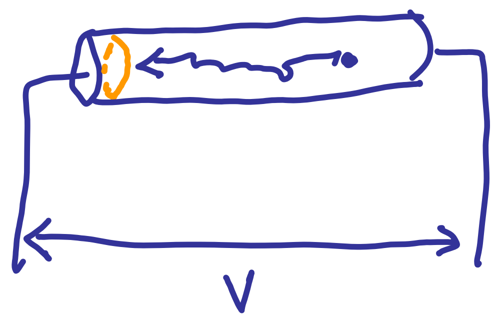
Physics 142 - October 7, 2010

- Try to have Exam I graded to return by next Thursday

Last Time

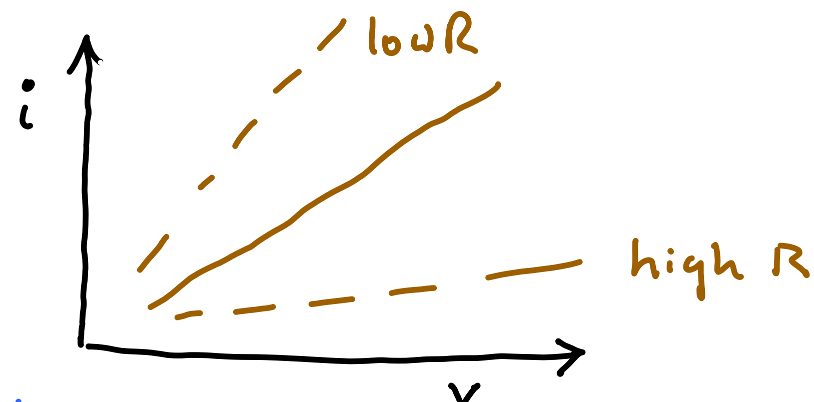


$i = dq/dt$

i in Amperes

electrons impeded as they look for 

$V = iR$



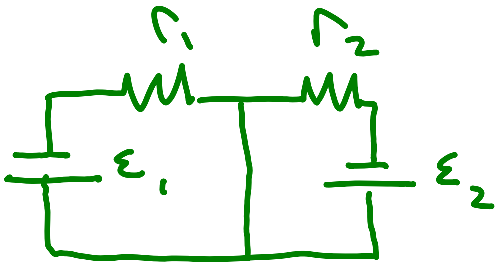
R in Ohms, R depends on material + geometry

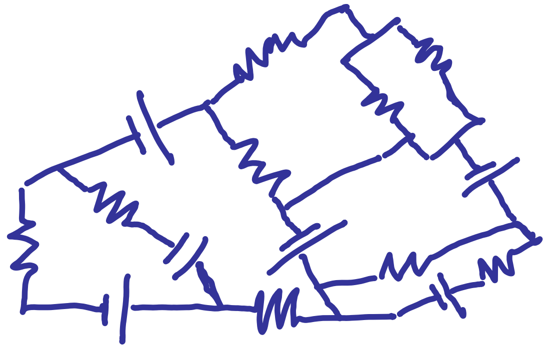
Energy lost to resistance
↳ heat

$$P = iV = \frac{V^2}{R} = i^2 R$$

"Resistive heating"

	Parallel	Series
Resistors	$\frac{1}{R} = \sum \frac{1}{r_i}$	$R = \sum_i r_i$
Capacitors	$C = \sum_i c_i$	$\frac{1}{C} = \sum_i \frac{1}{c_i}$





Suppose you meet a circuit in a dark Alley one night...

... And the electrons Are NOT looking For love...

Kirchoff's Rules:

1. $\Sigma V = 0$ around closed Loop in circuit
2. Current is conserved at any Branch point in circuit

- use these rules to create N independent equations to solve for N unknowns

- Choose independent loops
- Use sign conventions consistently + with care

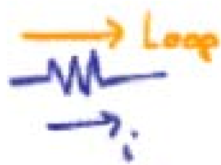
Convention

[told this is opposite that of ECE 210]

↳ no matter if consistent

Choose currents in each branch (arbitrary)

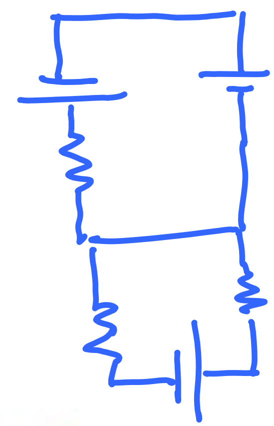
Sum ΔV across each circuit component as you go around an imaginary closed loop in the circuit

