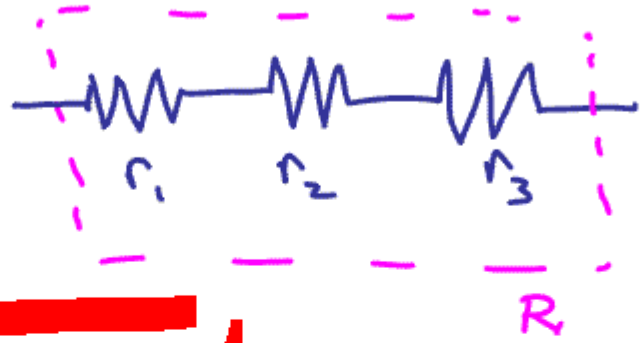
Physics 114 - March 7, 2006

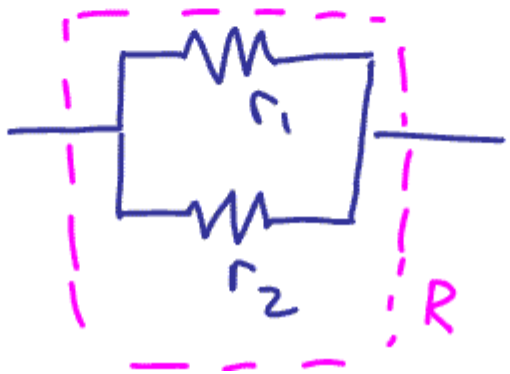
Last Time

Resistors in Series



$$R = \sum_i r_i$$

Resistors in Parallel



$$\frac{1}{R} = \sum_i \frac{1}{r_i}$$

Kirchoff's Rules

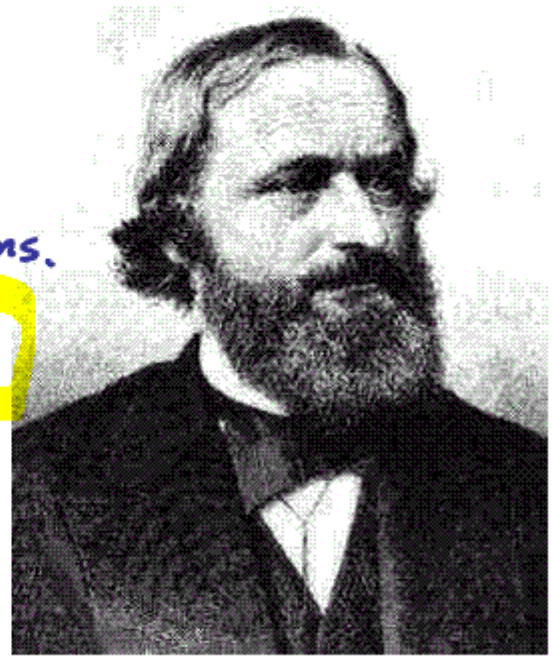
① $\Sigma V = 0$ around closed loop

② $\Sigma i = 0$ at junctions

Gustav Robert Kirchoff
Germany (1824-1887)

Apply to independent loops and junctions.
Derive N independent eqns
can solve for N indep. unknowns.

