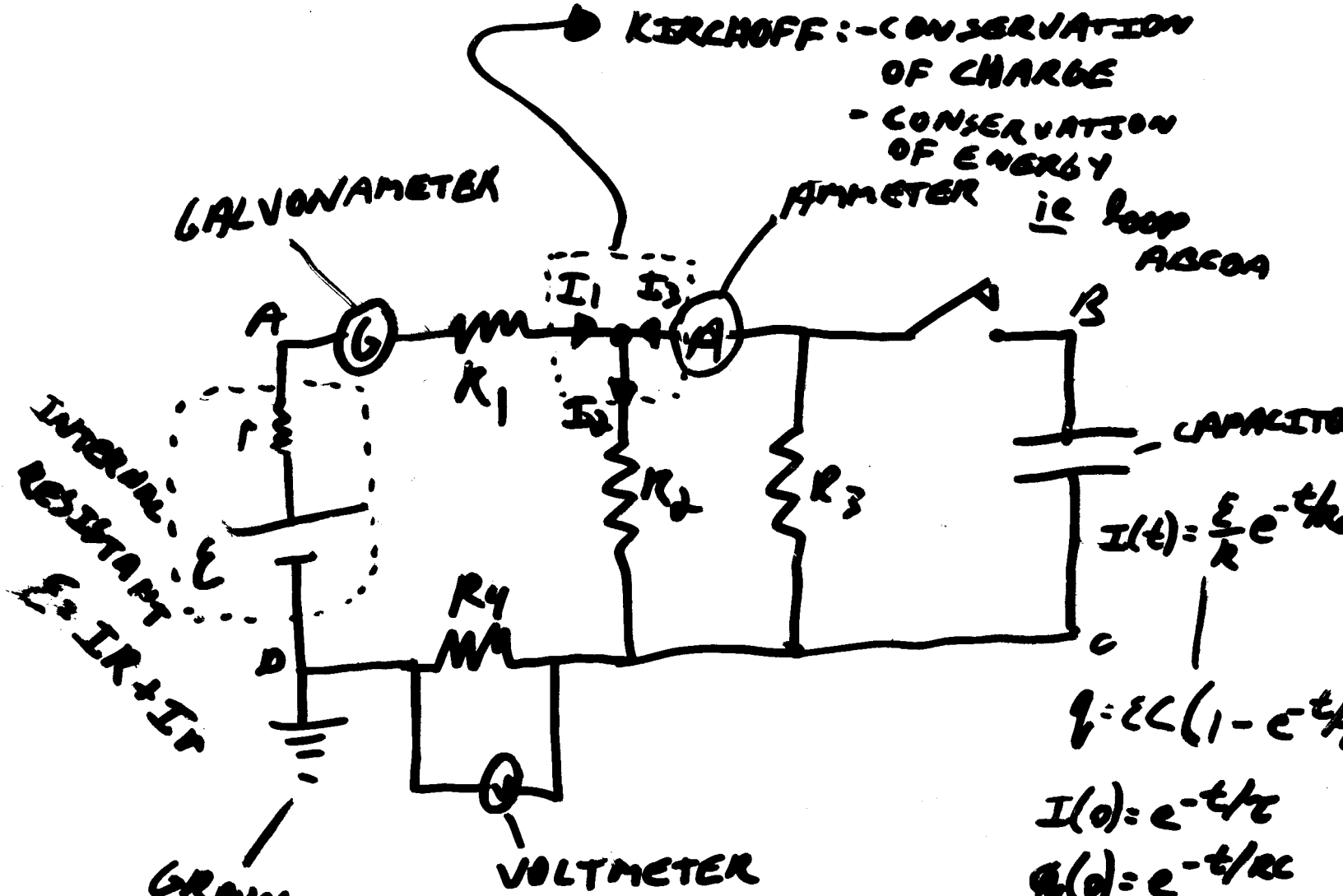
CHAPTER 28

SERIES → $R_{eq} = R_1 + R_2 + \cdots$

PARALLEL → $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$



OTHER DEVICES

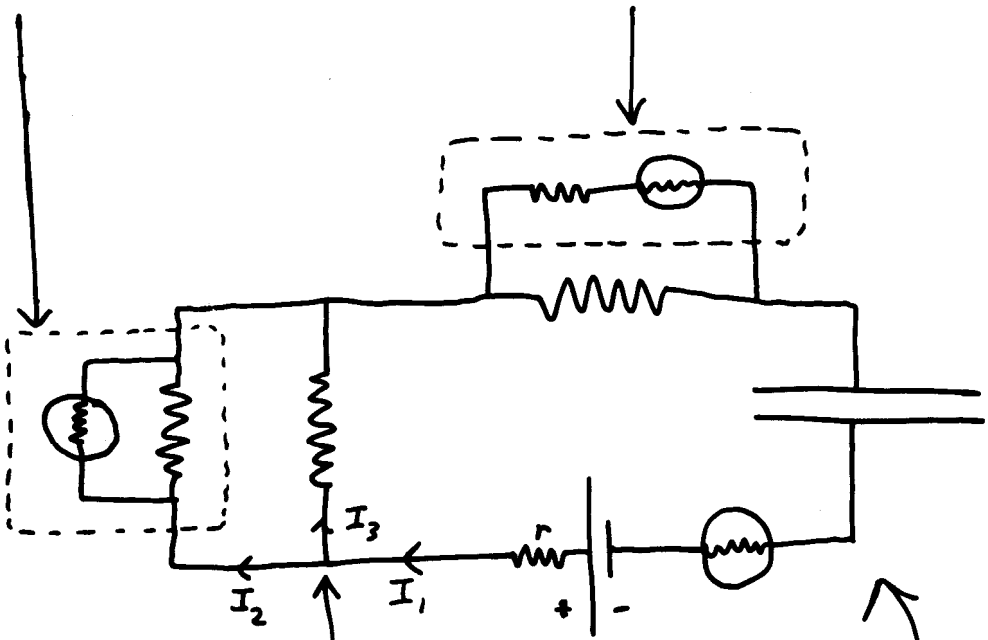
- WHEATSTONE BRIDGE
- POTENTIOMETER

$$V = \frac{q}{C}$$

CHAPTER 28

AMMETER

VOLTMETER



CAPACITOR

$\mathcal{E} = \frac{V}{d}$ $F = q\mathcal{E}$

$q(t) = q_{max}(1 - e^{-t/RC})$

$I(t) = I_{max} e^{-t/RC}$

JUNCTION RULE:

$I_1 = I_2 + I_3$

IN SERIES:

$I_1 = I_2$

SOURCE OF EMF

$\mathcal{E} = I(R + r)$

PARALLEL:

$\frac{1}{R_E} = \frac{1}{R_1} + \frac{1}{R_2}$

SERIES:

