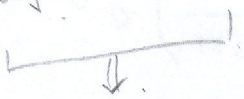
2017.09.04. Mechatronics.

Mechanical	electrical.
Flow rate. [mm³/min]	Current [A]
Pressure [Pa]	Voltage [V]



Pipe line maker - Circuit

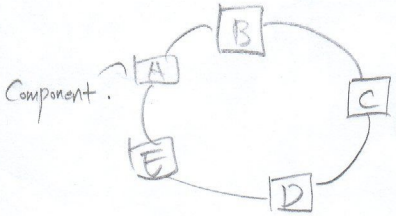
Nozzle.	Resistor [Ω]
Accumulator. (tank)	Capacitor [F]

Laws of circuit

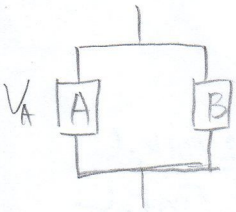
Kirchhoff's law.

1) Voltage.

Any loop (Closed)



$\sum V_i = 0$.



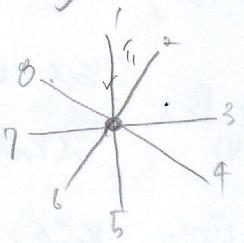
Parallel.

$-V_A + V_B = 0$

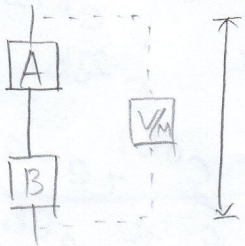
$V_A = V_B$ = const.

2) Current.

Any Junction.



$\sum I_i = 0$



Serial

$-V_A - V_B + V = 0$.

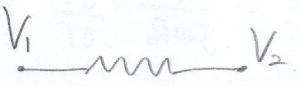
$\therefore V = V_A + V_B$ (Voltage divide)

$I_A = I_B = I$

Elements.

1. Resistor

: 60 ~ 70% all electrical elements



: To restrict current. = control.

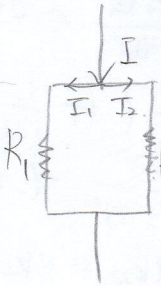
Drop voltage.

→ To Work/Functioning.

→ To dissipate energy

Law : $I = \frac{V_1 - V_2}{R}$ (Ohm's law)

1) Parallel connection.



$V_1 = V_2$ = const.

$I = I_1 + I_2$.

$\frac{V}{R_{tot}} = \frac{V}{R_1} + \frac{V}{R_2}$

$R_{tot} = \frac{R_1 R_2}{R_1 + R_2}$

① $R_1 = R_2 = R$,

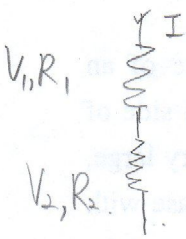
$R_{tot} = \frac{R^2}{2R} = \frac{R}{2}$.

② $R_1 >> R_2$

$R_{tot} = \frac{R_1 R_2}{R_1 + R_2} = \frac{R_1 R_2}{R_1(1 + \frac{R_2}{R_1})} \to 0 = R_2$.

Smaller R_2, dominates.

2) Serial Connection.



$V = V_1 + V_2$

$R_{tot} I = R_1 I + R_2 I$

$\therefore R_{tot} = R_1 + R_2$.

① $R_1 = R_2 = R$.

$R_{tot} = 2R$.

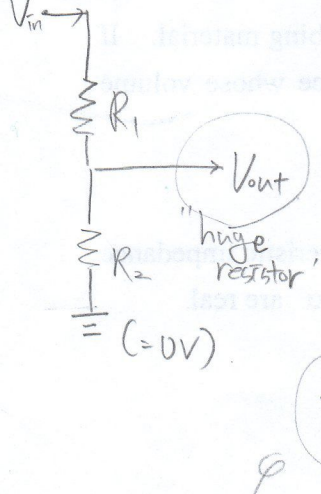
② $R_1 \gg R_2$.

$R_{tot} = R_1 + R_2$

$= R_1 (1 + R_2/R_1)$ ($R_2/R_1 \to 0$)

$\approx R_1$.

* Voltage Divider.



$I = \frac{V_{in}}{R_1 + R_2}$

$V_{out} = I \cdot R_2$

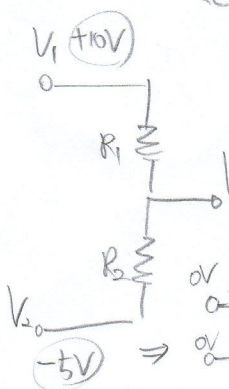
$= V_{in} \frac{R_2}{R_1 + R_2}$.

$\frac{V_{out}}{V_{in}} = \frac{R_2}{R_1 + R_2}$.

