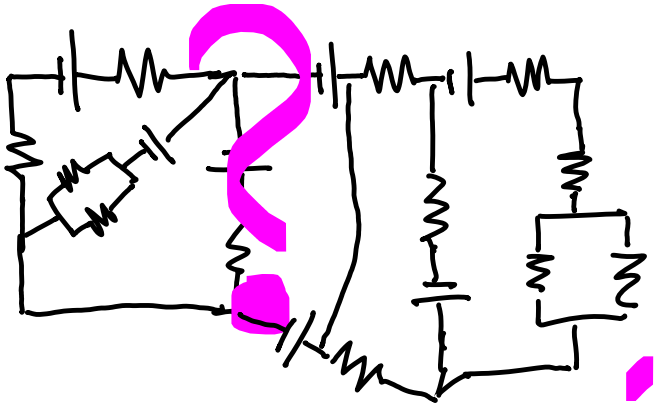
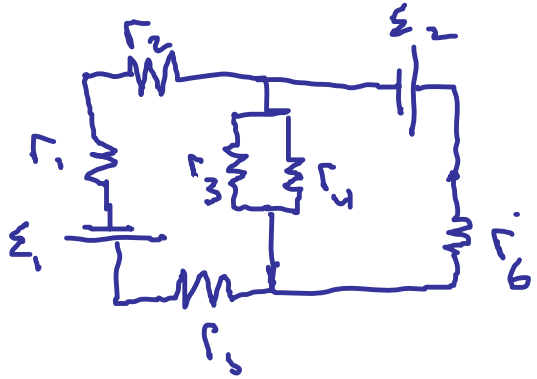
Physics 114 - March 3, 2015

Last Time

Kirchoff's Rules:



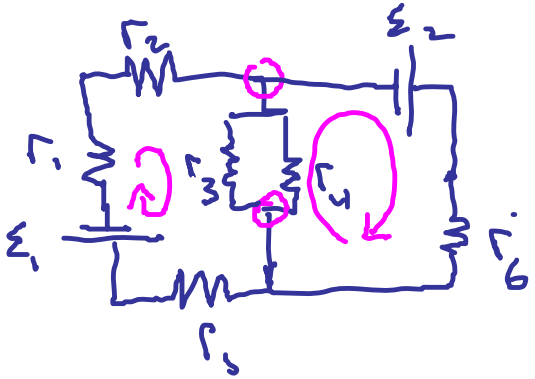
- Assign currents
- Select independent loops
- $\Sigma i = 0$ at junctions
- $\Sigma V = 0$ around loops
- N equations, N unknowns
  - Solve algebra for unknowns



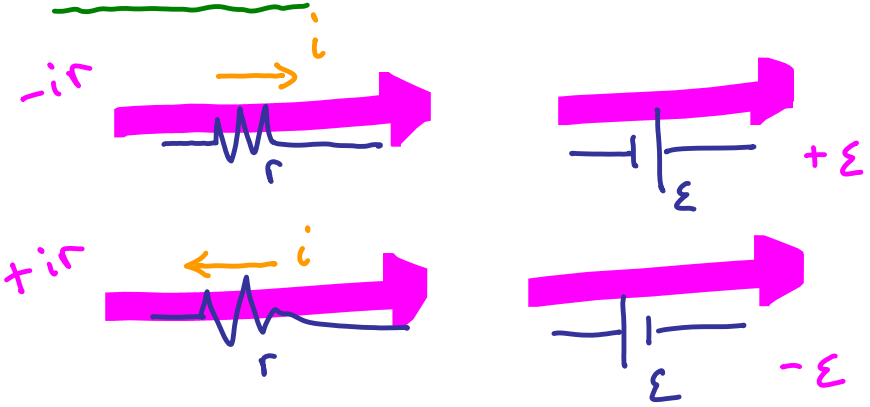
How Many independent currents?

How Many independent loop equations?