$R_E = R_1 + R_2$

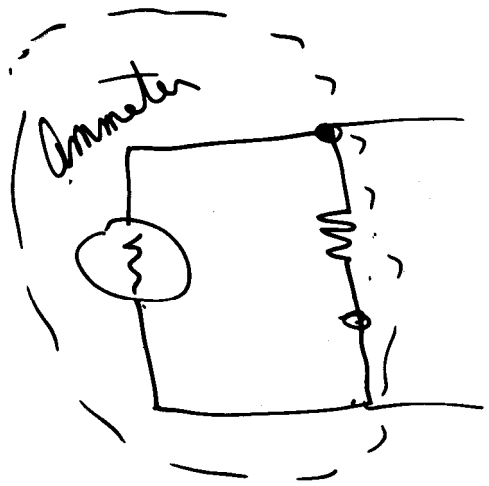
KIRCHOFF'S RULES

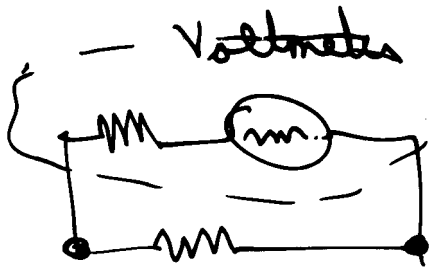
CONSERVATION OF CHARGE

$\sum_j I_j = 0$

CONSERVATION OF ENERGY

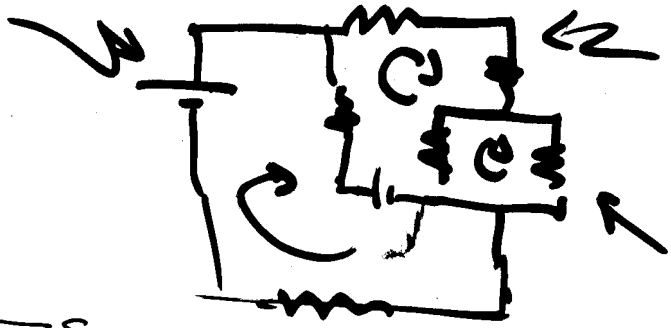
$\sum_j \Delta V_j = 0$





$R_x = \frac{R_2 R_3}{R_1}$

Emf DC CIRCUITS

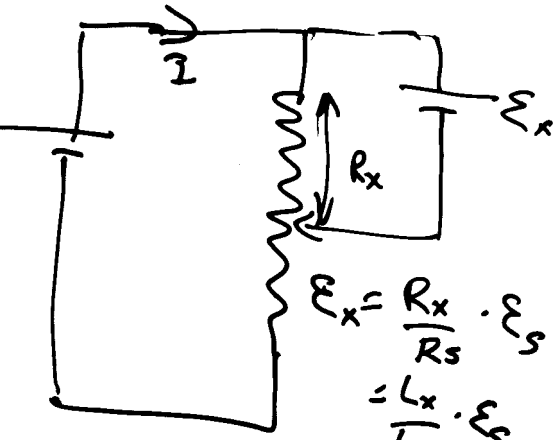


Series

$R_T = \sum_i R_i$

$\frac{1}{R_T} = \sum_i \frac{1}{R_i}$

Potentiometer



$\mathcal{E}_x = \frac{R_x}{R_s} \cdot \mathcal{E}_s = \frac{L_x}{L_s} \cdot \mathcal{E}_s$

Kirchhoff: $\sum I_j = 0$

$\sum \Delta V_j = 0$

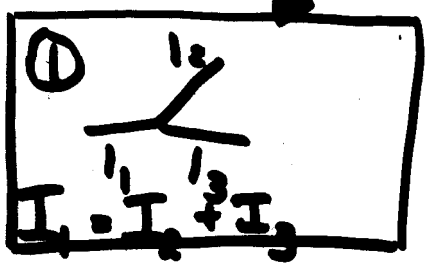
Capacitor

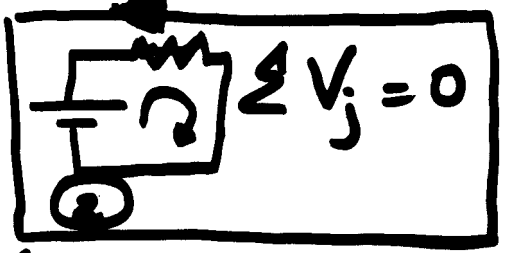
$E = \frac{\sigma}{\epsilon_0} = \frac{q}{\epsilon_0 A} \Rightarrow V = Ed = q/C$ ⇒ charging & discharging C

$\oint E \cdot dA = q/\epsilon_0$

EMF $\Rightarrow \mathcal{E} = I(R+r)$

Kirchhoff's Laws





Resistors → series $R_{eq} = \sum R_i$

→ Parallel $\frac{1}{R_{eq}} = \sum \frac{1}{R_i}$

CAPACITORS

charging

$q = \mathcal{E}C(1 - e^{-t/RC})$

$q(\infty)$

$I = \mathcal{E}/R\, e^{-t/RC}$

|| plate

$V = \frac{qd}{\varepsilon_0 A} = \frac{q}{C}$

discharging

$q = q(0)e^{-t/RC}$

$I = I(0)e^{-t/RC}$

GALVANOMETER

In series with a resistor is a **VOLTMETER**

In parallel with a resistor is an **AMMETER**

BRIDGE + POTENTIOMETERS

CH. 28

DC CIRCUITS:

$$V = \mathcal{E} - Ir = IR \qquad P = I\mathcal{E} = I^2(R+r)$$

$$I = \frac{\mathcal{E}}{R+r}$$

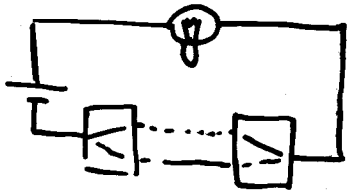
Series: $R_{eq} = R_1 + R_2 + R_3 + \dots R_N$

Parallel: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots \frac{1}{R_N}$

Kirchoff's Rules:

$\sum I_j = 0$ @ junction

$\sum \Delta V_j = 0$ around loop.



RC CIRCUITS

Charging: $I = \frac{\mathcal{E}}{R} e^{-t/RC}$ $\qquad q = q(\infty)(1 - e^{-t/\tau})$

Discharging: (DECAY) $I = I(0)\, e^{-t/\tau}$ $\qquad q = q(0)\, e^{-t/\tau}$

capacitor: $\tau = RC$ ← time constant.

$q_{max} = C\mathcal{E}$ ← voltage
↑ charge ↑ capacitance

$I_{max} = \frac{\mathcal{E}}{R}$ ← volt
↑ current ↑ resis

Electrical Instruments

Ammeter: measures current

Voltmeter: " voltage.

