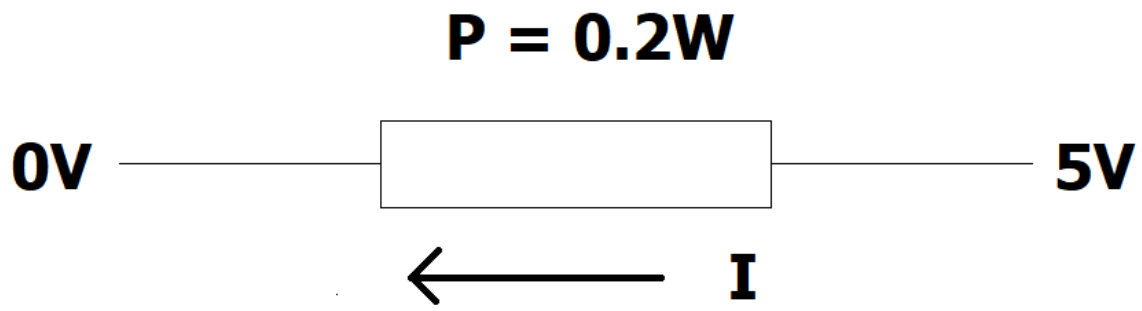
ECE 20001 Solutions
Spring 2021
Exam 1 (8:30 AM)

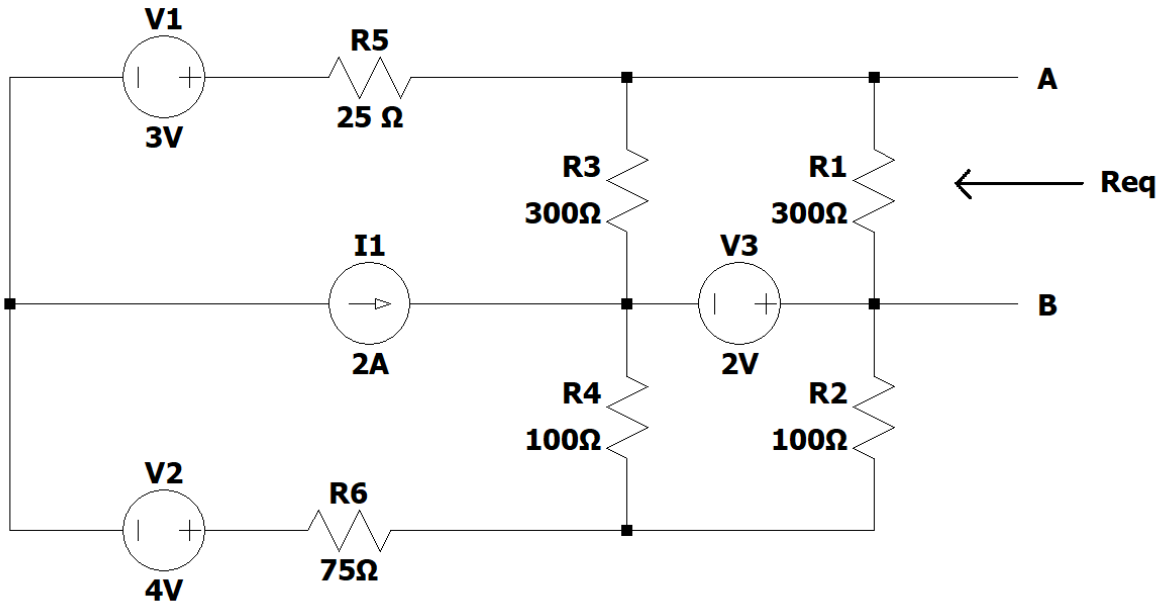
1. A device consumes 0.2 W power at 5V DC. How much charge flows through the wiring during a 10 second interval?