ΔV − if 

ε + if 

ΔV + if 

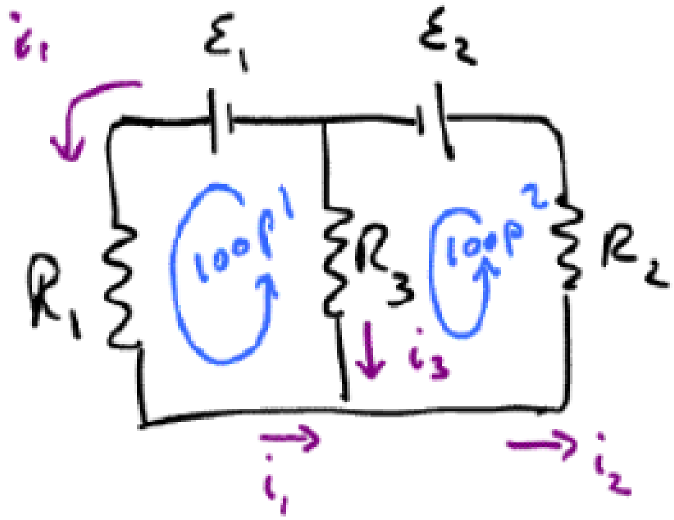
ε − if 



Get N eqns, N unknowns and Solve

Tedious ⟶ must be careful and consistent w/ Conventions and Signs

Use only independent loops



Know $\mathcal{E}_1, \mathcal{E}_2$

R_1, R_2, R_3

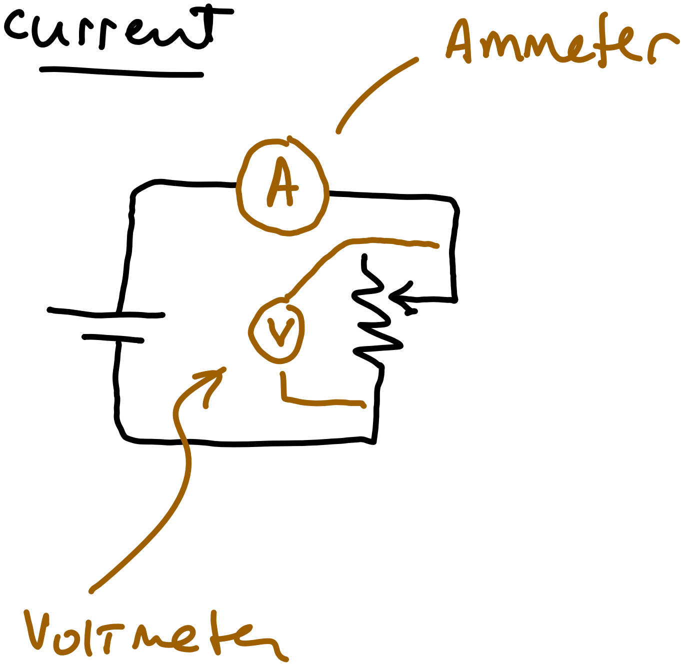
Solve for current throughout circuit

Kirchoff's 2ND rule $\quad i_1 + i_3 = i_2 \quad$ (I)

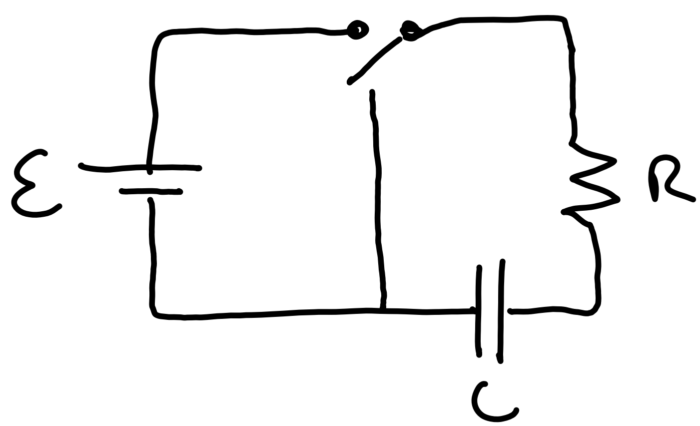
$$\mathcal{E}_1 - i_1 R_1 + i_3 R_3 = 0 \quad \text{(II)}$$