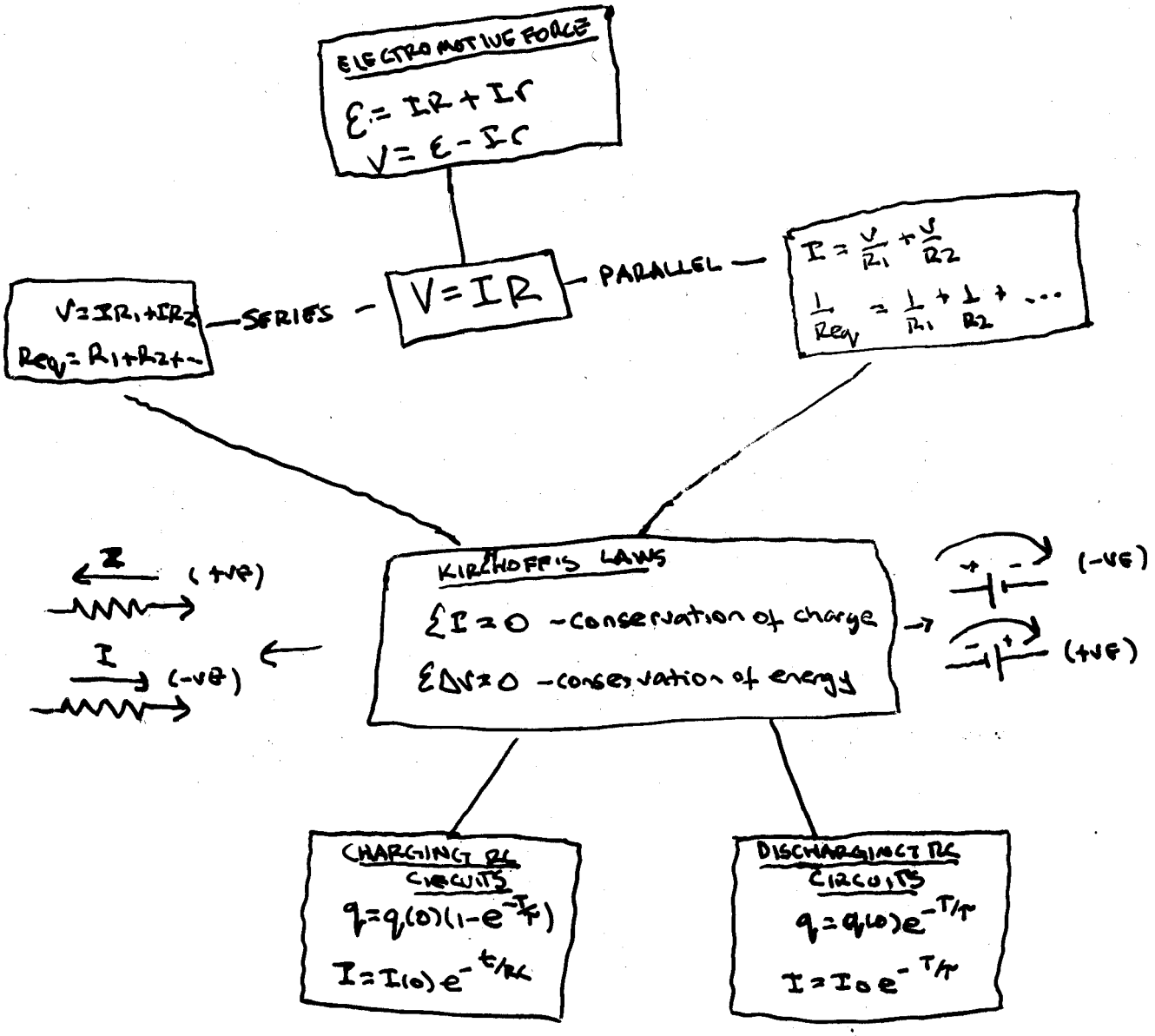
Galvanometer: uses magnetic field to measure current.

Wheatstone Bridge: $R_x = \frac{R_2 R_3}{R_1}$

Potentiometer: $\mathcal{E}_x = \frac{L_x}{L_s} \cdot \mathcal{E}_s \Rightarrow \frac{\mathcal{E}_x}{\mathcal{E}_s} = \frac{R_x}{R_s} = \frac{L_x}{L_s}$

Household Wiring & Electrical Safety:

CHAPTER 28


ELECTROMOTIVE FORCE
$\mathcal{E} = IR + Ir$
$V = \mathcal{E} - Ir$
$V = IR$
SERIES
$V = IR_1 + IR_2$
$R_{eq} = R_1 + R_2 + \cdots$
PARALLEL
$I = \frac{V}{R_1} + \frac{V}{R_2}$
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
KIRCHHOFF'S LAWS
$\Sigma I = 0$ - conservation of charge
$\Sigma \Delta V = 0$ - conservation of energy
R (+VE)
I (-VE)
(-VE)
(+VE)
CHARGING RC CIRCUITS
$q = q(0)(1 - e^{-t/\tau})$
$I = I(0)\, e^{-t/RC}$
DISCHARGING RC CIRCUITS
$q = q(0)\, e^{-t/\tau}$
$I = I_0\, e^{-t/\tau}$