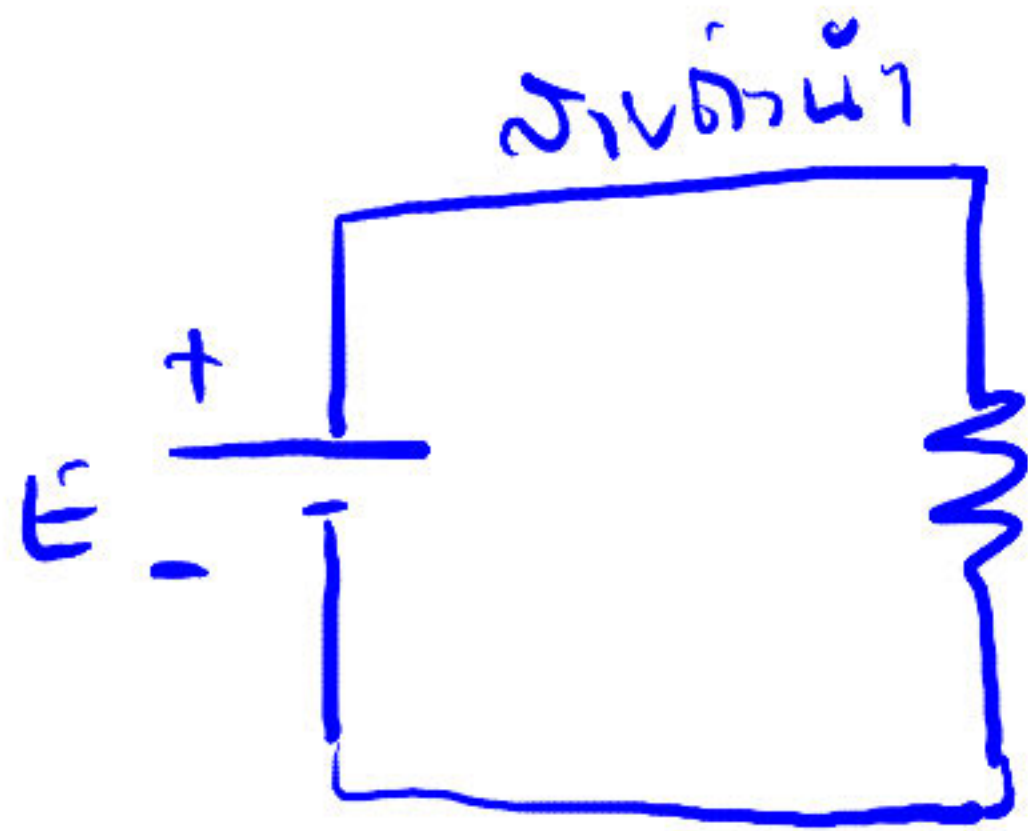




ความต้านทาน (Resistance)

→ อัตราการไหลของกระแสไฟฟ้า

- ตัวนำ → ความต้านทานน้อย

- ฉนวน → ความต้านทานมาก

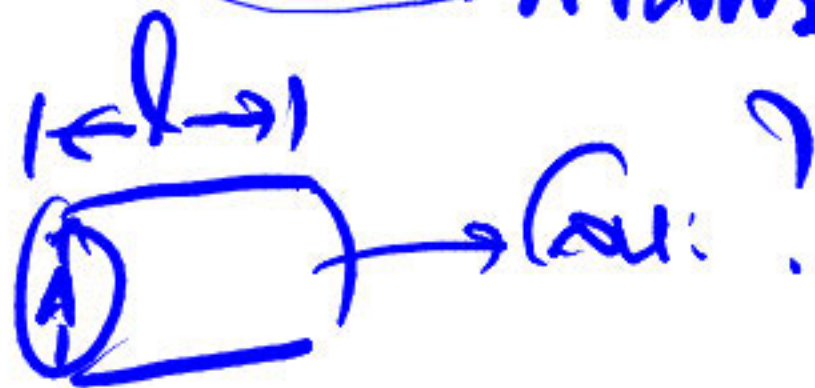
- Carbon 

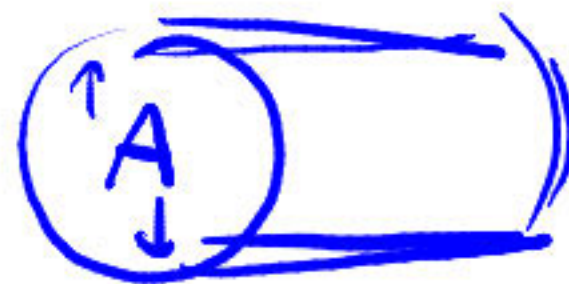
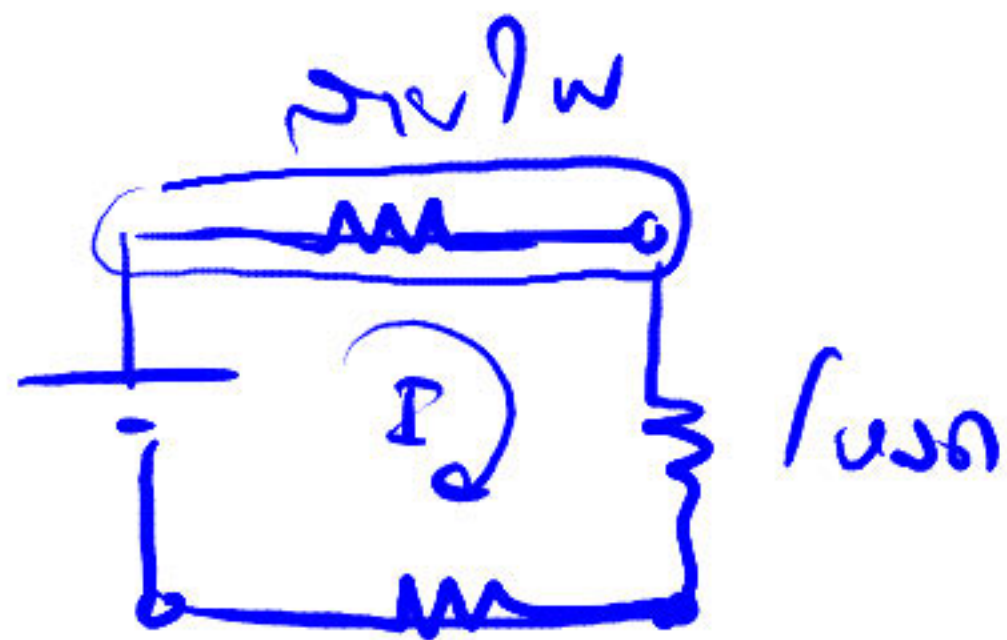


$R \rightarrow$ តង់ , 1000 តង់ $\geq 1 \text{ K}\Omega$
 $1,000,000$ តង់ $= 1 \text{ M}\Omega$

$$R = \rho \frac{l}{A}$$

$l \rightarrow$ កម្រិត
 $A \rightarrow$ ផ.ប.កាត់ទទឹង
 $\rho \rightarrow$ តម្លៃចំពោះធាតុនីមួយៗ





$$R = \rho \frac{l}{A}$$

$I(t)$

Unit (SI)