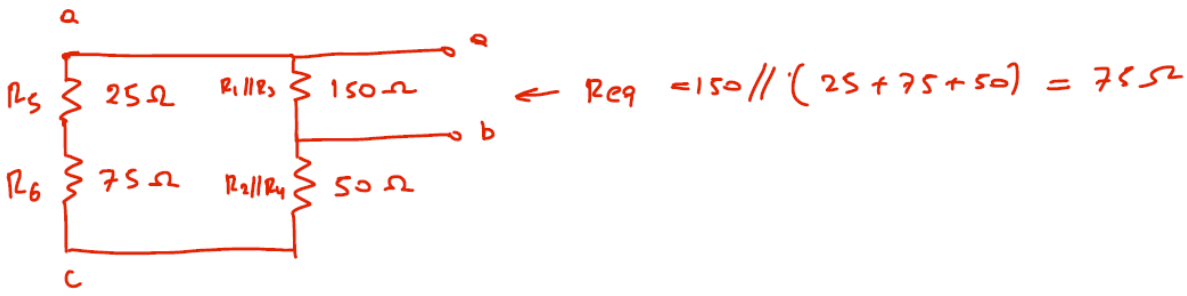


$$I = P/V = 0.04\,A$$

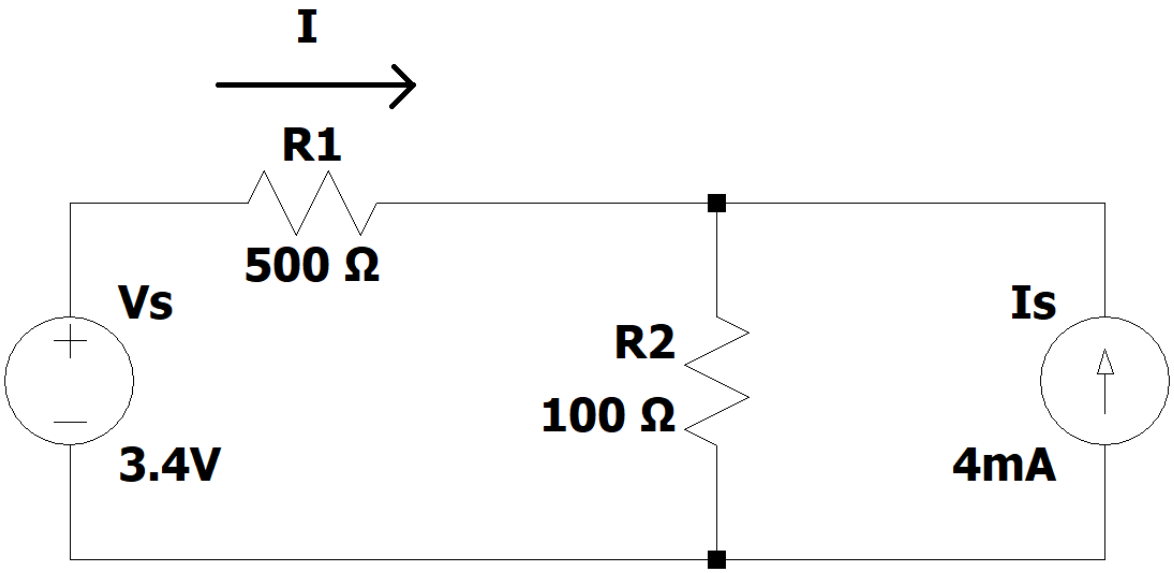
$$q = \int_0^{10} 0.04\,dt = 0.4\,C$$

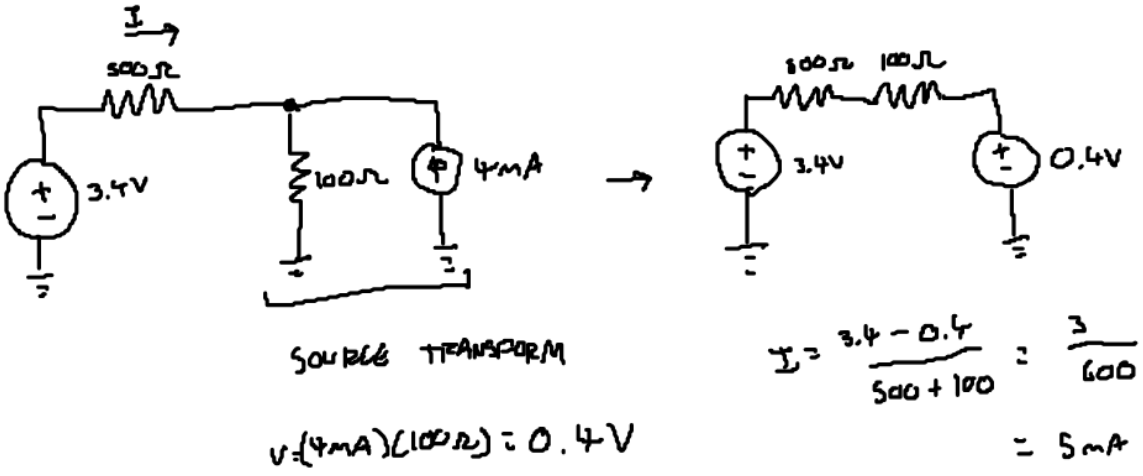
2. What is the equivalent resistance as seen from port AB?





