

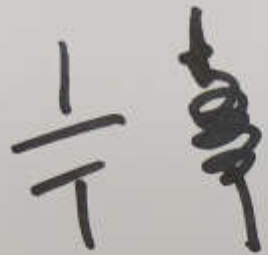
positive power  
~~negative~~

absorb / dissipate

deliver / output / supplies → negative power

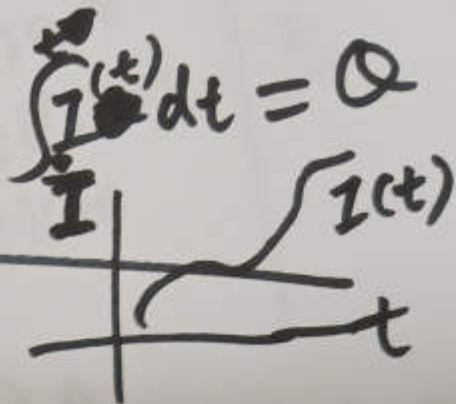
$E = P \cdot t$   
 $\text{W} = \text{E} = \text{Energy}$   
 $\text{W} = \text{Power}$   
 $\text{P} = \text{Power}$

①



$$P = VI = \frac{V^2}{R} = I^2R$$

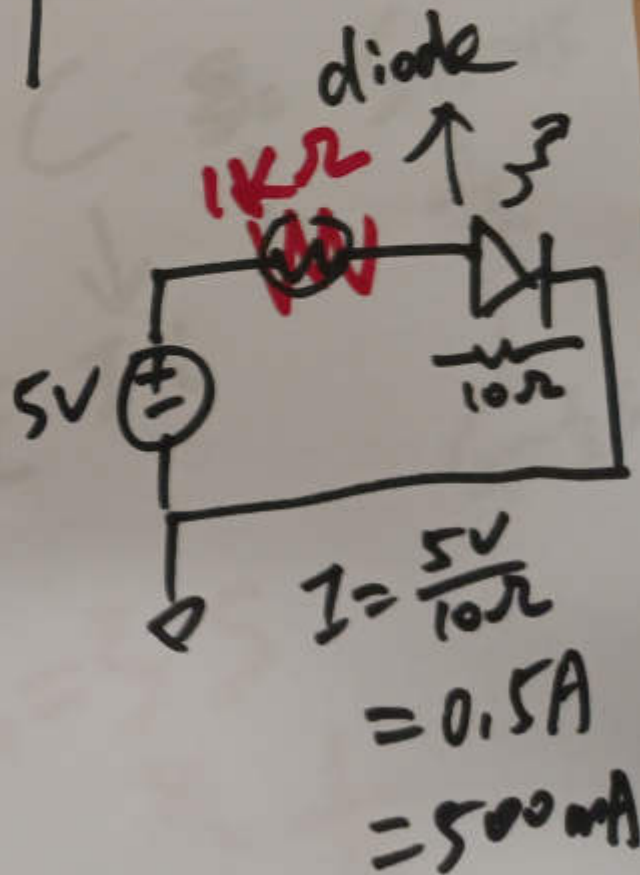
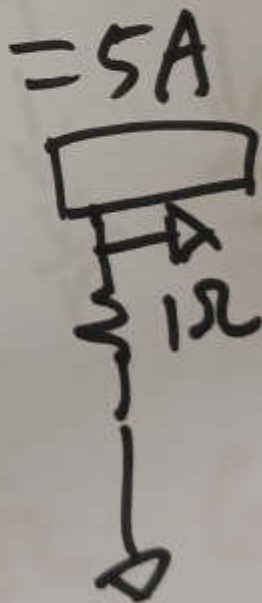
$$R = \frac{V}{I} \quad I = \frac{V}{R}$$