- အမီတာ m
- ကီလိုဂရမ် kg
- စက္ကန့် s
- အမ်ပီယာ A
- ကီလ်ဗင် K
- ကန်ဒီလာ cd

$$I = \text{အမ်ပီယာ}$$

$$E = \text{ဗို့တန်}$$

$$R = \text{အဟိန်းတာ}$$

$$G = \text{အဟိန်းတာ} = \frac{1}{R}$$

$$T = \text{အဟိန်းတာ}$$

$$P = \text{ဝါတ်}$$

$$10^9 = \text{ຈັກ}$$

$$10 =$$

$$10^3 = \text{ພັນ}$$

$$10^3 = \text{ສິບ}$$

$$10^9 = \text{ພັນ}$$

$$10^{-12} = \text{ຕຣິລລິຍົນ}$$

$$10^{-15} = \text{ພິກໂຊ}$$

$$10^{-18} = \text{ອັດຕາ}$$

$$10^{+12} = \text{ໜ້າ}$$

$$I = \frac{Q}{t}$$

$$I(t) = \frac{dq}{dt}$$

งาน/พจน์

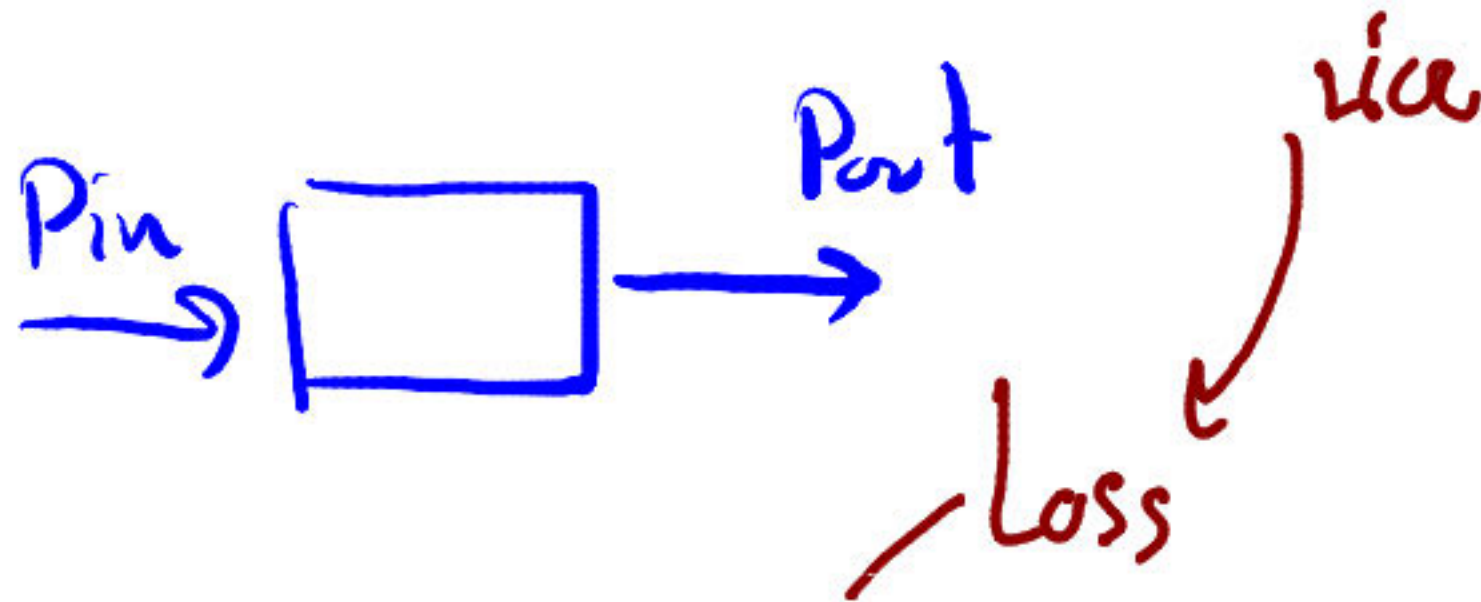
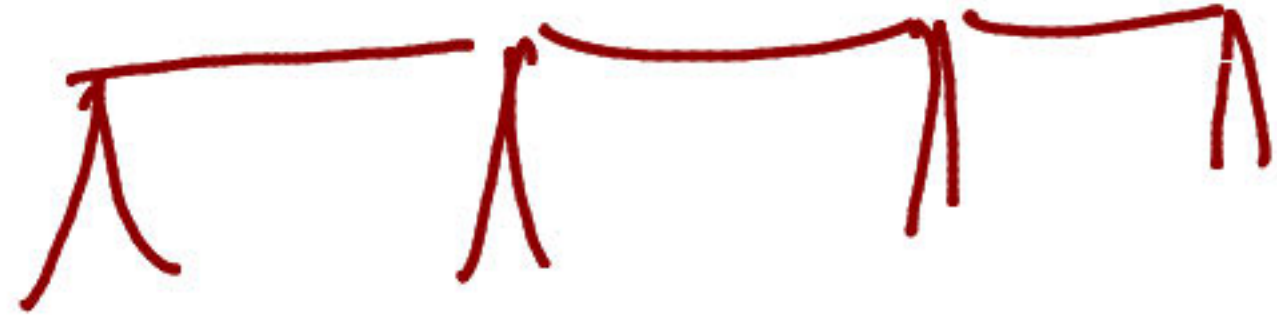
$$E = \frac{W}{Q} \begin{matrix} \rightarrow J \\ \rightarrow C \end{matrix}$$

$$W = Pt \xrightarrow{\text{พลังงาน}} (J)$$

$$P = \frac{W}{t} (W)$$

$$1 \text{ hp} = 746 \text{ W}$$

$$\eta = \frac{P_{out}}{P_{in}} \times 100$$



Input = output

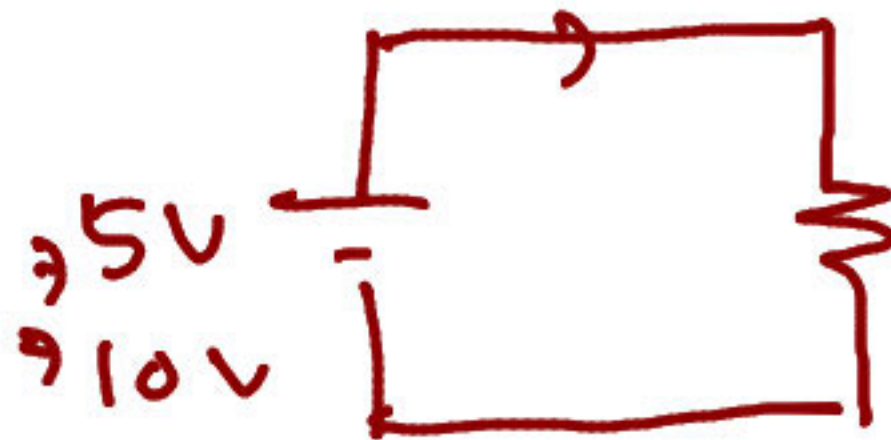
กฎโอห์ม

$$\boxed{I \propto V}, \boxed{I \propto \frac{1}{R}}$$

$$R \uparrow \Rightarrow I \downarrow$$

$$R \downarrow \Rightarrow I \uparrow$$

$$I_5 = \frac{5}{10} = 0.5 \text{ A}$$



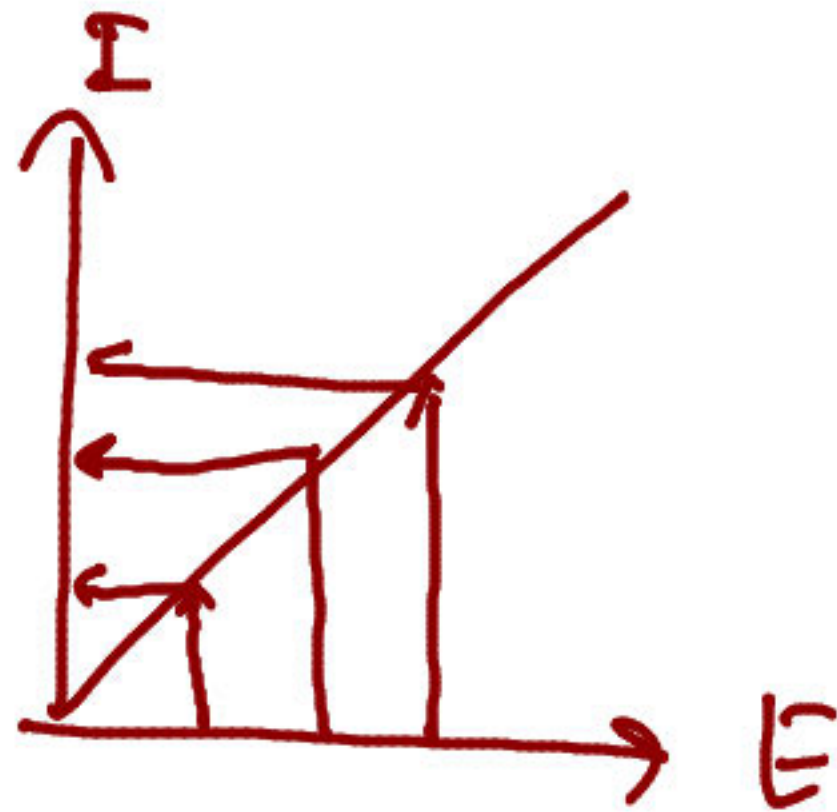
$$R_1 = 10 \Omega$$

$$R_2 = 20 \Omega$$

$$I_{10\Omega} = \frac{5}{10} = 0.5 \text{ A}$$

$$I_0 = \frac{10}{10} = 1 \text{ A}$$

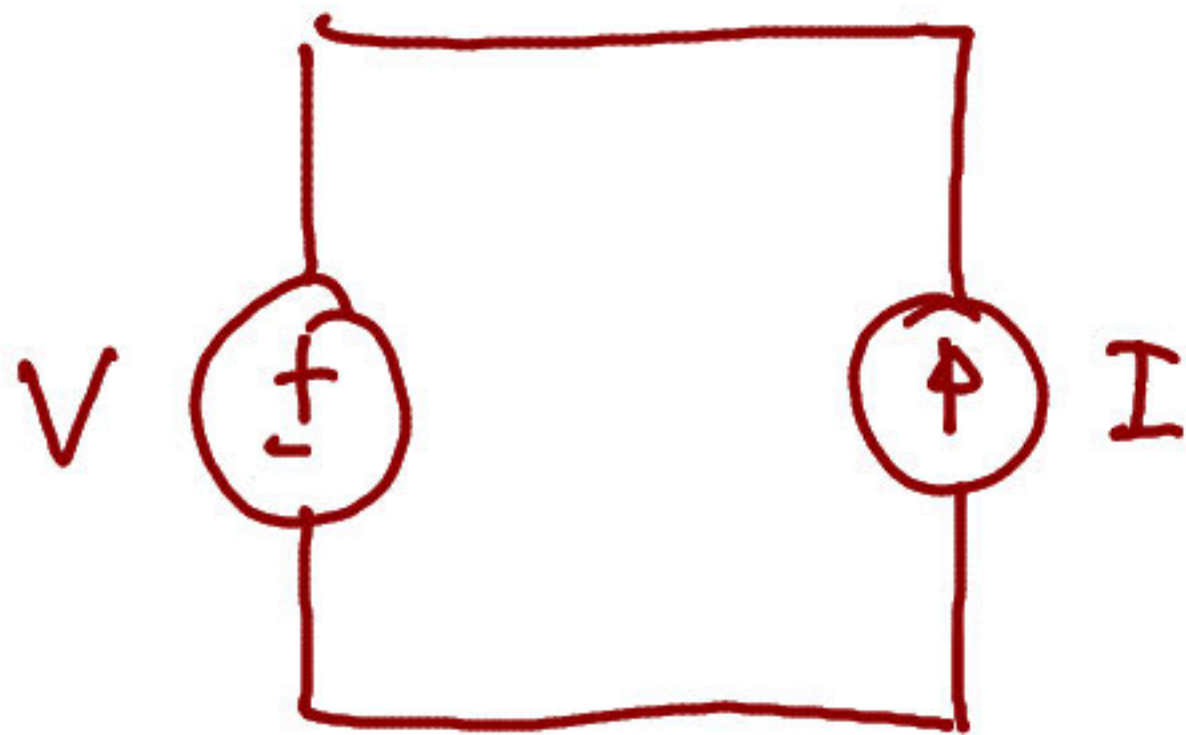
$$I_{20\Omega} = \frac{5}{20} = 0.25 \text{ A}$$



