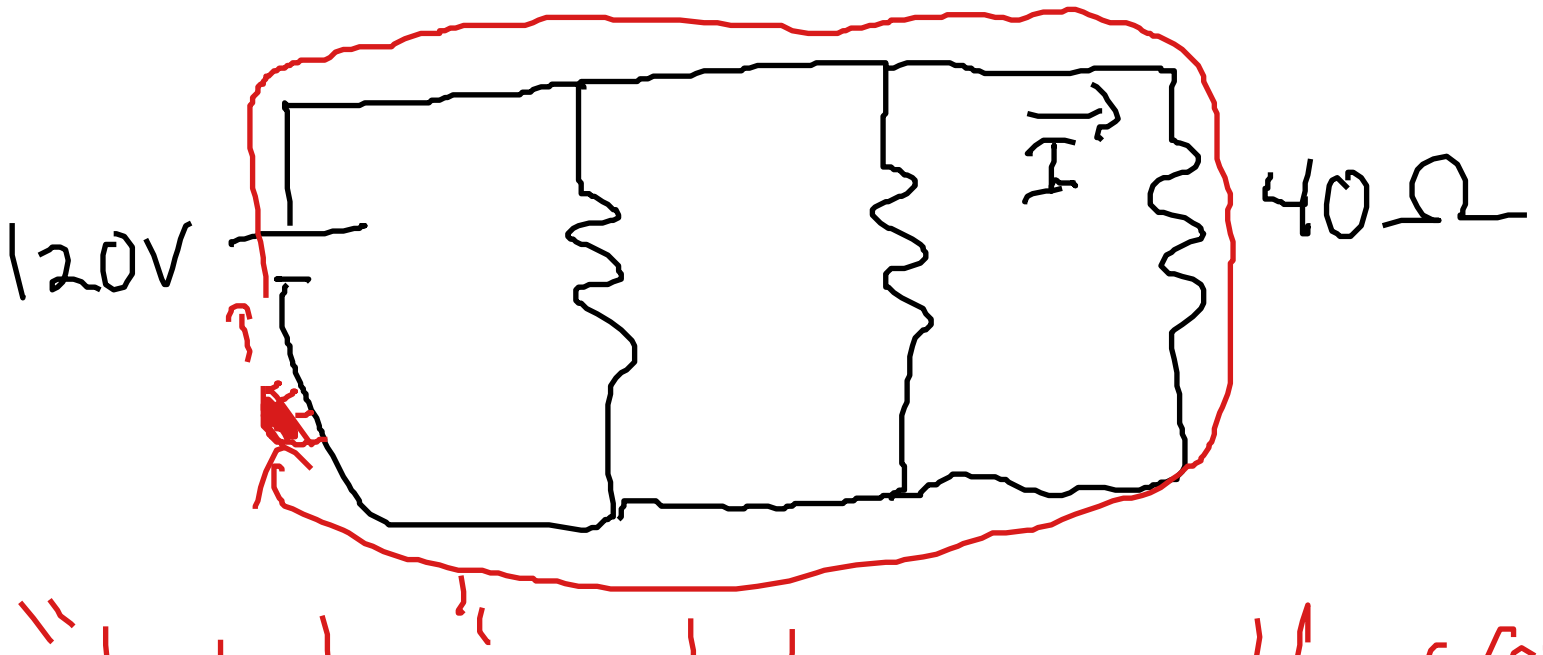


"ladybug" takes a walk around circuit keeping track of changes of potential. Returns to start? Total $\Delta V = 0$