$I = \frac{Q}{t}$  Coulombs  
 Ampere  
 Amps



1K 10K 5K  
~~300Ω~~  
 protection  
 current limiting  
 resistor



(2)

nano :  $10^{-9}$   
 micro :  $10^{-6}$   
 milli :  $10^{-3}$

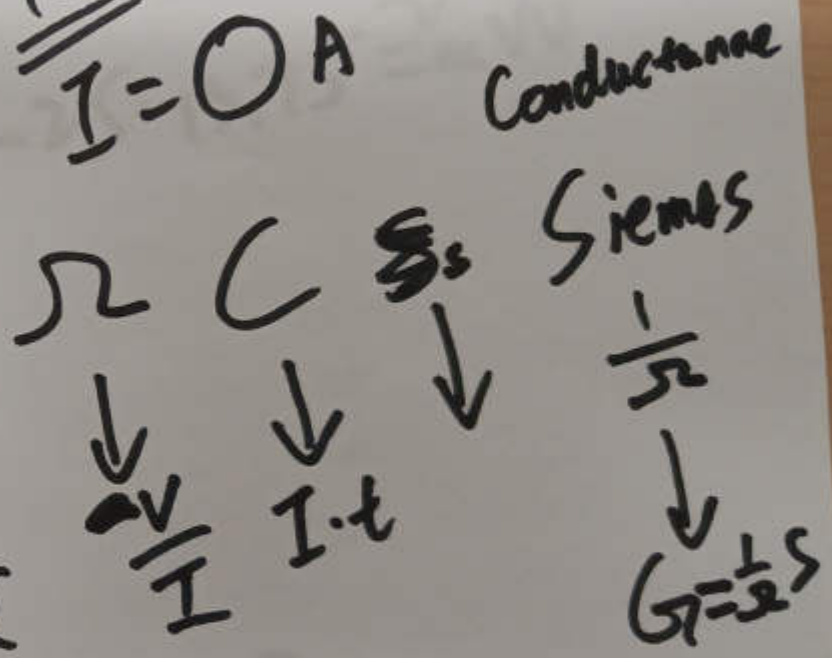
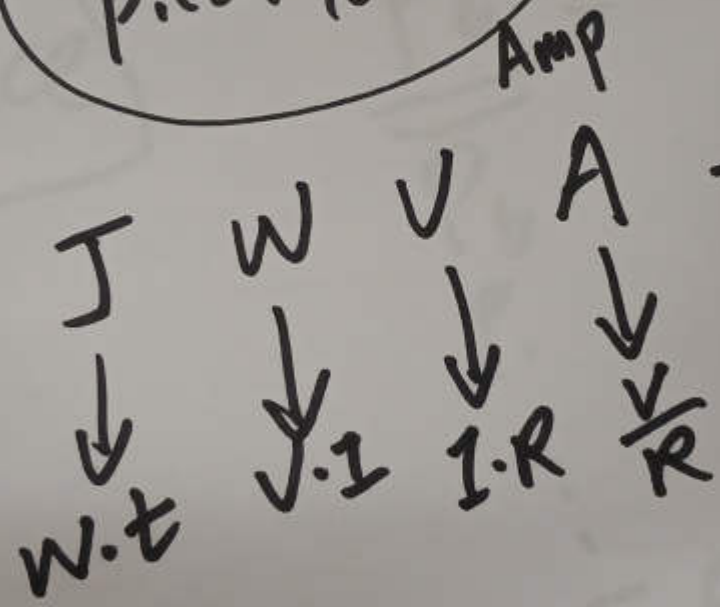
→ atto :  $10^{-18}$   
 femto :  $10^{-15}$   
 pico :  $10^{-12}$

$10^3$  : k  
 $10^6$  : Million  
 $10^9$  : Billion  
 $10^{12}$  : Trillion

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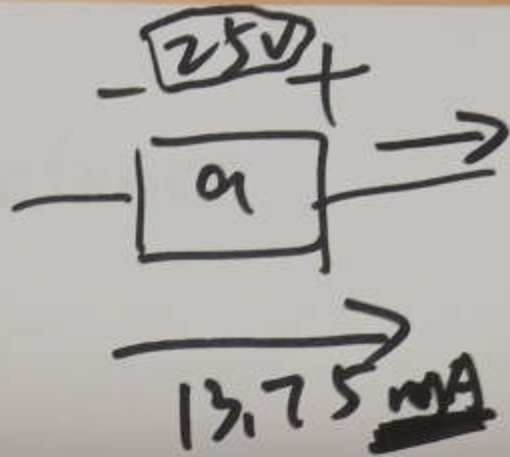
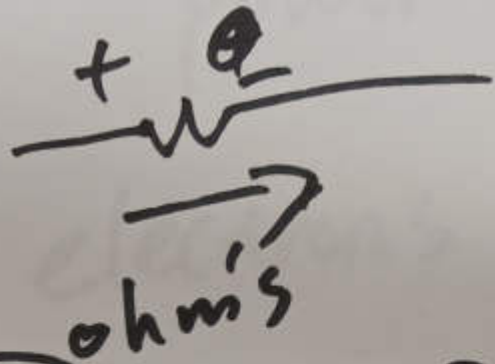
$10^0$