Ranin $\triangle \frac{E}{I/R}$

$$P = VI = E \cdot I$$

$$I = \frac{E}{R} = \frac{V}{R}, \quad E = \frac{P}{I} = \sqrt{\frac{P}{R}}$$



$$1. \quad V = 2 \text{ V}, I = 4 \text{ A}$$

$$P = ? \quad 8 \text{ W}$$

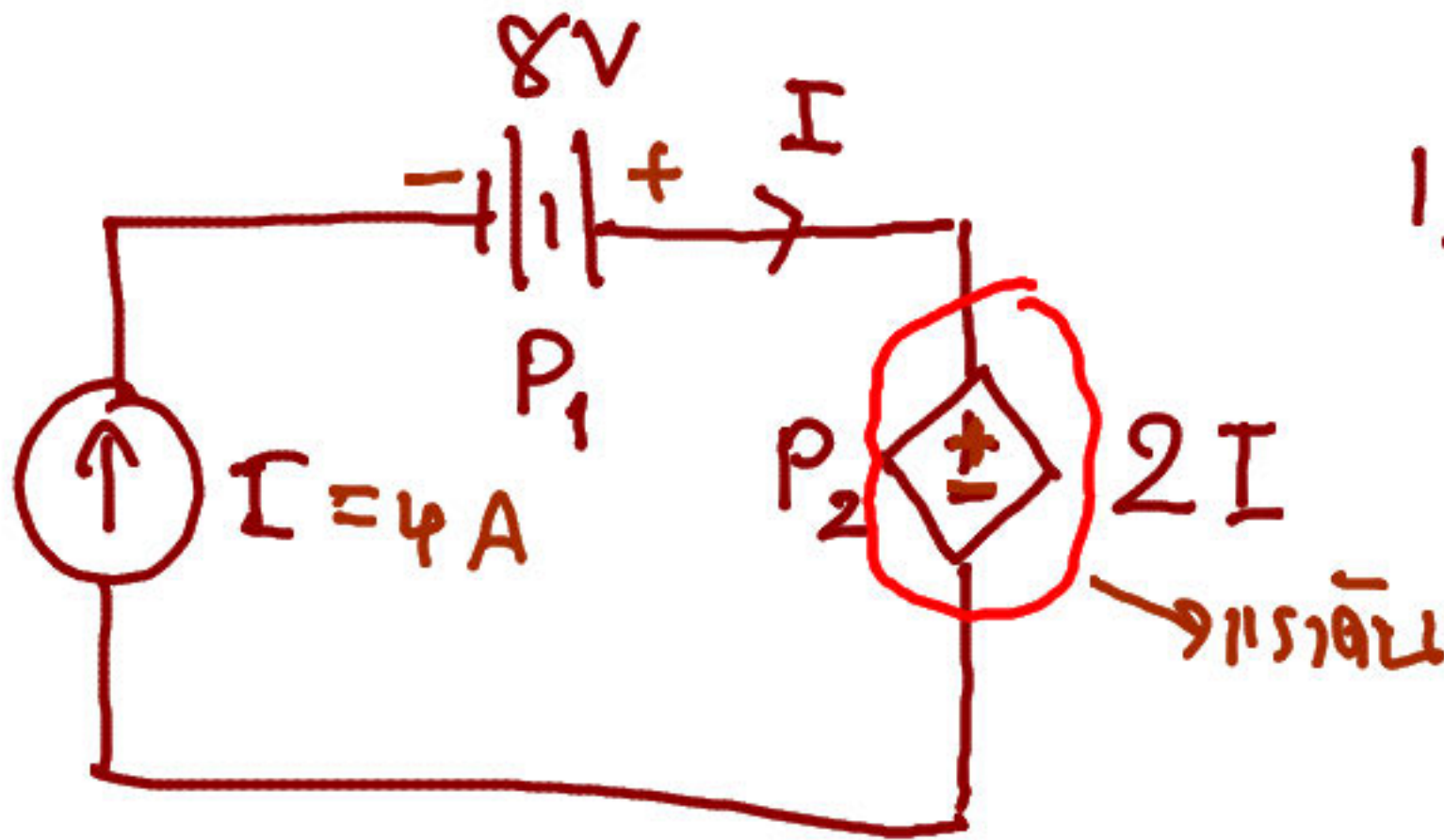
$$2. \quad V = 3 \text{ V}, I = -2 \text{ A}$$

$$P = -6 \text{ W}$$

$$3. \quad V = -6 \text{ V}, I = -8 \text{ A}$$

$$P = 48 \text{ W}$$

②



1. $I = 4A$

or P_1 and P_2

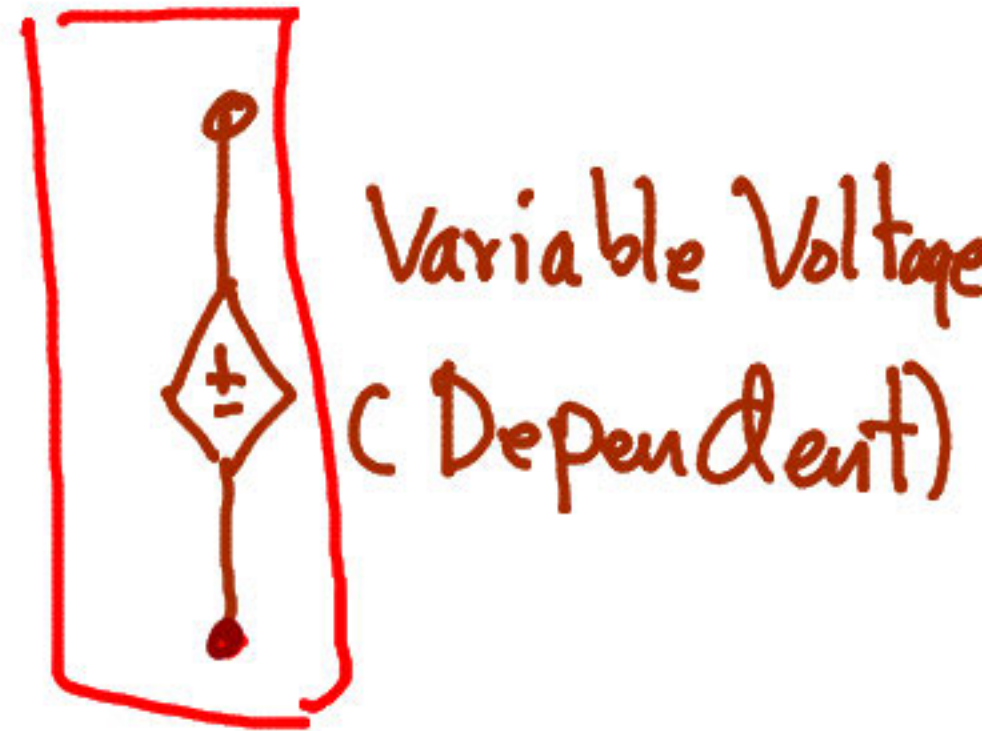
$$P_1 = IV = (4) \times (-8) = -32W$$

$$P_2 = (2I)I = 2I^2 = 2(4^2) = 32W$$

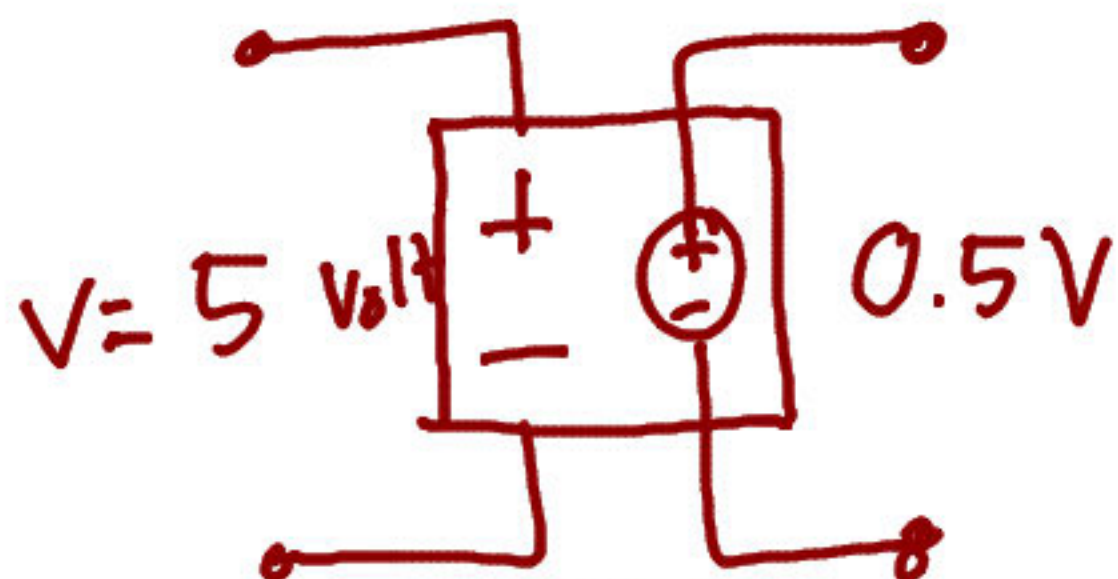
2. $I = -3A \rightarrow P_1, P_2$

$$P_1 = 24W, P_2 = 18W$$

Source



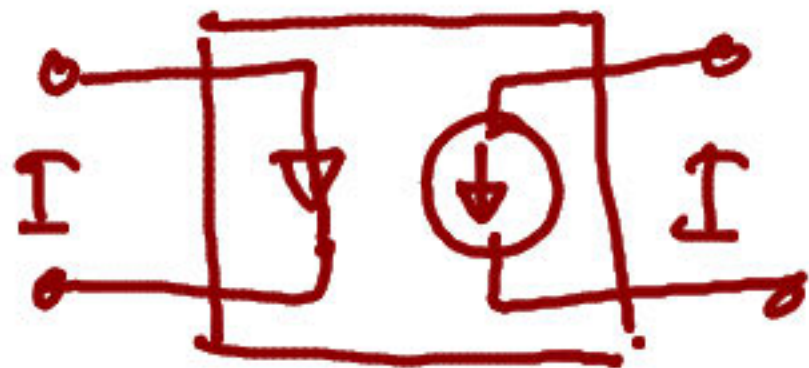
Dependent Source (নির্ভরশীল উৎস)



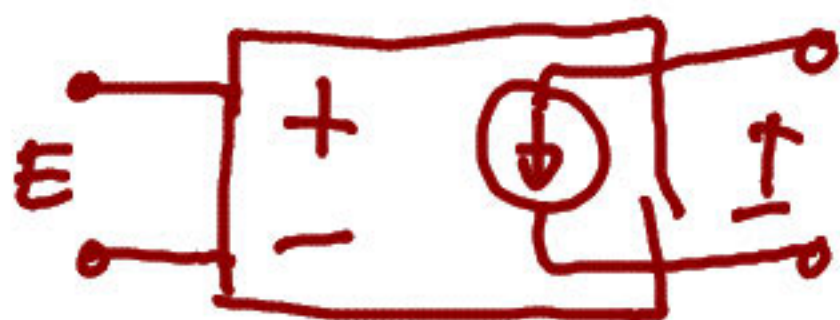
Voltage Controlled Voltage Source.