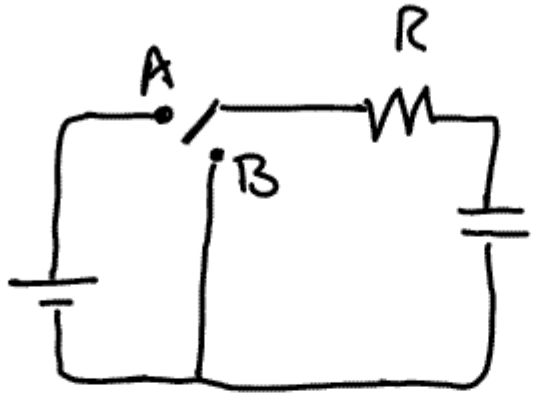
guts + Conventions + Consistency



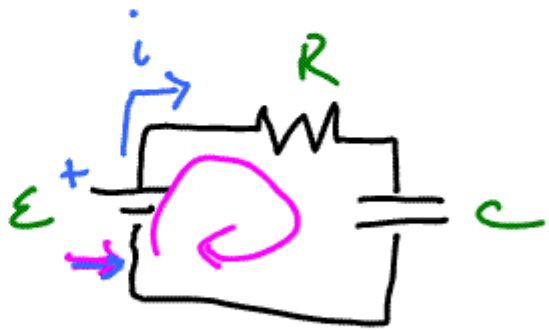
determined Kirchoff's laws at age 21

played for ZZ Top in the early days

RC Circuits



Switch in pos A



Kirchoff's Law

$Q = CV$

$$0 = \mathcal{E} - iR - \frac{q}{C}$$

$\mathcal{E} - iR - \frac{q}{C}$ > time dependent

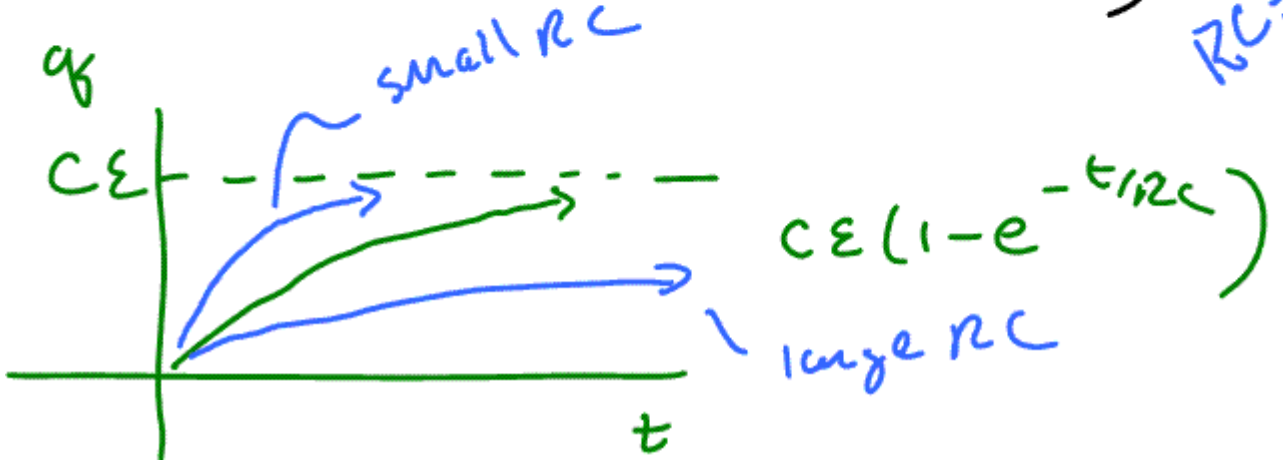
V_R V_C

$q \longrightarrow q(t)$ $\qquad i = \frac{dq}{dt}$

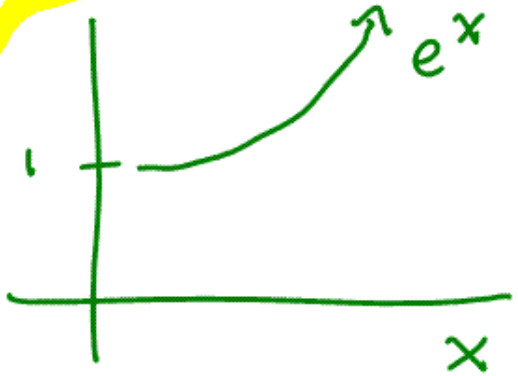
$$0 = \mathcal{E} - \frac{dq}{dt} R - \frac{q}{C}$$

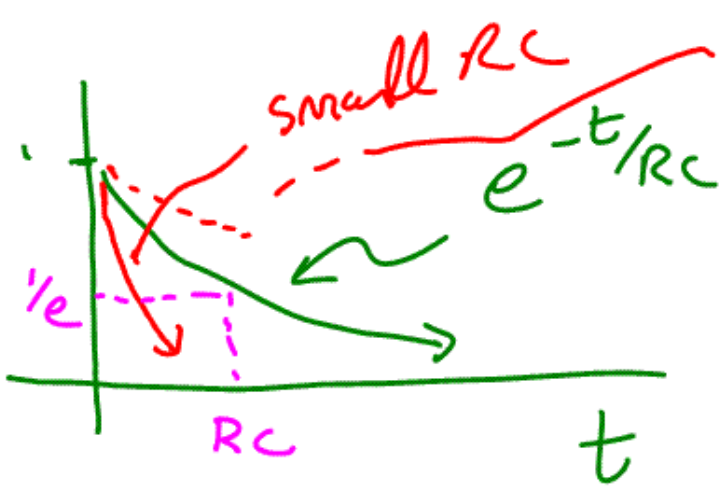
$$q(t) = C\mathcal{E}\left(1 - e^{-t/RC}\right)$$

