximize

$P_L = v_{R_L}^2 / R_L$.

Voltage div.: $v_{R_L} = \frac{R_L}{R_e + R_L} V_e$.

So $$P_L = \left(\frac{R_L}{R_e+R_L} V_e\right)^2 / R_L = \frac{R_L}{(R_e+R_L)^2} V_e^2$$

must be maximized in R_L.

Differentiate: $$\frac{\partial P_L}{\partial R_L} = \left(\frac{(R_e+R_L)^2 - 2R_L(R_e+R_L)}{(R_e+R_L)^4}\right) V_e^2$$

Set to zero and solve for R_L:

$$\left(\frac{(R_e+R_L)^2 - 2R_L(R_e+R_L)}{(R_e+R_L)^4}\right) V_e^2 = 0$$

$$(R_e+R_L)^{\cancel{2}} = 2R_L \cancel{(R_e+R_L)}$$

$$R_e = 2R_L - R_L$$

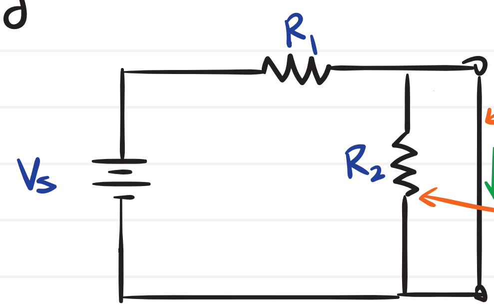
$$R_e = R_L$$

We should probably check that this is a max, not a min.

HH 1.37

$$R_e = \frac{(10\,K)(10\,K)}{10K + 10K} = 5\ k\Omega$$

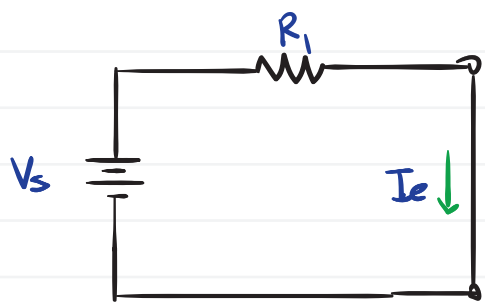
Finding I_e :



short output terminals

shorts this resistor because now it is parallel w/ zero resistance:

$$\frac{R_2 \cdot 0}{R_2 + 0} = 0 \text{ eq. resistance}$$



So $I_e = \frac{V_{R_1}}{R_1} = \frac{V_s}{R_1} = \frac{10}{10 \cdot 10^3}$

$= 10^{-3}\ A$

$= 1\ mA$ //

There is also the loading part of the problem.