Current Controlled Voltage S.



Current Controlled Current Source.



Voltage Controlled Current Source.

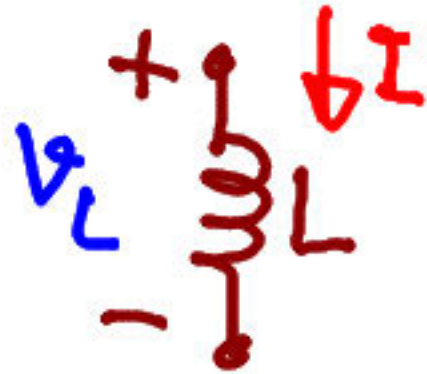
Circuit Element

↳ Passive

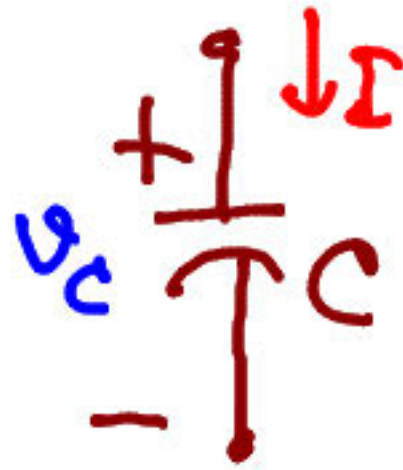
(ຮັບພລັງກາມ)