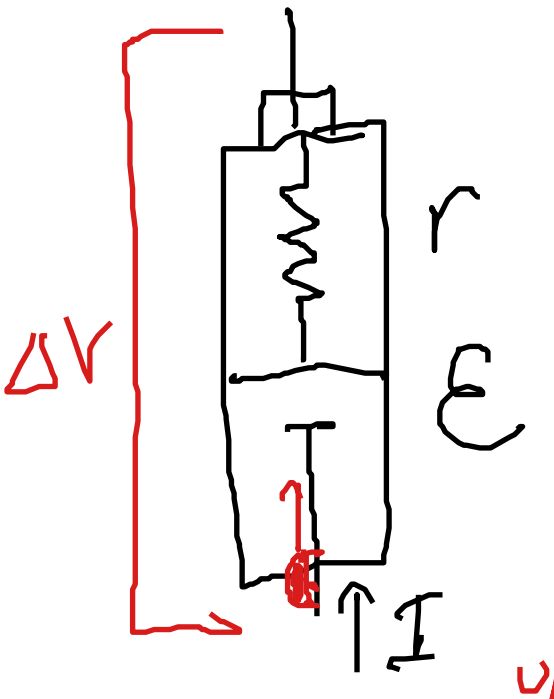
$$+120 - 40I = 0$$

$$120 = 40I$$

$$3A = I$$

regardless of other parts of circuit

In a real house battery power supply

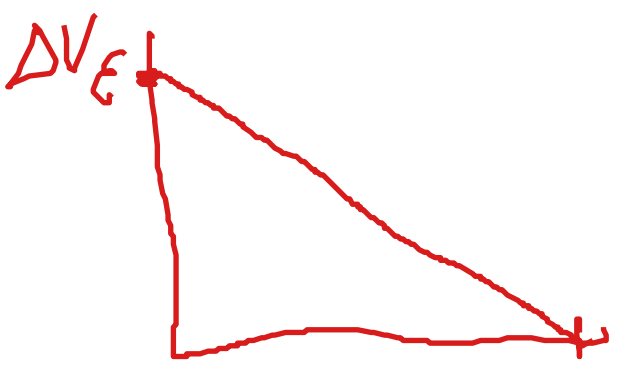


internal resistance

up battery

down stream

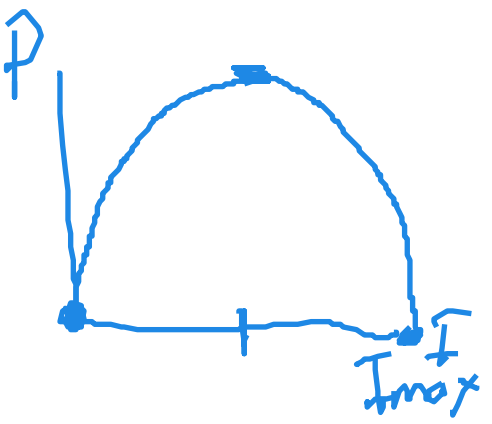
$$\Delta V = +\mathcal{E} - Ir$$



$$I_{max} = \frac{\mathcal{E}}{r}$$

$$P = I\Delta V = I(\mathcal{E} - Ir)$$

$$= \mathcal{E}I - I^2 r$$



max P occurs where

$$\frac{dP}{dI} = 0$$

$$\frac{dP}{dI} = \mathcal{E} - 2Ir = 0$$

$$I = \frac{1}{2}\frac{\mathcal{E}}{r} = \frac{1}{2} I_{max}$$

$$P_{max} = P\left(\frac{1}{2}\frac{\mathcal{E}}{r}\right)$$

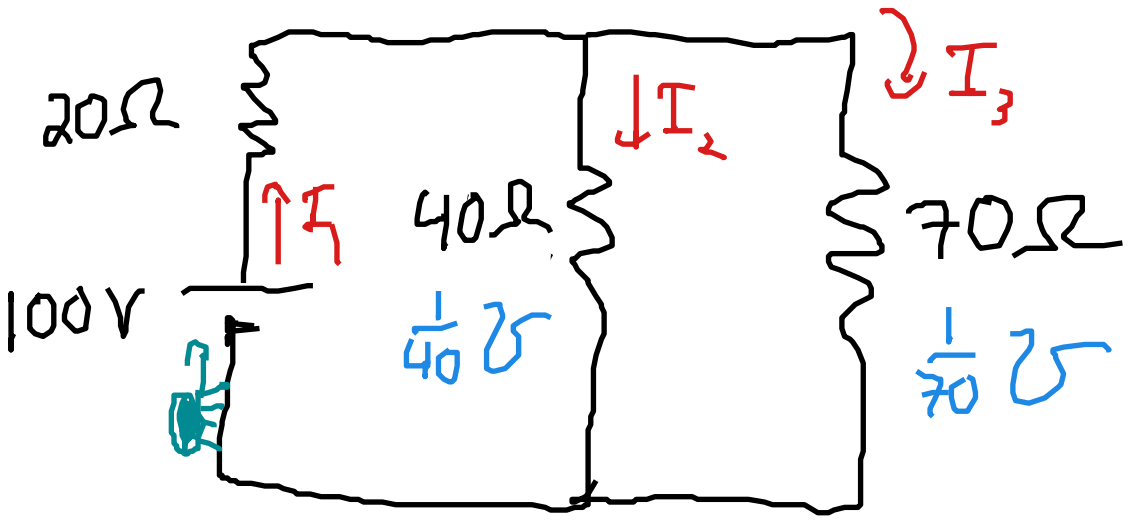
$$= \left(\frac{1}{2}\frac{\mathcal{E}}{r}\right)\left(\mathcal{E} - \left(\frac{1}{2}\frac{\mathcal{E}}{r}\right) r\right)$$

$$= \frac{1}{2}\frac{\mathcal{E}^2}{r} - \frac{1}{4}\frac{\mathcal{E}^2}{r}$$

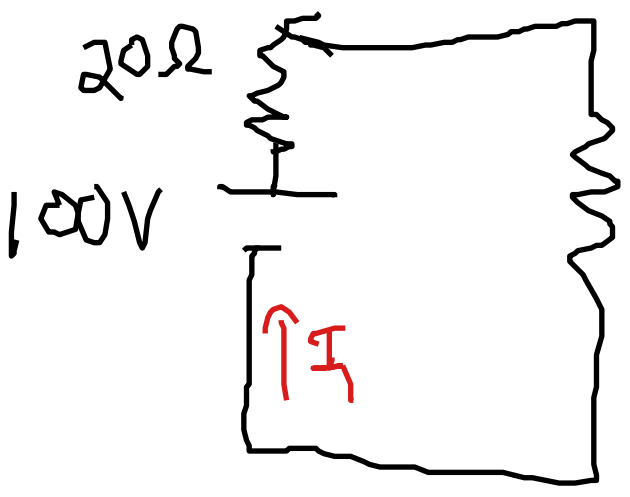
$$= \frac{1}{4}\frac{\mathcal{E}^2}{r}$$