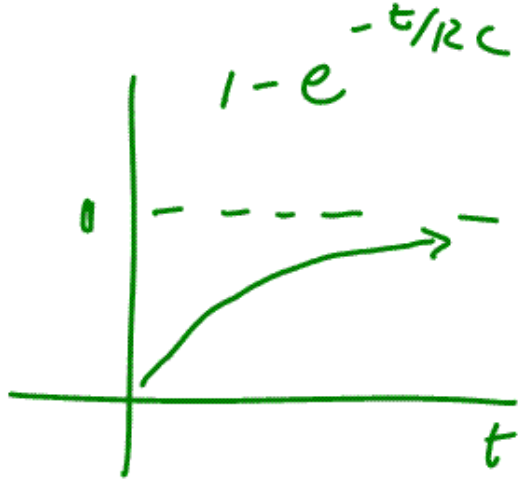
$RC \equiv$ Time constant

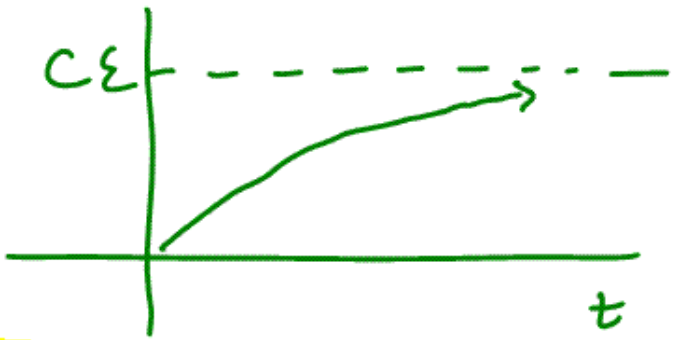


Let's look at this formula and try to think our way thru it



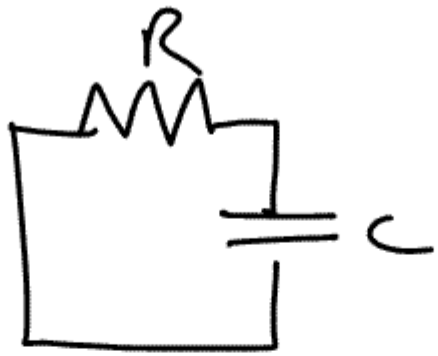






$c\varepsilon(1-e^{-t/RC})$

Throw switch to B



$$0 = \mathcal{E} - iR - \frac{q}{C}$$

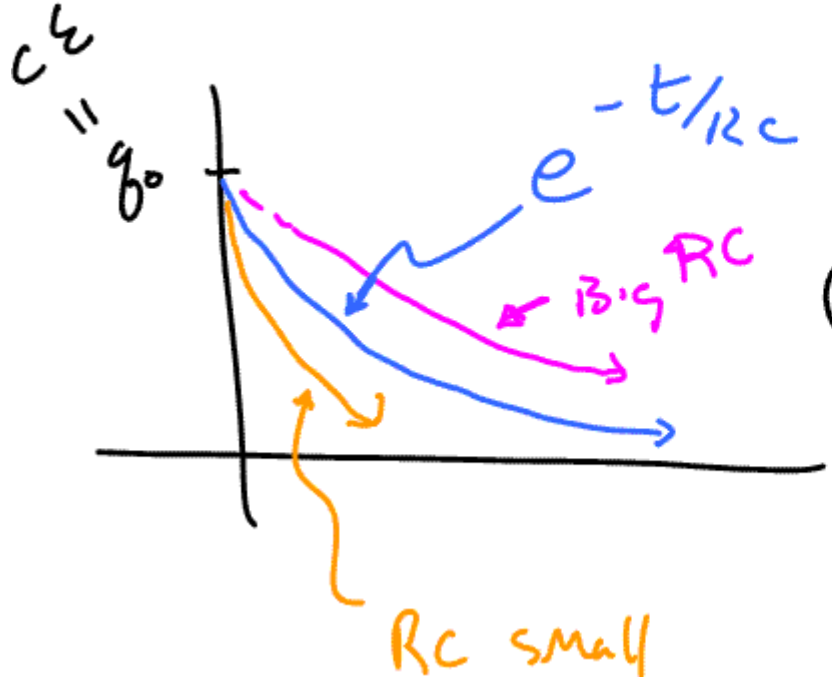
$$0$$

$$iR + \frac{q}{C} = 0$$

$$\frac{dq}{dt} = -\frac{q}{CR}$$

$$\int_{q_0}^{q} \frac{dq}{q} = \int_{0}^{t} -\frac{dt}{CR}$$

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



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

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

Magnetism

apply a force

Magnetic "fields" affect moving charges and currents

Also find currents can affect little magnets (like a compass)

⇒ So, currents must generate magnetic fields.

There is a deep relationship between electricity and magnetism.

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

Lorentz Force Law

Due to Magnetism

$\vec{B}$ ≡ Magnetic field vector

$\vec{v} \times \vec{B} = |\vec{v}||\vec{B}| \sin\theta$