$$R = \frac{V_R}{I}$$



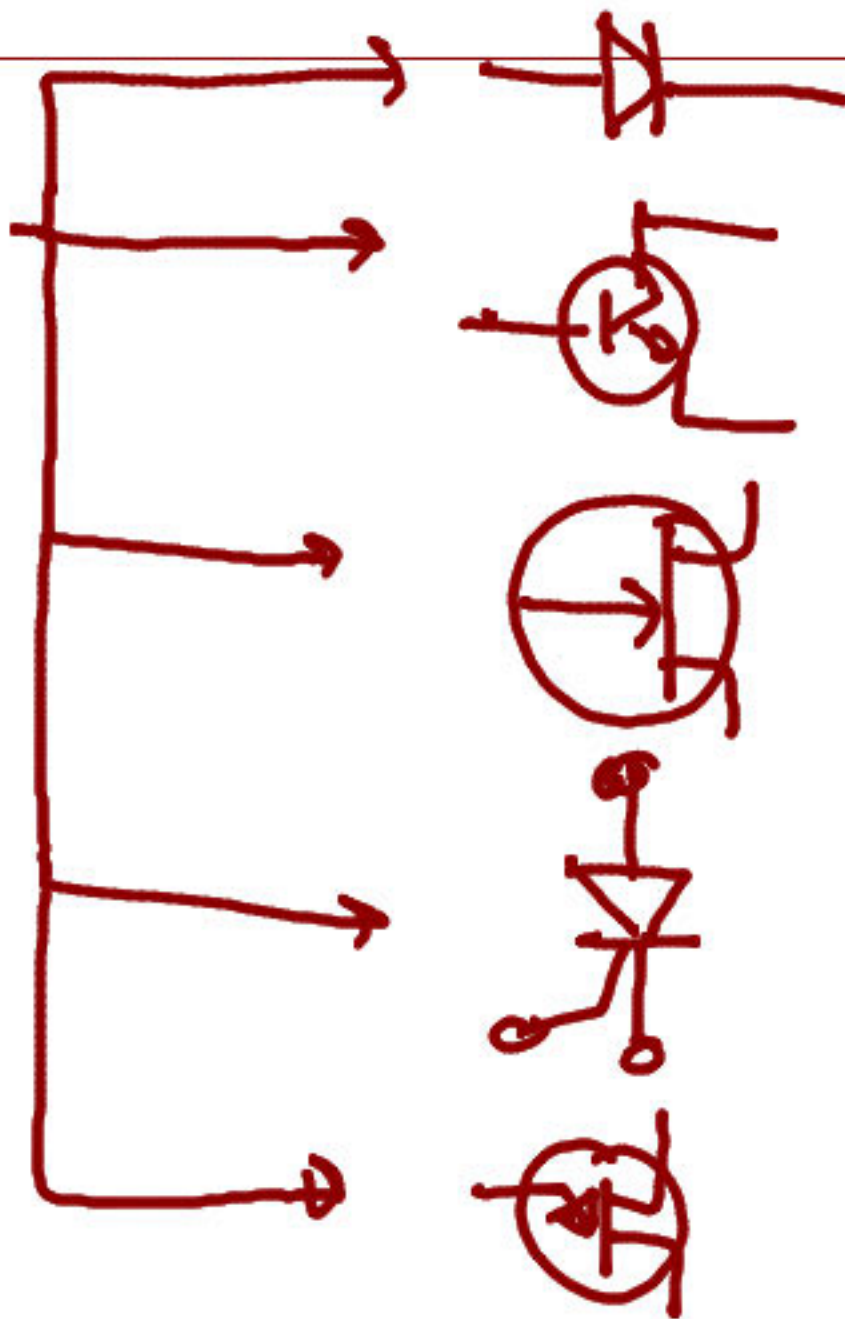
$$V_L = L \frac{di}{dt}$$



$$V_C = \frac{1}{C} \int i dt$$

Circuit Element

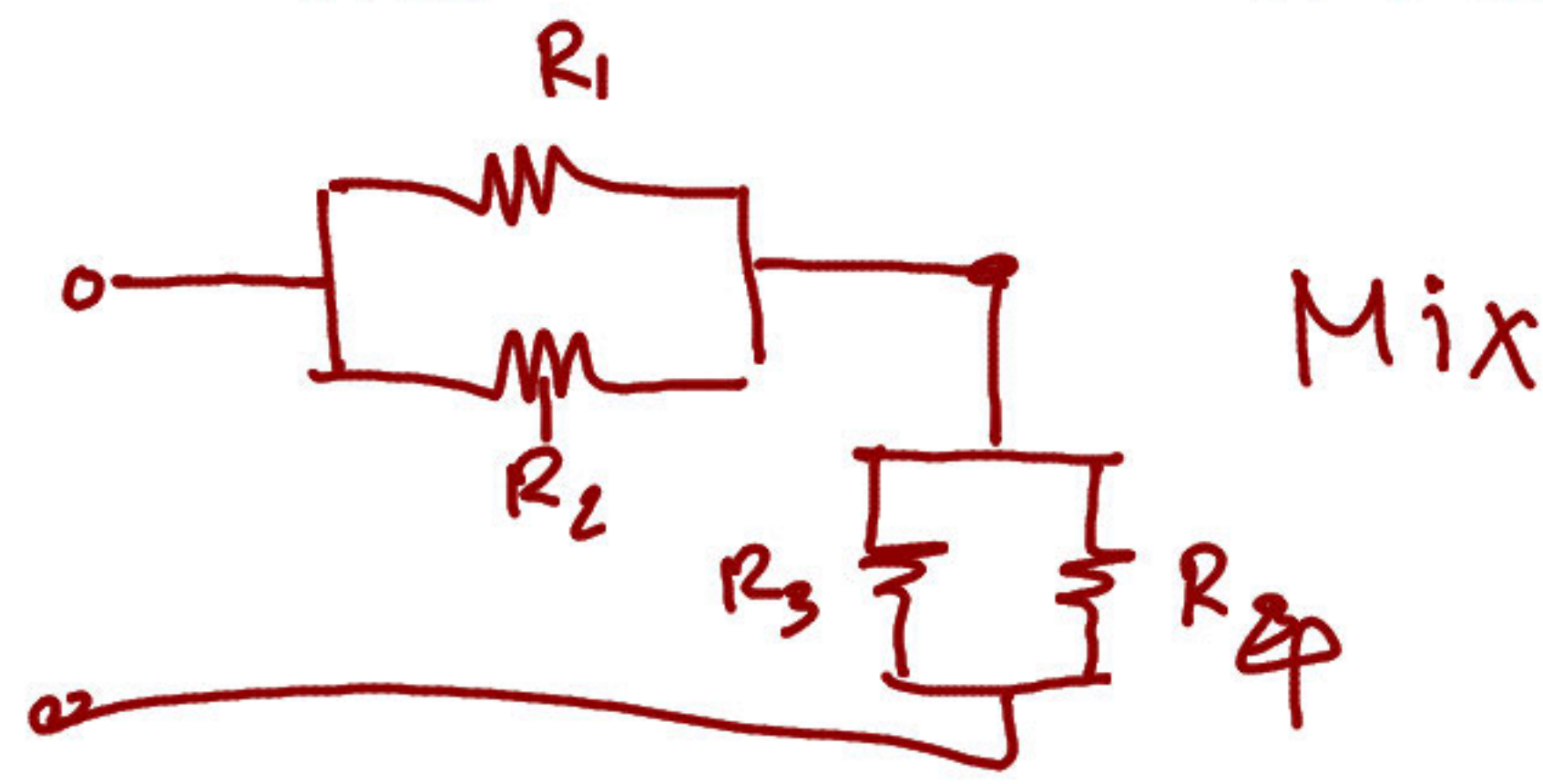
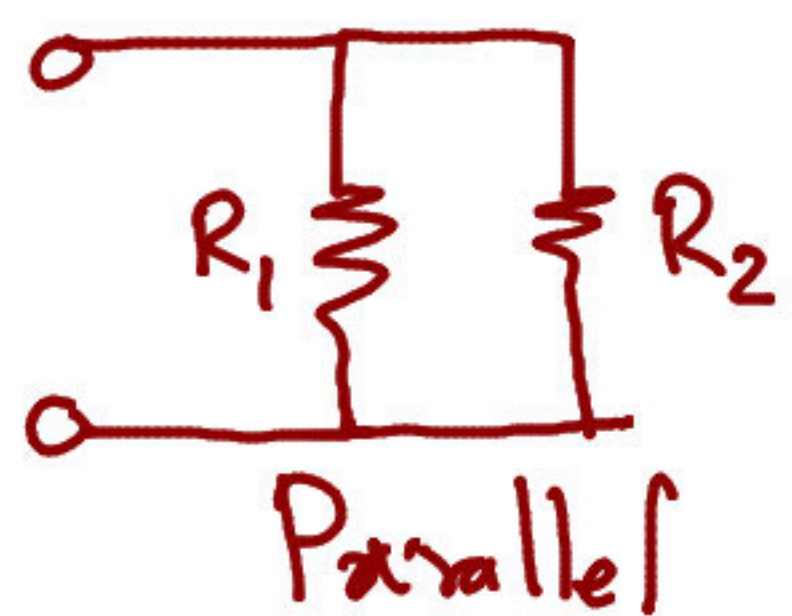
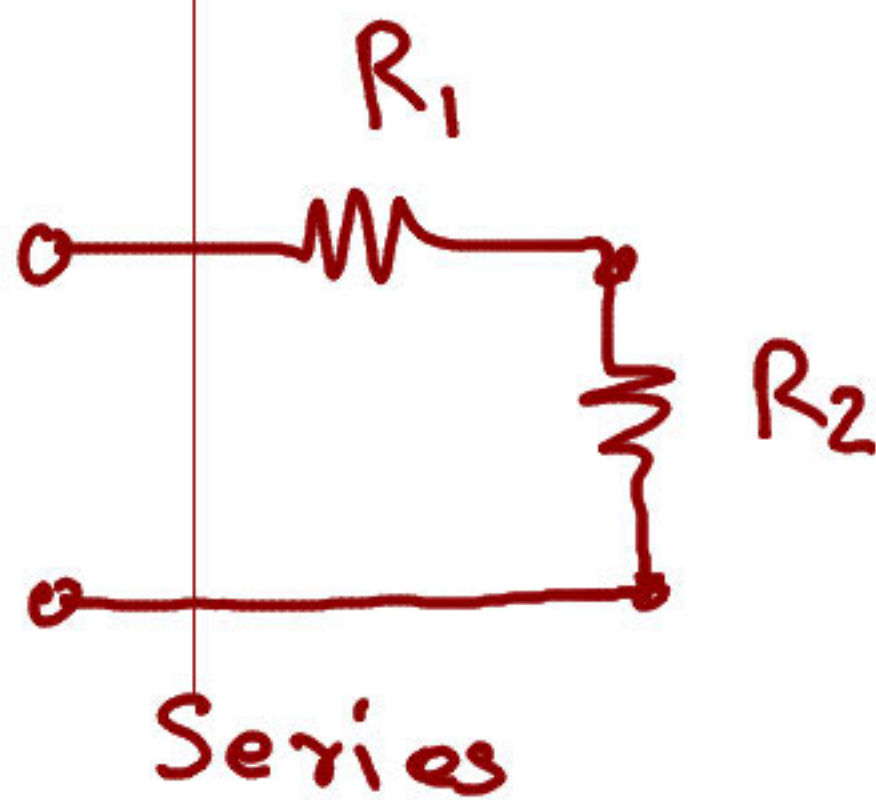
↳ Active

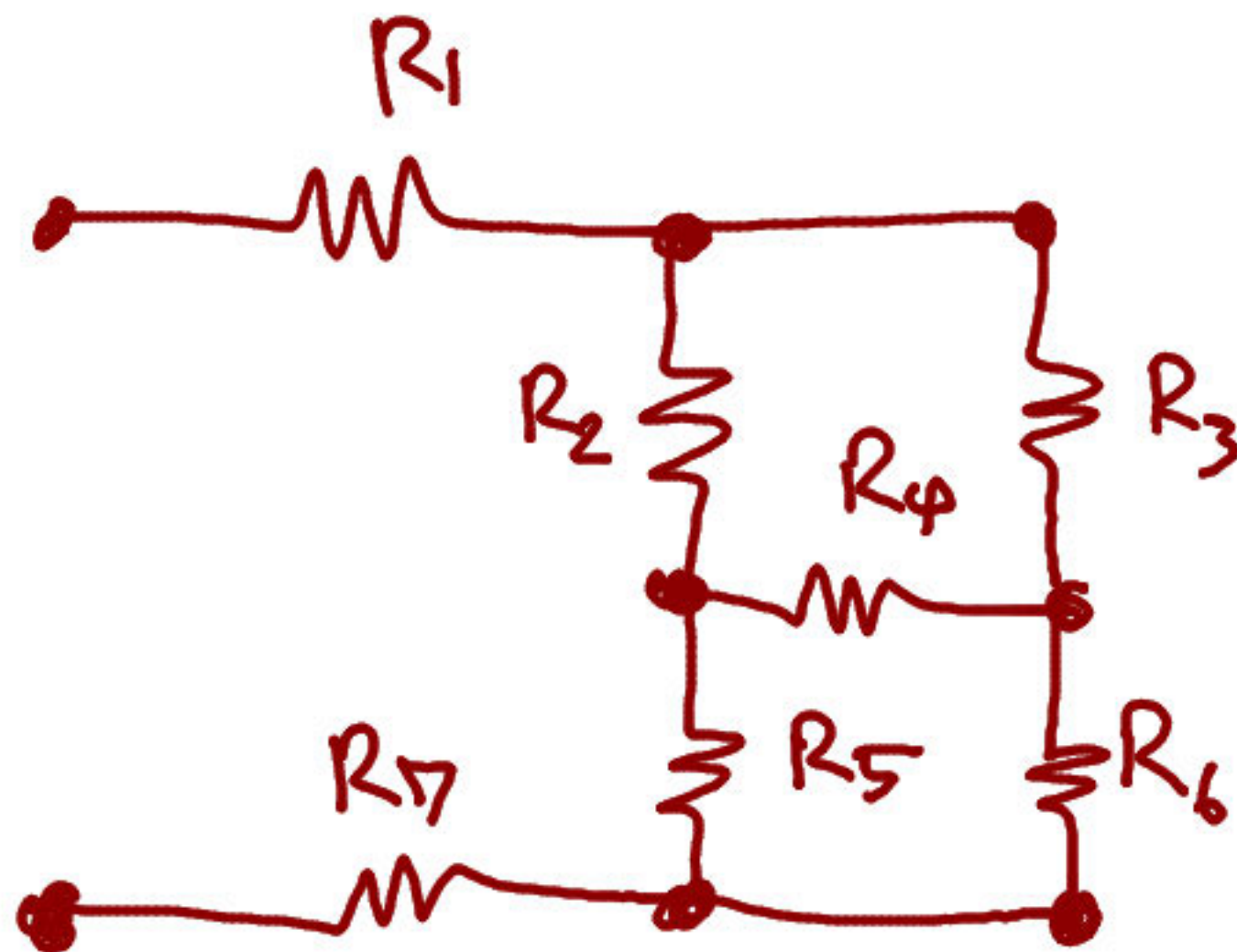


(อิล็กทอนิกส์)

Circuits element Combination

- Series Resistor (ပုဂံအား)
- Parallel Resistor (ချမျှ)
- Mix Resistor (မလဲအား)
- Complex ($Y \leftrightarrow \Delta$)

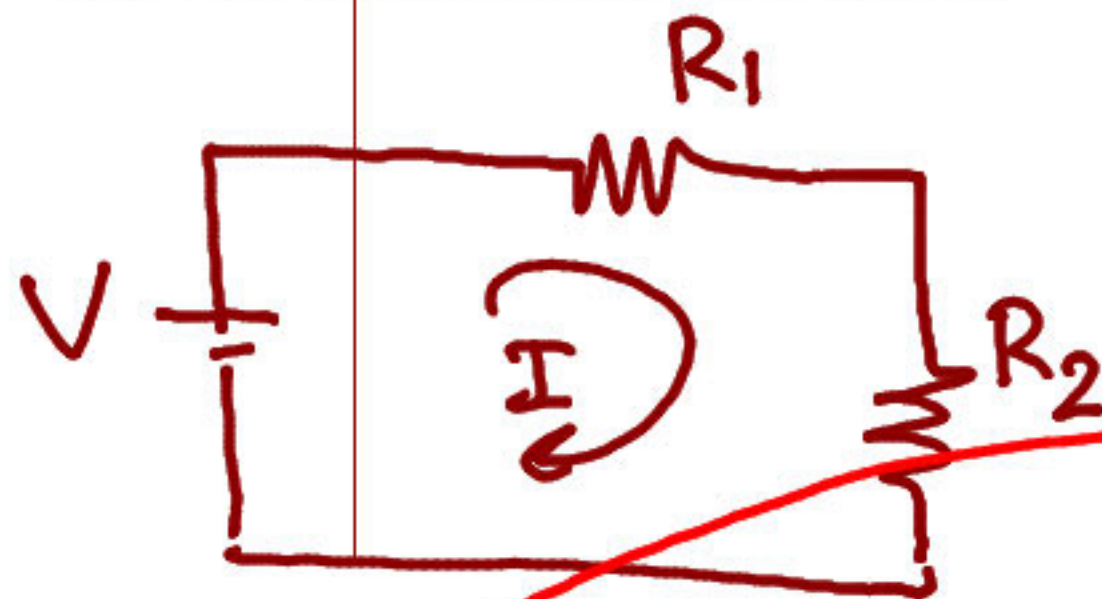




Complex

Circuit Connection (with supply)