3. Find I, the current traveling through R1.





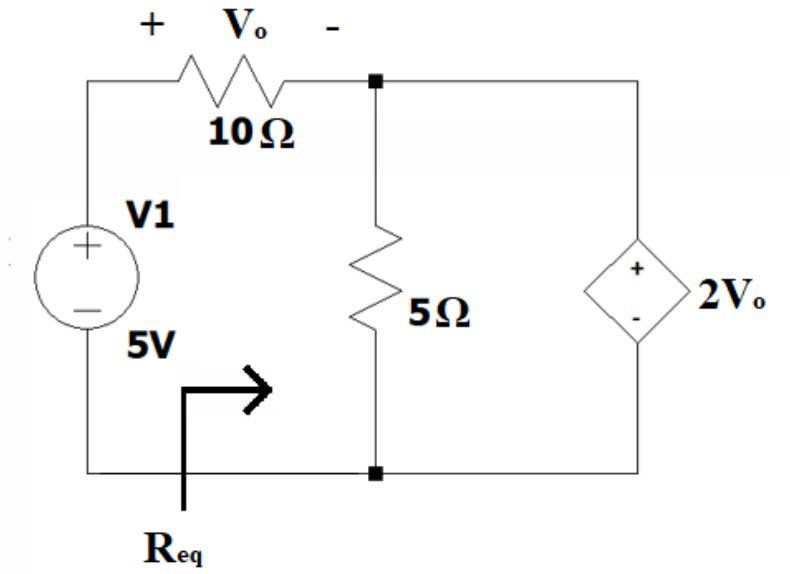
SOURCE TRANSFORM

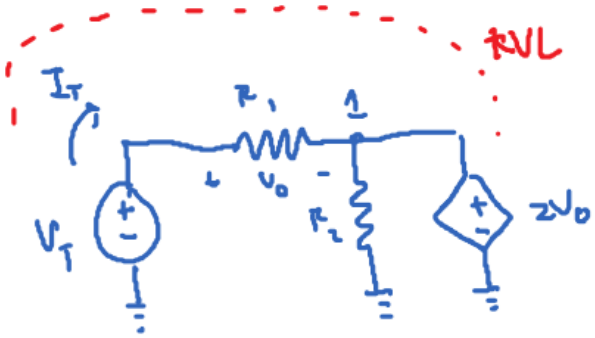
$V = (4mA)(100\Omega) = 0.4V$

$I = \frac{3.4 - 0.4}{500 + 100} = \frac{3}{600}$

$= 5mA$

4. Solve for R_{eq} as seen by the independent voltage source.





KVL:

$-V_T + V_0 + 2V_0 = 0$

$V_T = 3V_0$

$I = \frac{V}{R} \rightarrow = \frac{V_0}{R_1} = I_T$

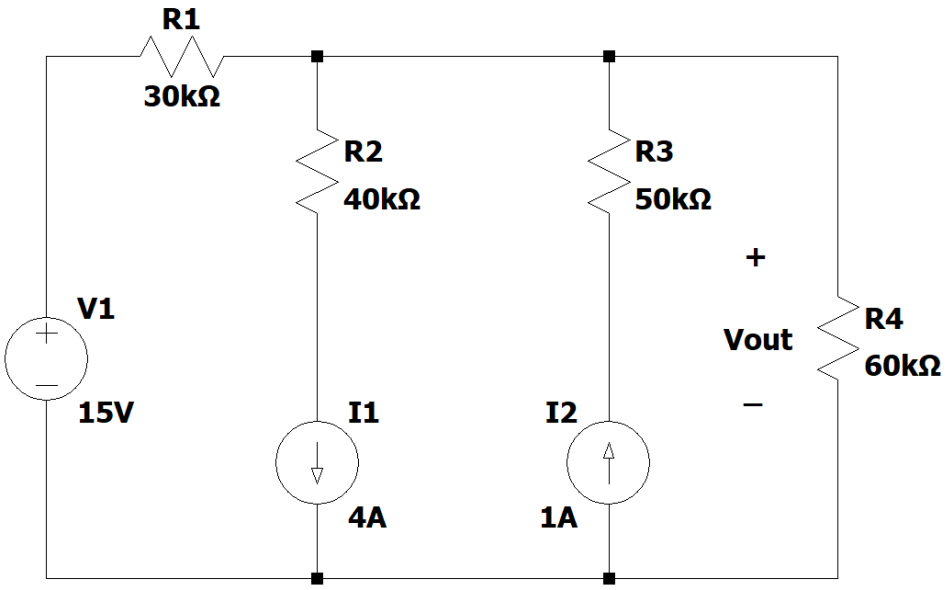
$V_T = 3 I_T R_1$

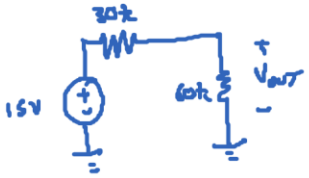
$\frac{V_T}{I_T} = R_T$

$R_T = 3R_1$

$= \boxed{30\ \Omega}$

5. How much would the voltage V_{out} decrease if the source V1 were turned off? (Hint: Find the contribution of V1).



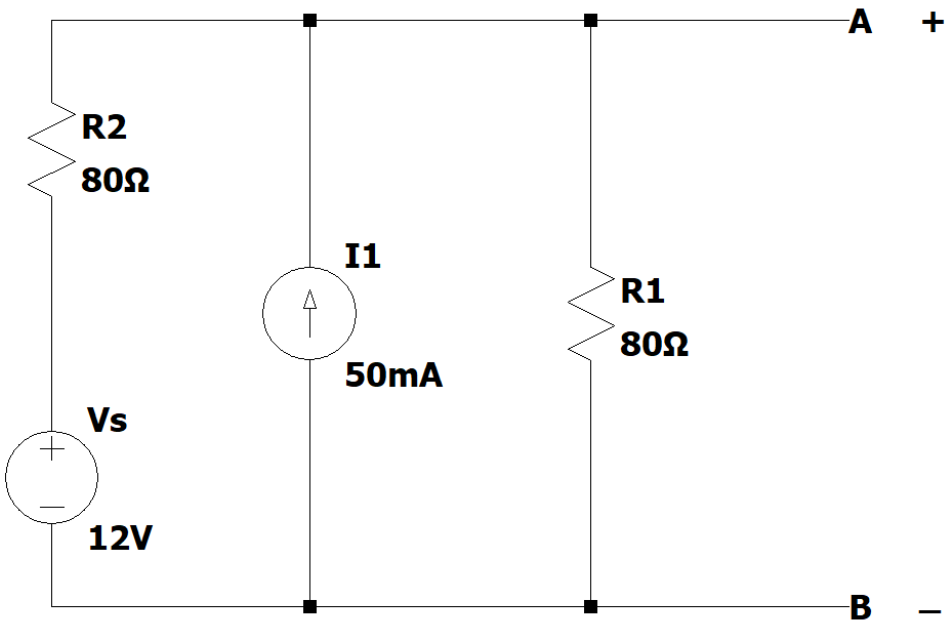


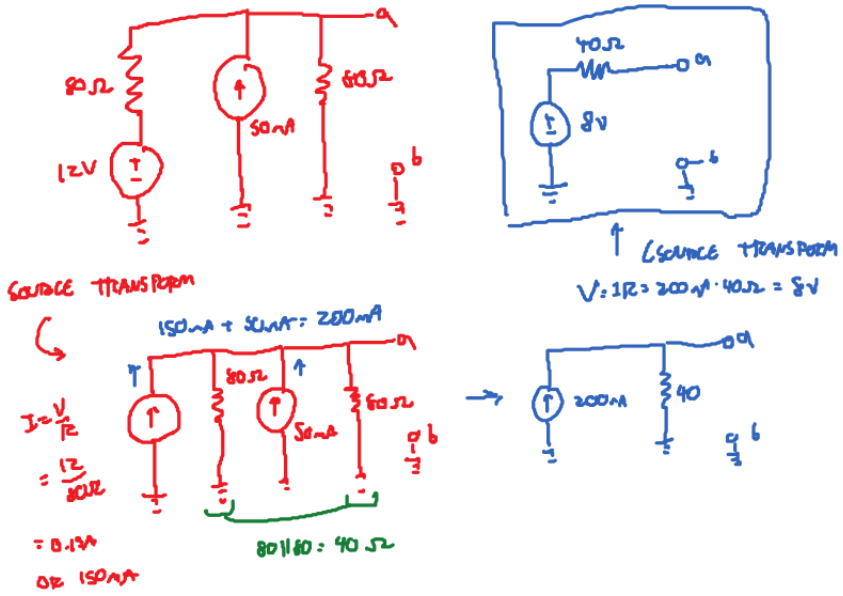
$V_{out} = 15 \cdot \frac{60k}{30k + 60k} = 15 \cdot \frac{2}{3}$