small r : large P_{max}

large r : small P_{max}



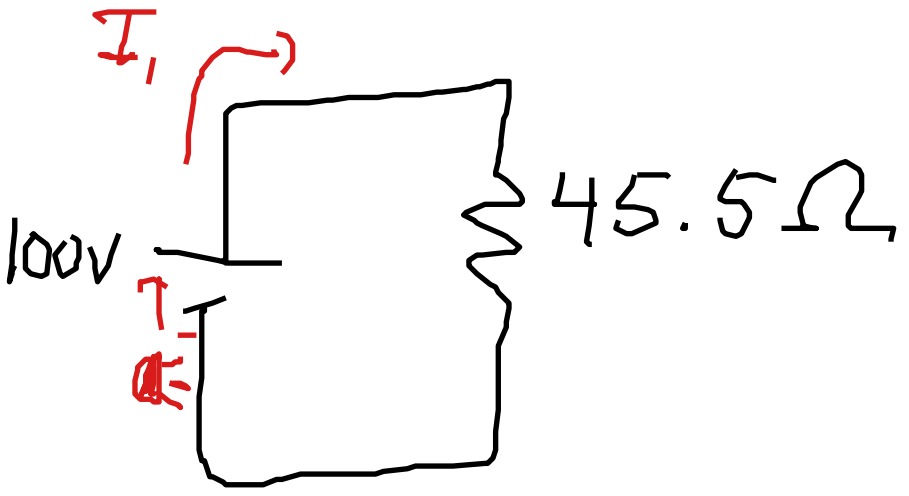
parallel



25.5Ω

$\frac{1}{40}$ ℧ + $\frac{1}{70}$ ℧ = 0.03935 ℧

series



$$100 - 45.5 I_1 = 0$$

$$100 = 45.5 I_1$$

$$I_1 = \frac{100}{45.5} = 2.2\ A$$

$$100 - 20(2.2) - 40I_2 = 0$$

$$100 - 44 - 40I_2 = 0$$

$$56 = 40I_2$$

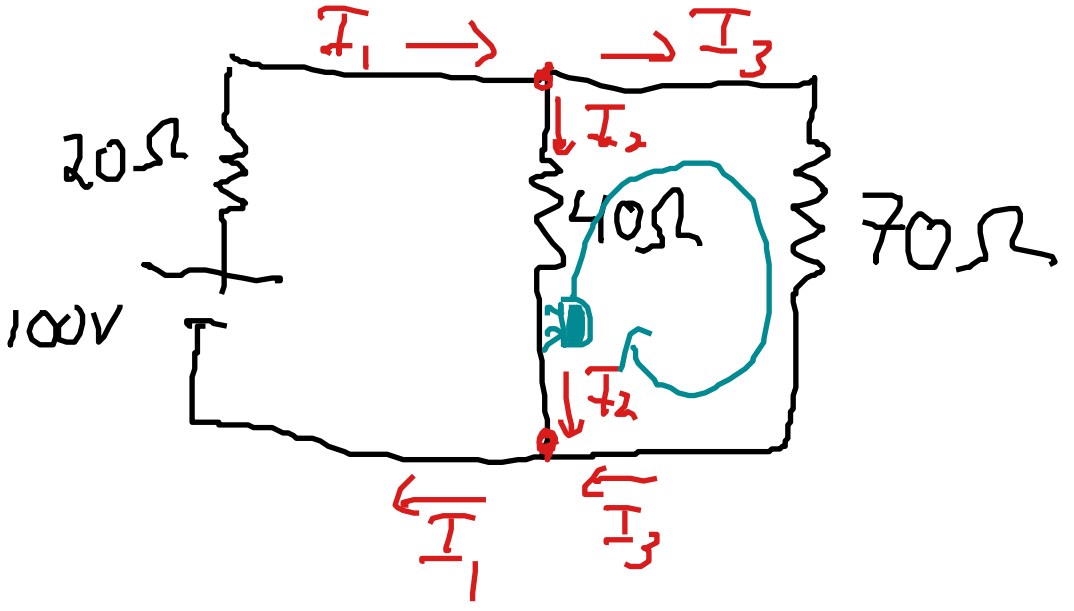
$$I_2 = \frac{56}{40} = 1.4A$$

$$100 - 20(2.2) - 70I_3 = 0$$

$$56 = 70I_3$$

$$\frac{56}{70} = I_3$$

$$0.8A = A$$



3 unknowns

need 3 equations

Junction Rule

current in = current out

$$I_1 = I_2 + I_3$$ ✓

Loop Rule

Left: $100 - 20I_1 - 40I_2 = 0$

Big: $100 - 20I_1 - 70I_3 = 0$

Right: up the 40Ω

$$+40I_2 - 70I_3 = 0$$