→ Voltage Divider → Ohm's



Ohm's

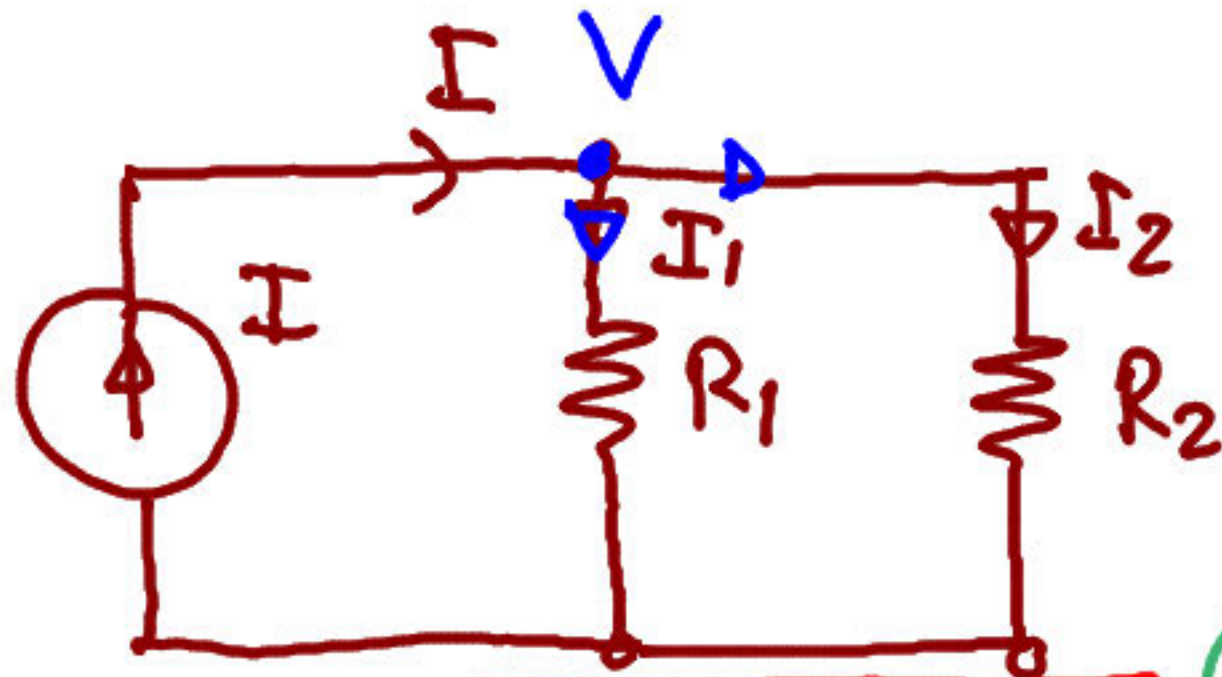
$$I = \frac{V}{R_1 + R_2}$$

$V_{R_1} =$
 $V_{R_2} =$

$$V_{R_1} = I R_1 = \frac{V}{R_1 + R_2} \cdot R_1$$

$$V_{R_2} = I R_2 = \frac{V}{R_1 + R_2} \cdot R_2$$

Current Divider (current)



$$I = I_1 + I_2$$

$$I = \frac{V}{R_1} + \frac{V}{R_2}$$

Ohm's Law

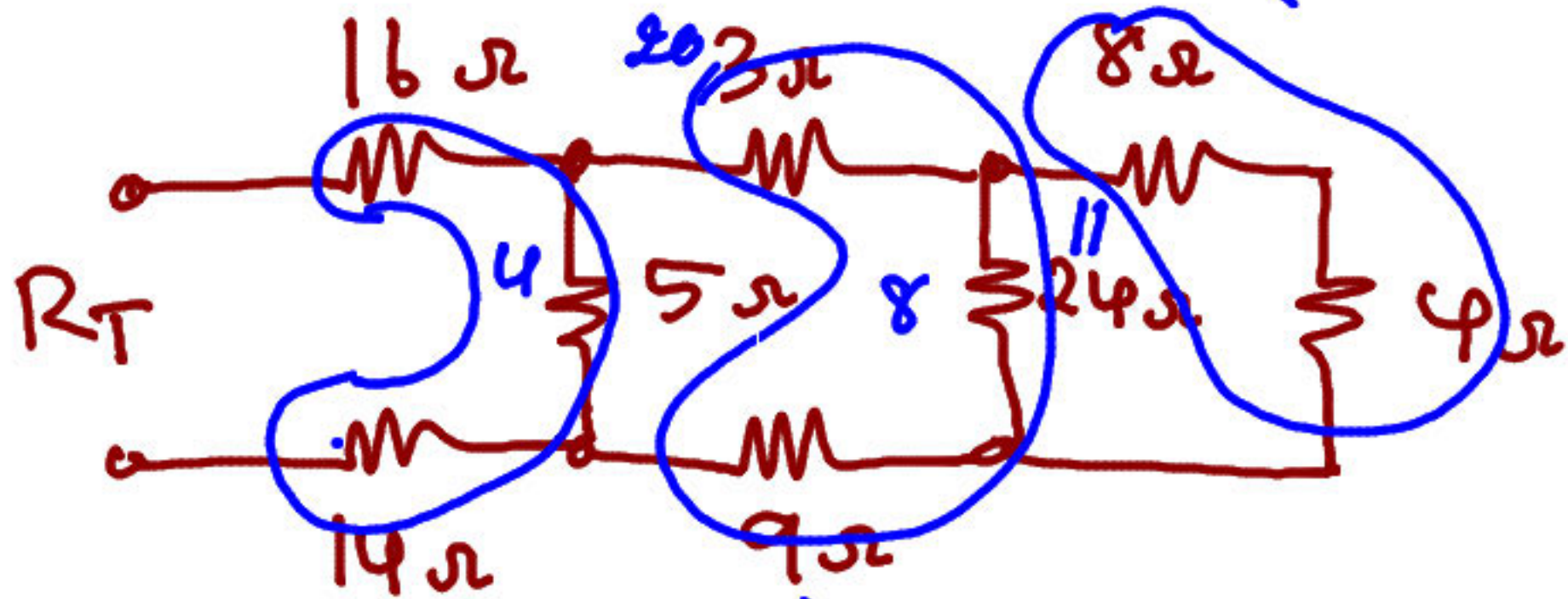
$$I = \frac{R_1 + R_2}{R_1 \cdot R_2} \cdot V$$

$$R = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

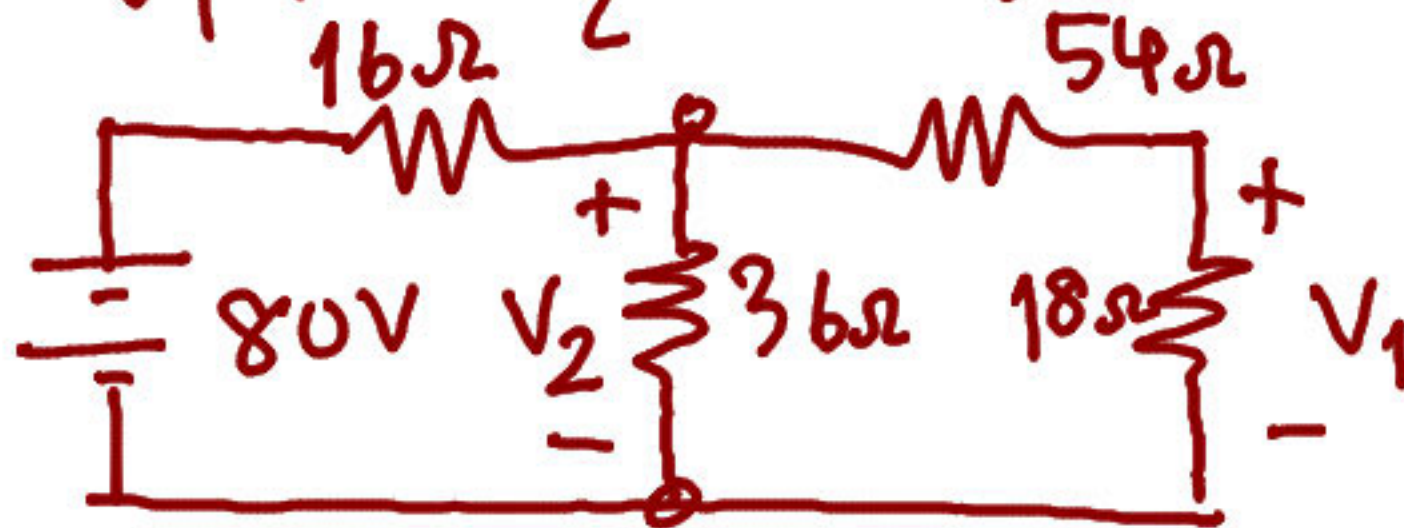
$$I_1 = \frac{V}{R_1} = \frac{R_2}{R_1 + R_2} \cdot I$$