$$-i_3 R_3 - i_2 R_2 - \mathcal{E}_2 = 0 \quad \text{(III)}$$

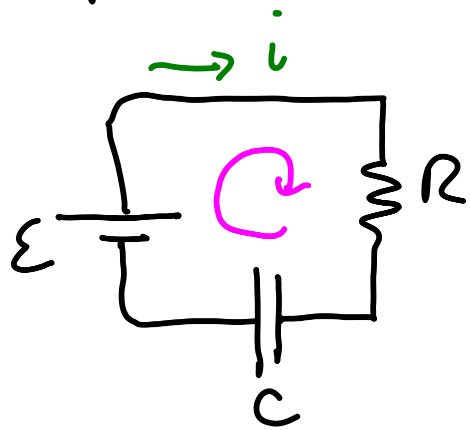
Direct current



RC circuit



Charging RC circuit



$$\Sigma \Delta V = 0$$

$$\varepsilon - iR - q/C = 0$$

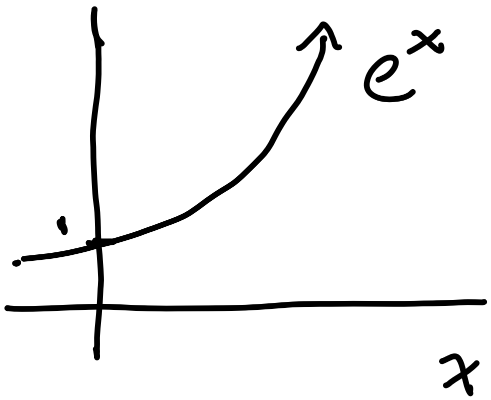
$$\varepsilon - \frac{dq}{dt}R - q/C = 0$$

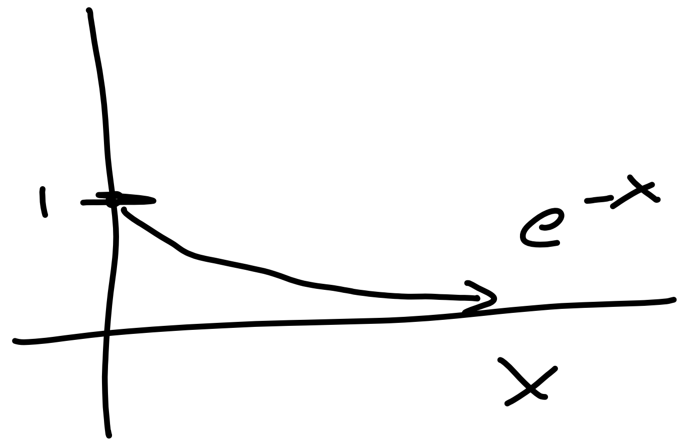
differential Equation

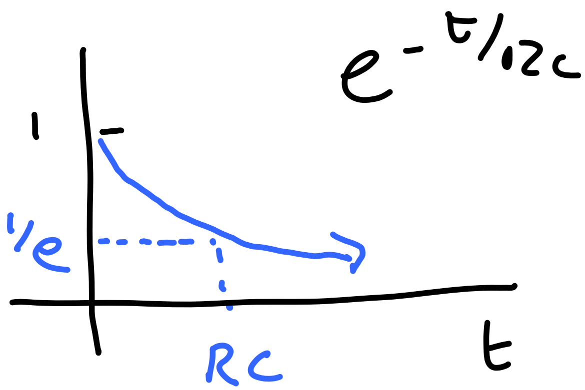
$$\varepsilon = \frac{dq}{dt}R + q/C$$

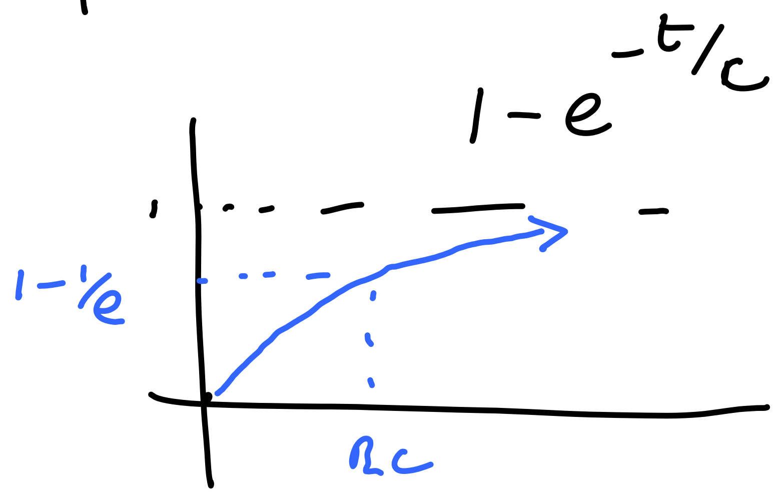
$$q(t) = C\varepsilon\left(1 - e^{-t/RC}\right)$$