$= 10V$

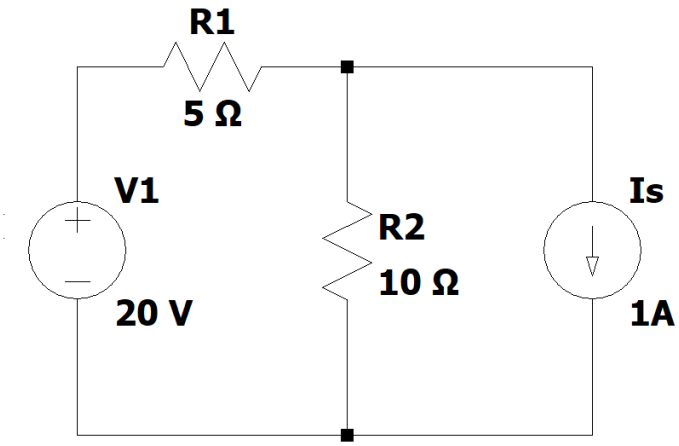
$\therefore V_1$ contributes 10V, so removing V_1 would decrease V_{out} by 10V

6. Find the Thevenin equivalent circuit as seen by terminals **A** and **B**.





7. Find the power consumed by the 10 Ω resistor.



$I_{10\Omega} = I_1 - I_2$, $I_2 = 1A$

① $-20V + 5I_1 + 10(I_1 - I_2) = 0$

$-20V + 5I_1 + 10I_1 - 10V = 0$

$15I_1 = 30V$

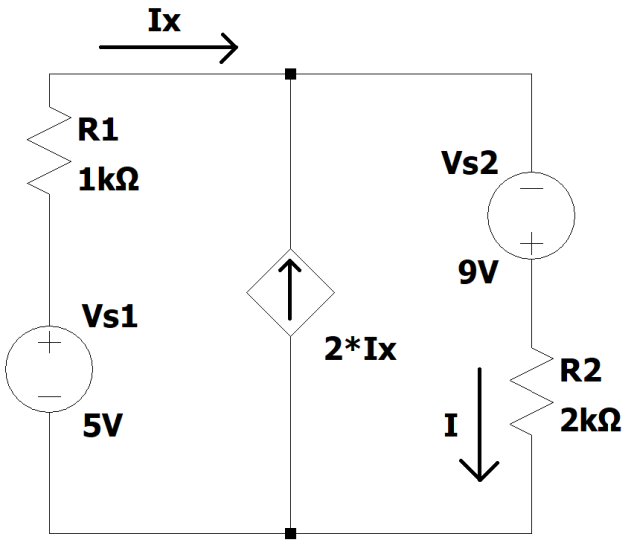
$I_1 = 2A$, so $I = I_1 - I_2$

$= 1A$

$P = IV = I^2R$

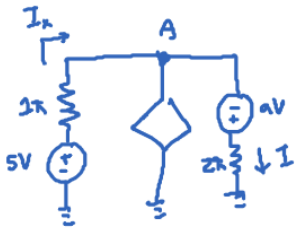
$= 1^2(10) = 10W$

8. Find the value of the current I.



$I_x + 2I_x = I$

$3I_x = I$



(A) $I_x = \frac{5V - V_A}{1k}$

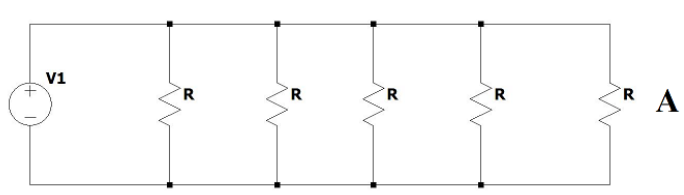
$I = \frac{V_A + 9V}{2k}$ so $3\left(\frac{5V - V_A}{1k}\right) = \frac{V_A + 9V}{2k}$

$= 30 - 6V_A = V_A + 9$

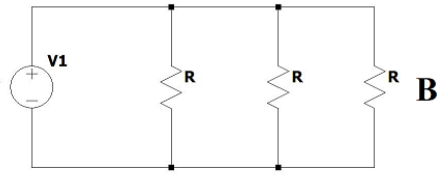
$\rightarrow V_A = 3V$

$I = \frac{3V + 9V}{2k} = \frac{12}{2k} = 6mA$

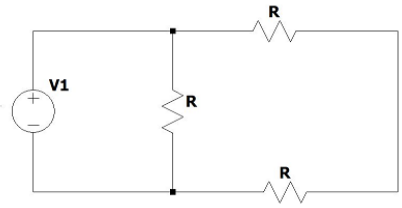
9. If all resistors and sources are the same, in which circuit does the source deliver the least power?