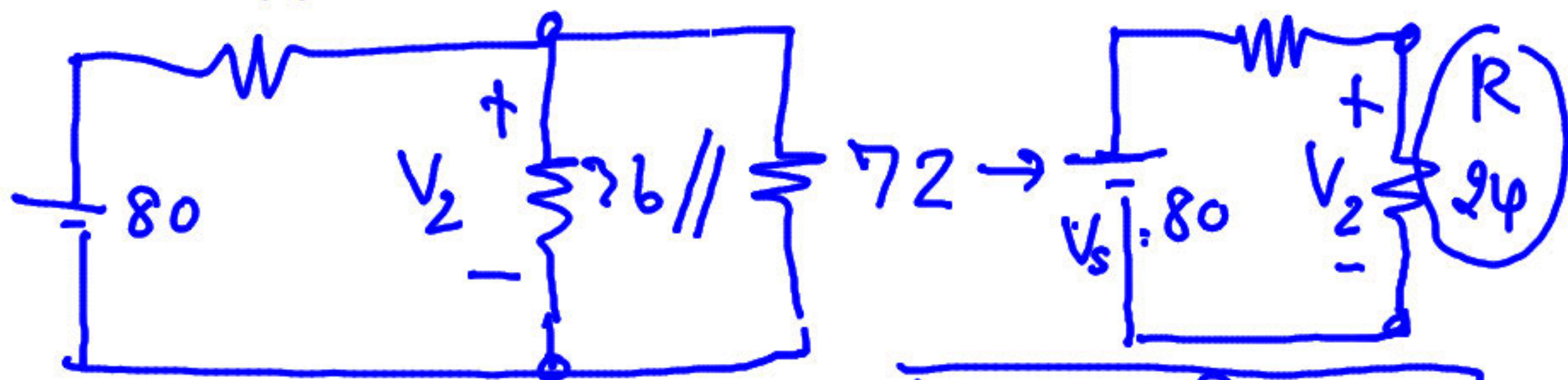
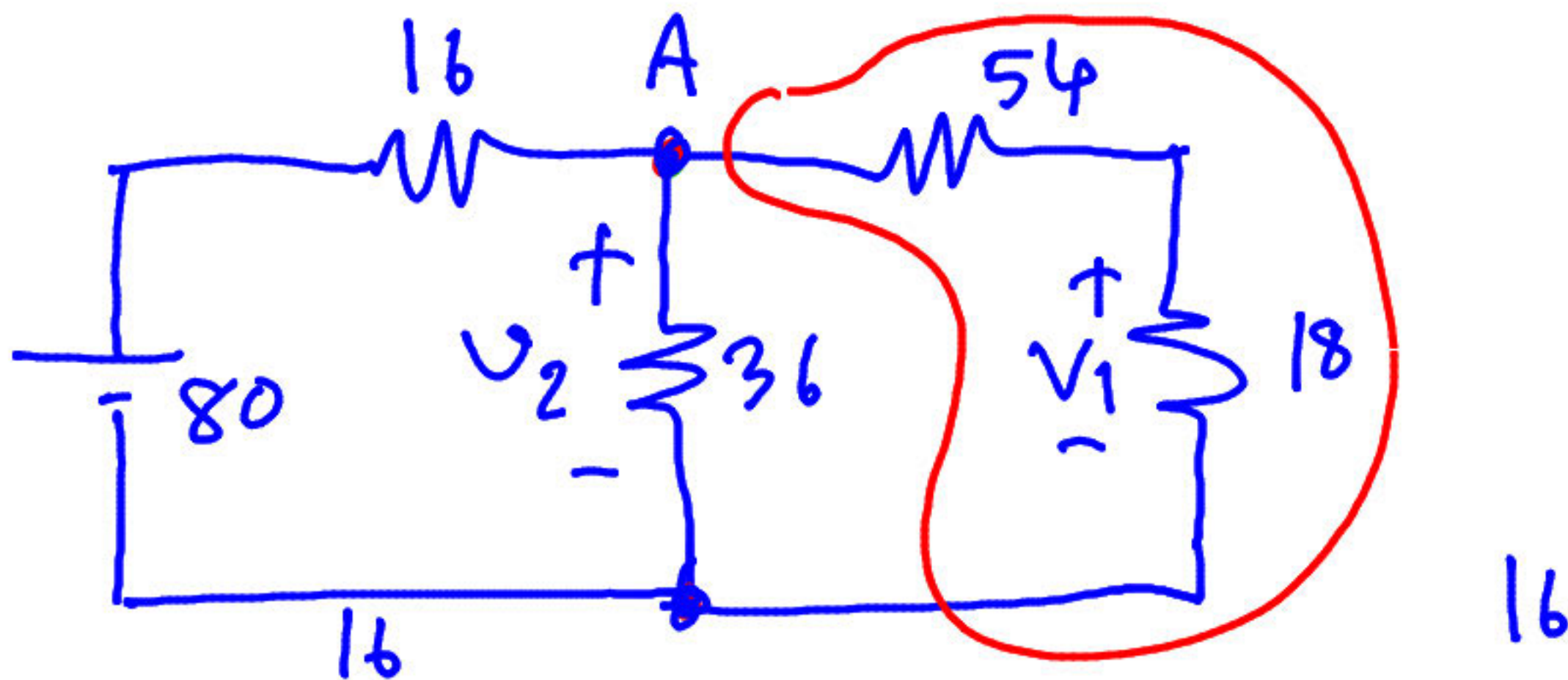
$$I_2 = \frac{V}{R_2} = \frac{R_1}{R_1 + R_2} \cdot I$$

1. ຈົບຄ່າລວມທັງໝົດ R_T (34 Ω)

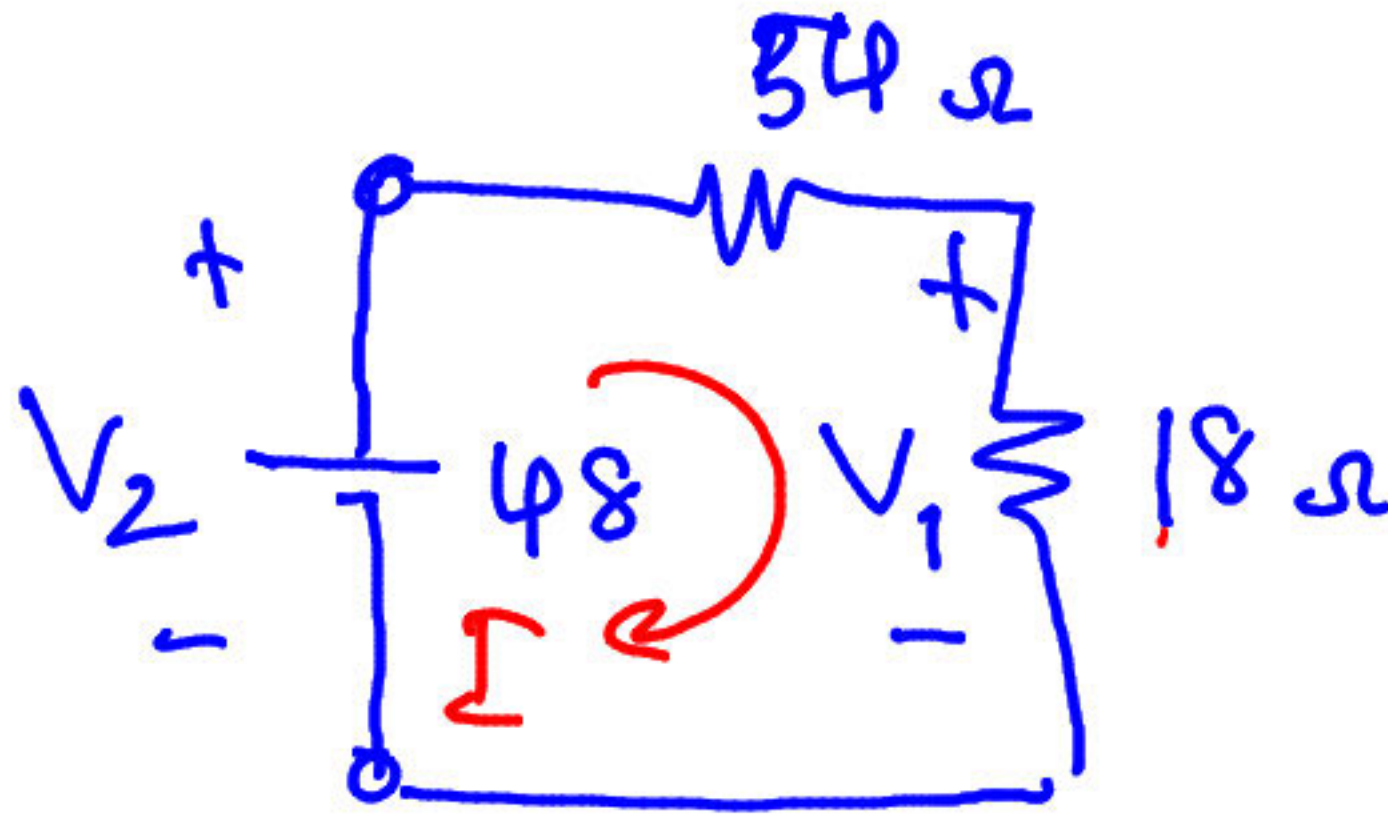


2. ຈົບຄ່າ V_1 ແລະ V_2 ໂດຍໃຊ້ Voltage Divider (48V)





$$\therefore V_2 = \frac{24}{(16+24)} \times 80 \rightarrow V_2 = \frac{R}{16+R} \times V_s$$