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

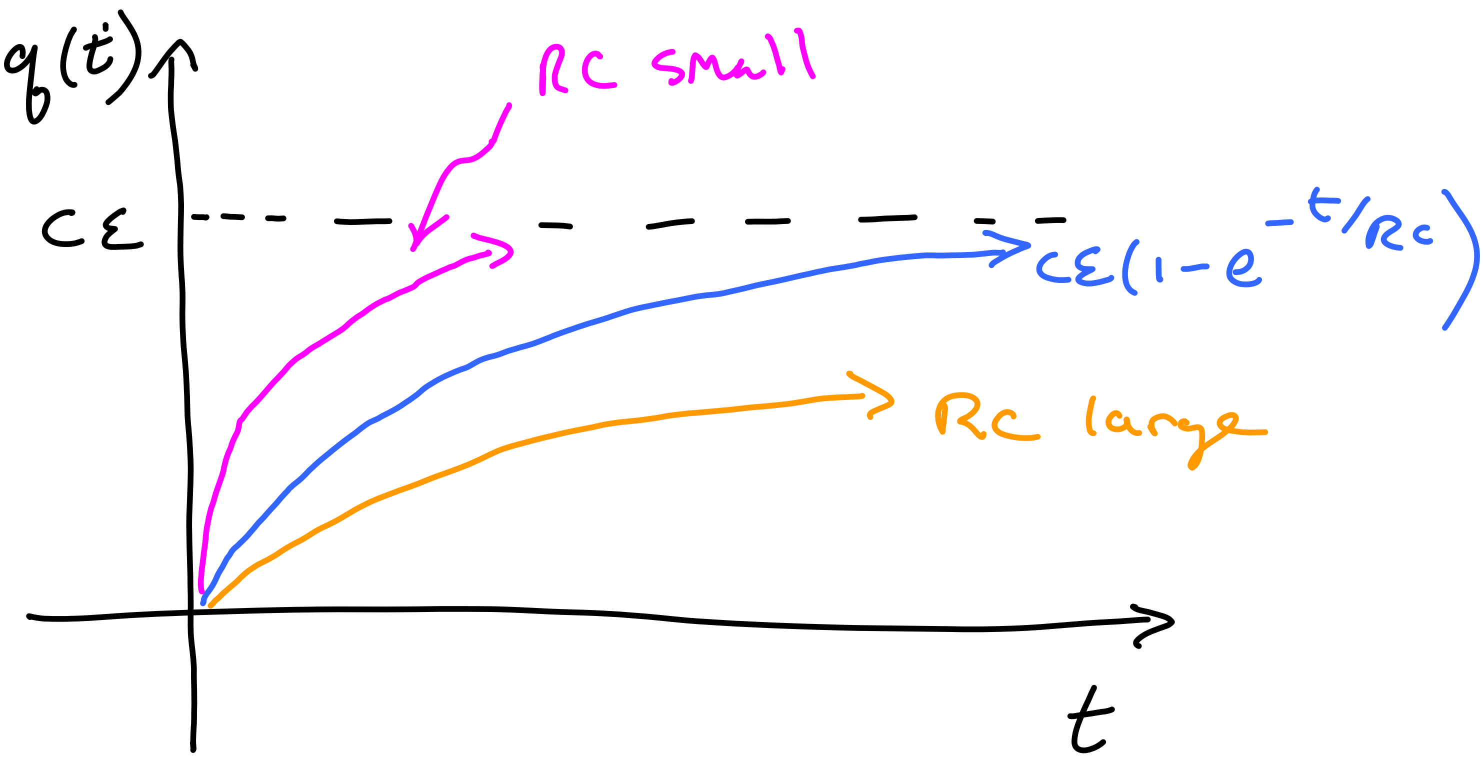






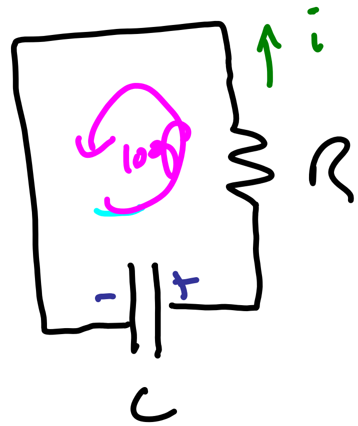


$$q(t) = C\mathcal{E}\left(1 - e^{-t/RC}\right)$$



$RC \equiv$ time constant

discharging RC circuit



$$\Sigma V = 0$$

$$-iR - q/C = 0$$

$$-\frac{dq}{dt}R = \frac{q}{C}$$