$V_1 = 3V$   
 $I_1 = 3A$   
 $Q = 3C$   
 $W = E_1 = 3J$   
 $P = 3W$   
 $W_1 = 3W$



$R_1 = 3 \Omega$        $G_1 = 3 S$   
 $\uparrow$        $\uparrow$   
 $\frac{1}{R}$

(3)



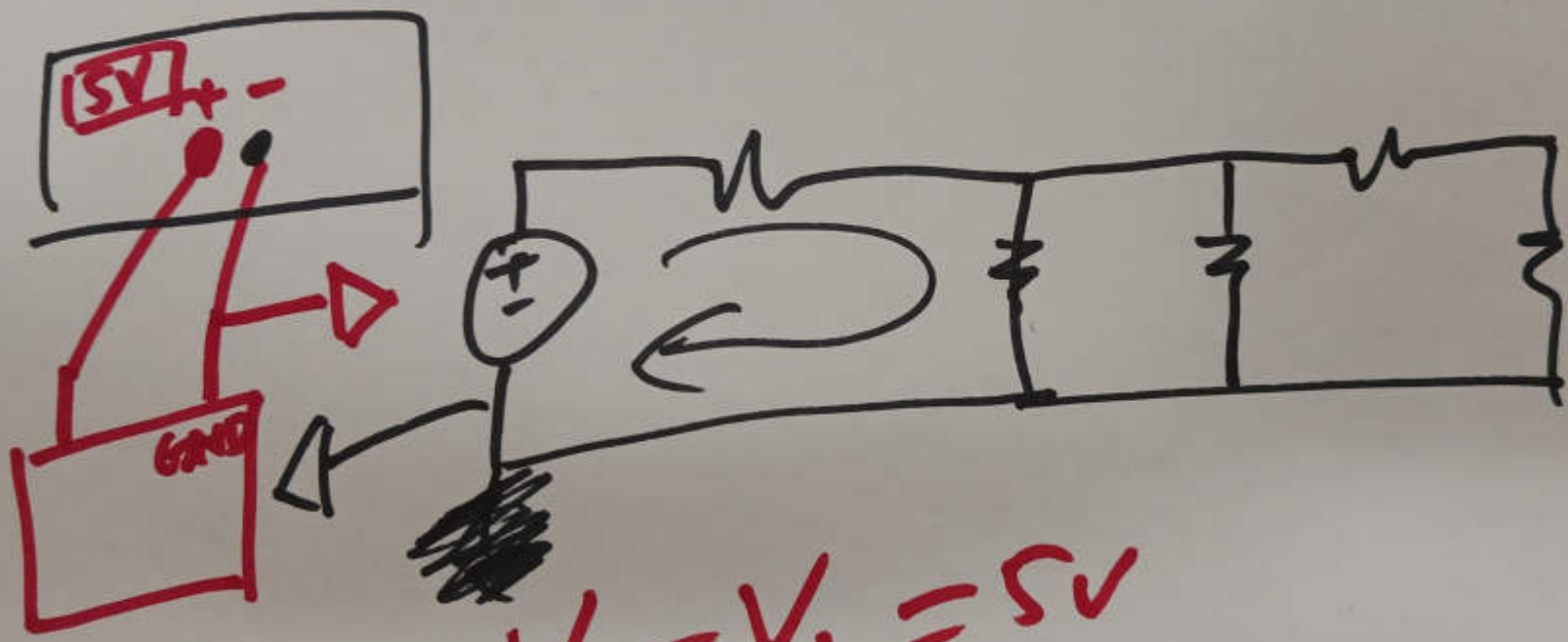
Power Balance

$$P_a = -25 \cdot 13.75 = -0.34375 \text{ W} = -343.75 \text{ mW}$$
$$\sum P = 0$$

(4)

# power balance

electrons



$$V_r - V_c = 5V$$

↓ 5V      ↓ 0V

(5)