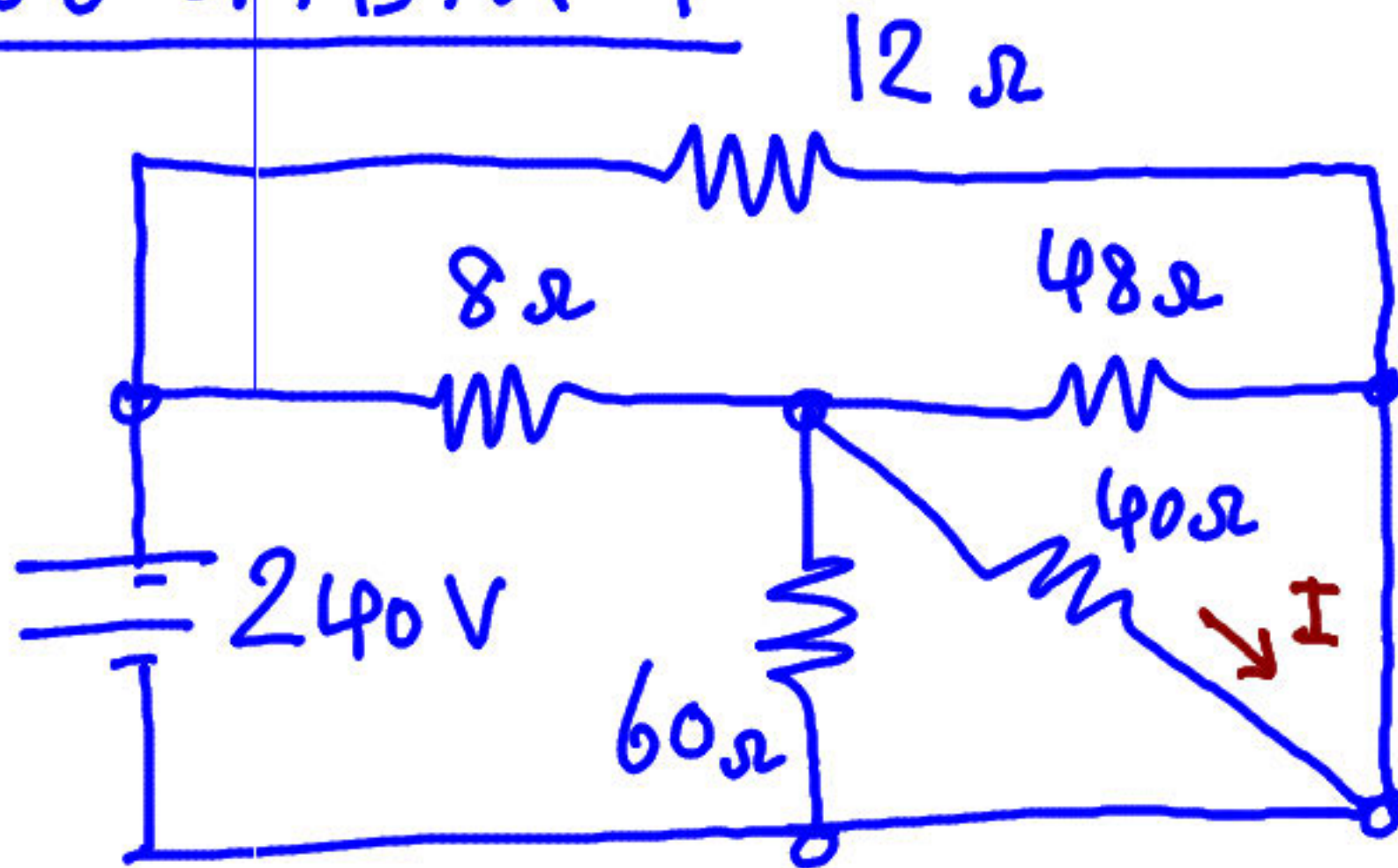


$$I = \frac{48}{54+18} = 0.67\text{ A}$$

$$V_1 = \frac{18}{54+18} \times 48 = 12\text{ V}$$

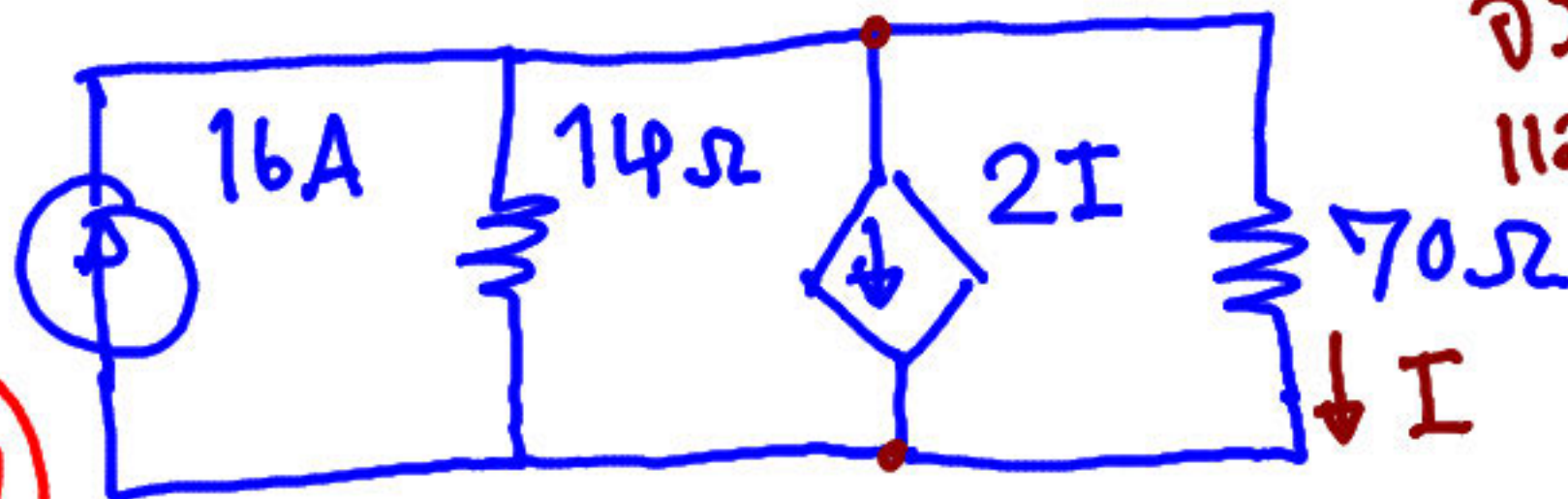
ทรานซิสเตอร์ 1

①



จงหา I
(4 A)

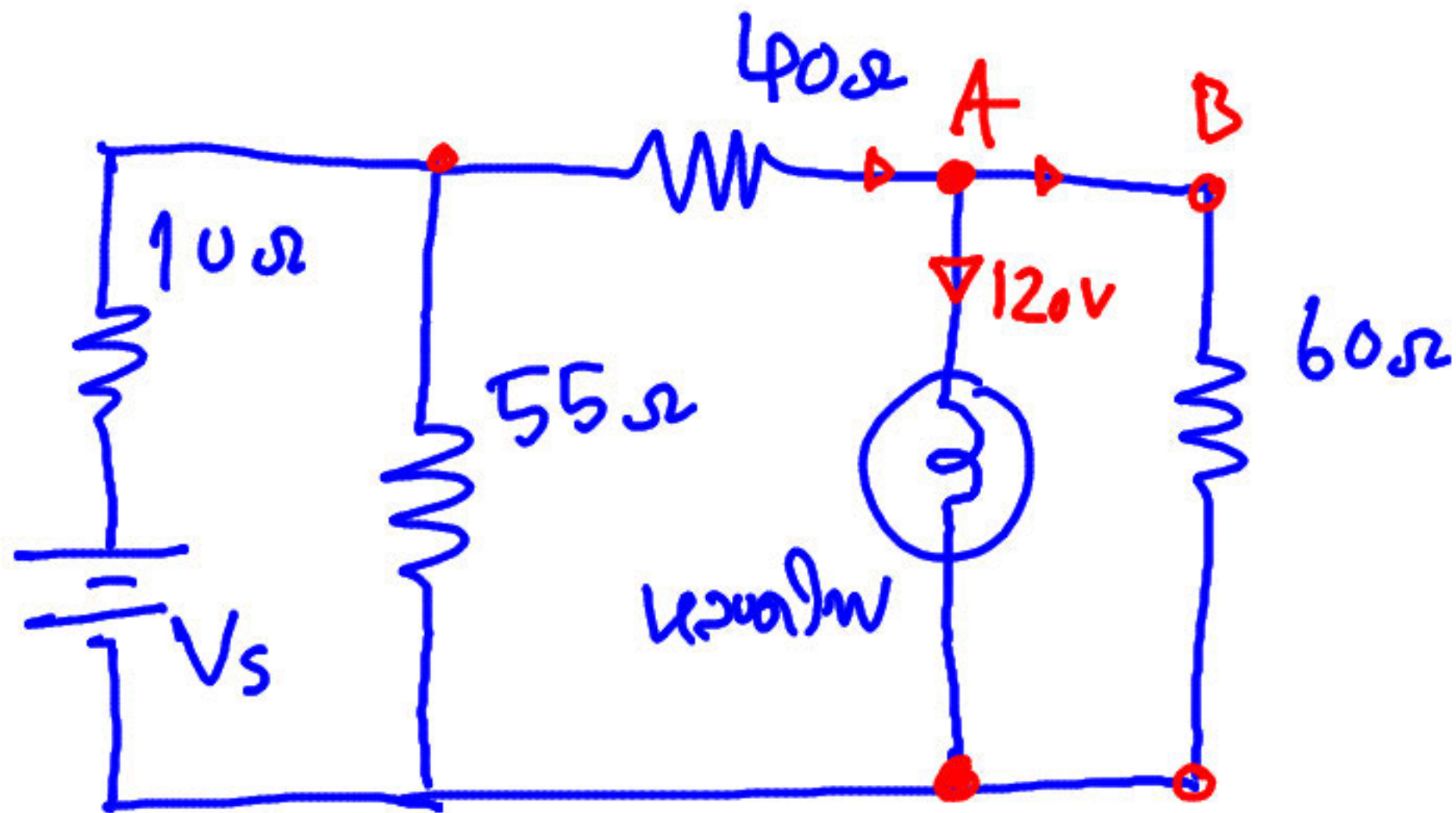
②



จงหา I
และ พลังงานที่
ได้รับโดย
แหล่งจ่าย Dependent

(2 A)
(560 W)

③



- แหล่งไฟ 120V, 60W

จงหา V_s ที่ทำให้หลอดไฟเริ่มสว่าง
(285 V)