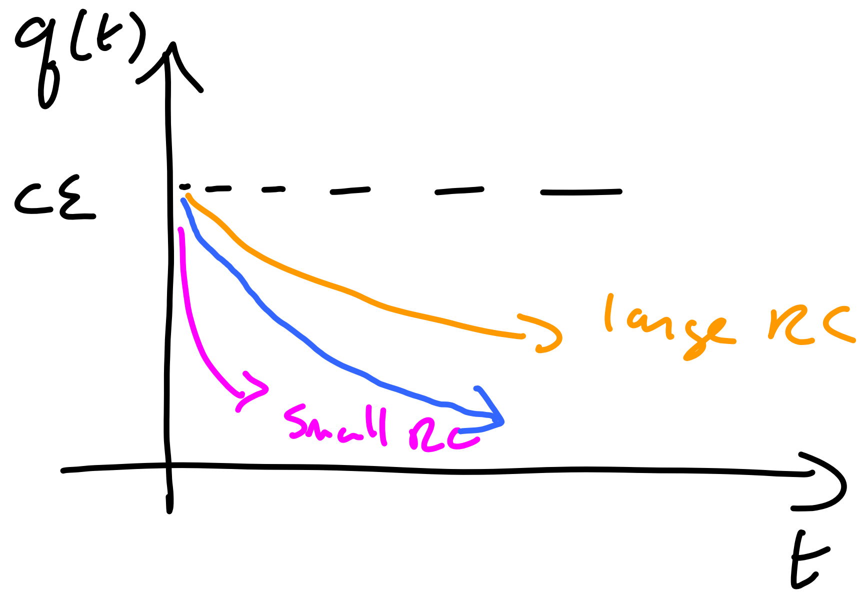
$$\int_0^t \frac{dt}{RC} = -\int_{q_0}^{q} \frac{dq}{q}$$

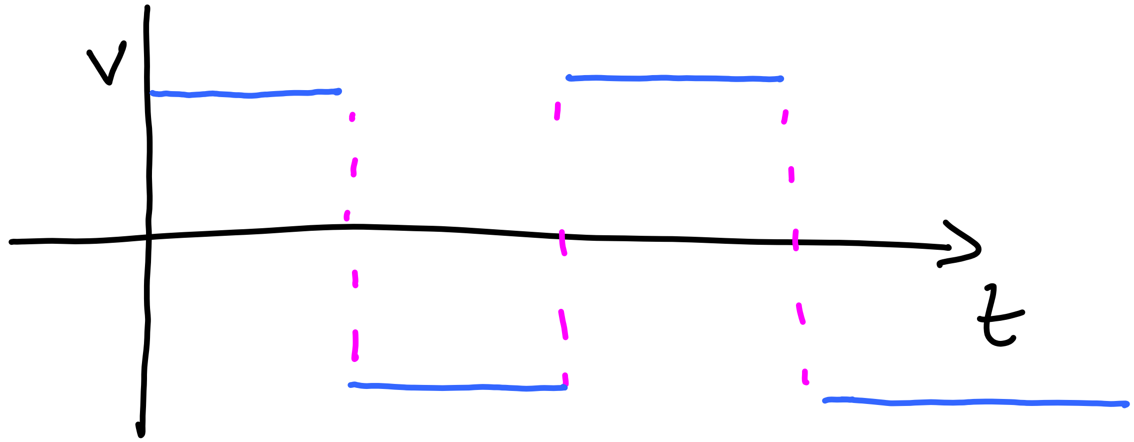
$$\frac{1}{RC}t = -\ln q/q_0$$

$$e^{-t/RC} = q/q_0$$

$$C\mathcal{E} e^{-t/RC} = q_0 e^{-t/RC} = q(t)$$

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





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