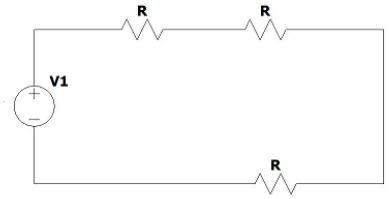
A



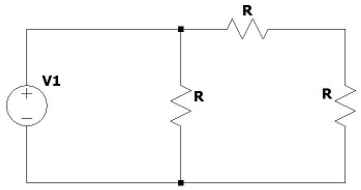
B



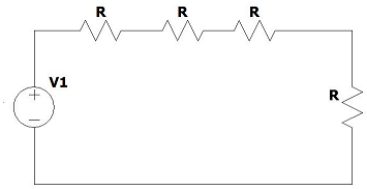
C



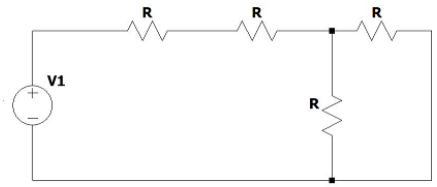
D



E



F



G

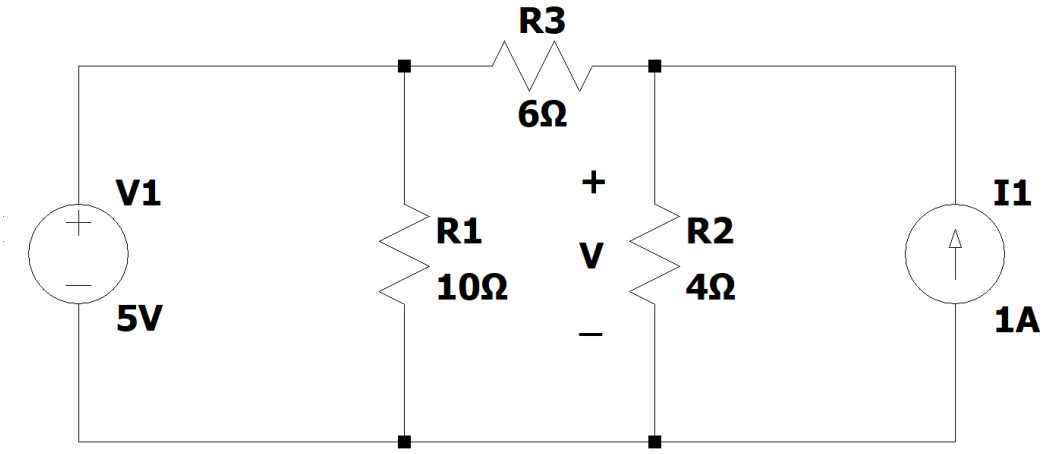
H: The source always delivers the same power

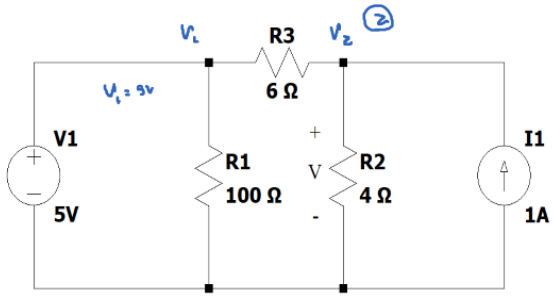
q. $P = IV$, $\begin{cases} V = IR \\ I = \frac{V}{R} \end{cases}$

$\therefore P = \frac{V^2}{R}$. If Voltage is constant, to get the least possible power we need to choose the circuit w/ the highest total R.

→ By inspection, F has 4 resistors in series & none in parallel so F would have the highest R_{eq} seen by the source

10. Find the voltage V across R2.





$$1A + \frac{V_1 - V_2}{R_3} = \frac{V_2}{R_2}$$

$$R_3 R_2 1A + R_2 V_1 - R_2 V_2 = R_3 V_2$$

$$R_3 R_2 1A + R_2 V_1 = (R_3 + R_2) V_2$$

$$V_2 = \frac{R_3 R_2 1A + R_2 (5V)}{R_3 + R_2}$$

$$= \frac{24 + 20}{10} = 4.4V$$