↓

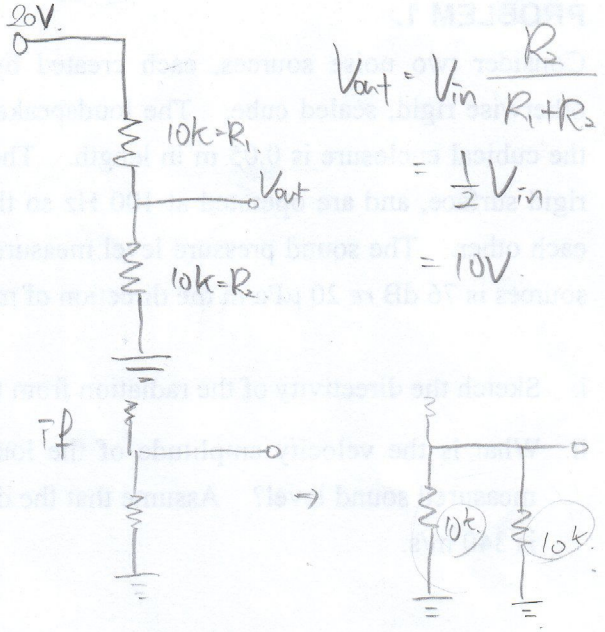
Can be adjusted by R_1, R_2 choosing.

Generalized Voltage Divider.



$V_{out} = V_2 + (V_1 - V_2) \frac{R_2}{R_1 + R_2}$.

Ex)

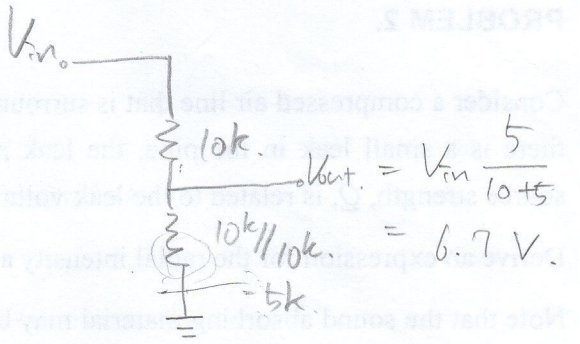


$V_{out} = V_{in} \frac{R_2}{R_1 + R_2}$.

$= \frac{1}{2} V_{in}$

$= 10V$.

① Conventional

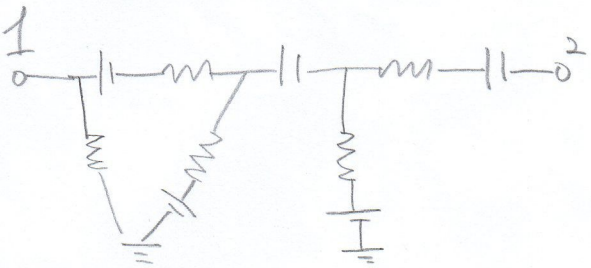


$V_{out} = V_{in} \frac{5}{10+5}$

$= 6.7\,V$.

② Thevenins' Mettices.

For Any Circuit. of R_i, V_i.



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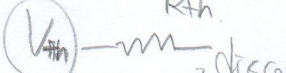
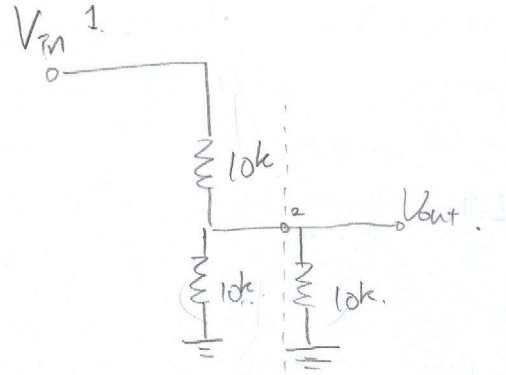


Vth : Open Voltage when nothing is attached.

By Voltmeter measurement or Calculation.

$R_{th} = \frac{V_{Th}}{I_{sc}}$ I_{sc} : short Circuited

③.



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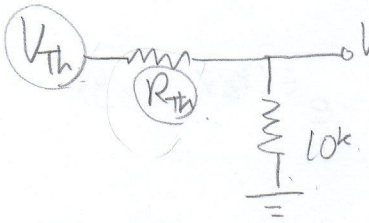

V_{Th} = Open Voltage.

$$= V_{in} \frac{R_2}{R_1+R_2}$$

$$V_{out} = V_{Th} \cdot \frac{10k}{R_{Th}+10k}$$

$$R_{Th} = \frac{V_{Th}}{I_{sc}}, \quad I_{sc} = \frac{V_{in}}{R_1}$$

$$R_{Th} = V_{in} \frac{R_2}{R_1+R_2} \frac{R_1}{V_{in}}$$

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

$\frac{10}{R_{Th}+10} = \frac{10}{5+10}$ ≠ 15

20 Ω

Hw1.