How Many independent current junction equations

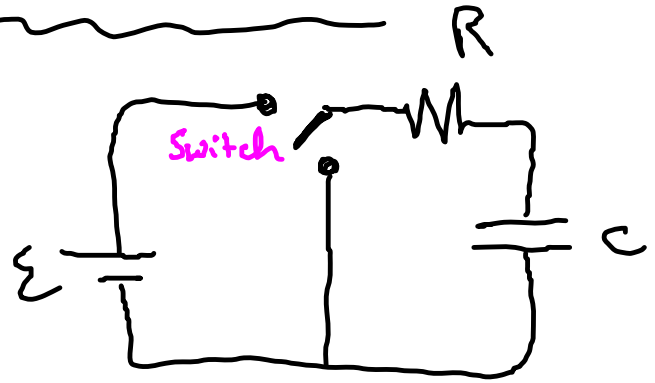


Conventions

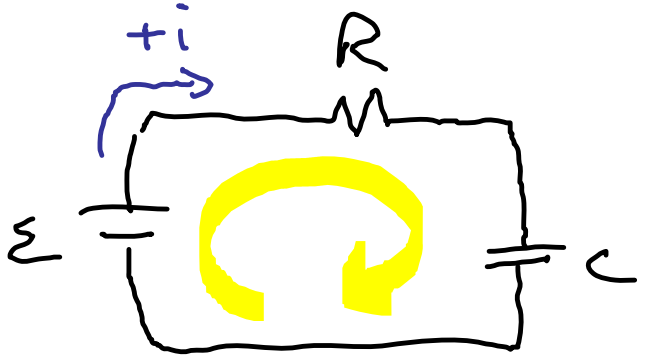


Be consistent
Be careful

RC circuits



Charging RC circuit



$Q = CV$

$\Sigma V = 0$

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

iR: V_R ; q/C: V_c

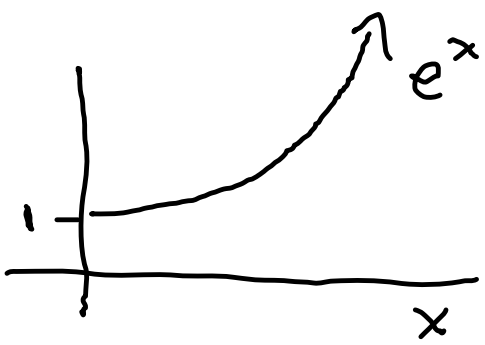
$$0 = \mathcal{E} - \frac{dq}{dt} R - q/C$$

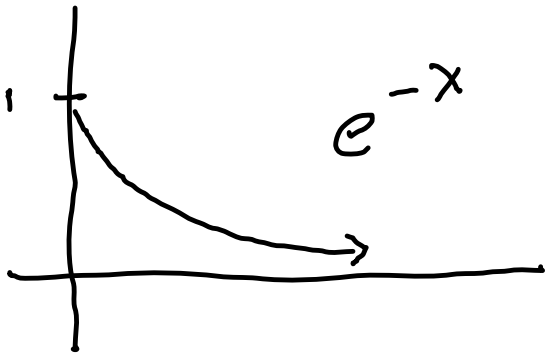
First order ordinary differential equation

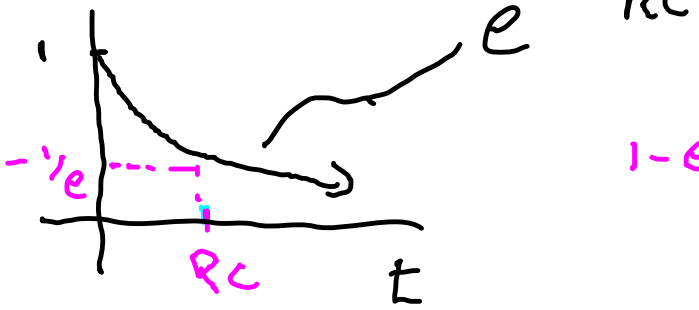
$$q \longrightarrow q(t)$$

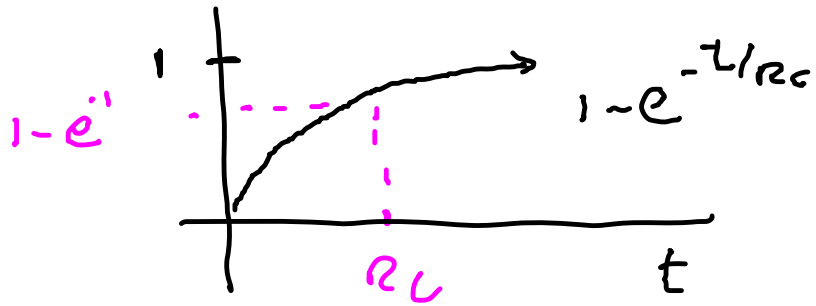
$$q(t) = C\mathcal{E}\left(1 - e^{-t/RC}\right)$$

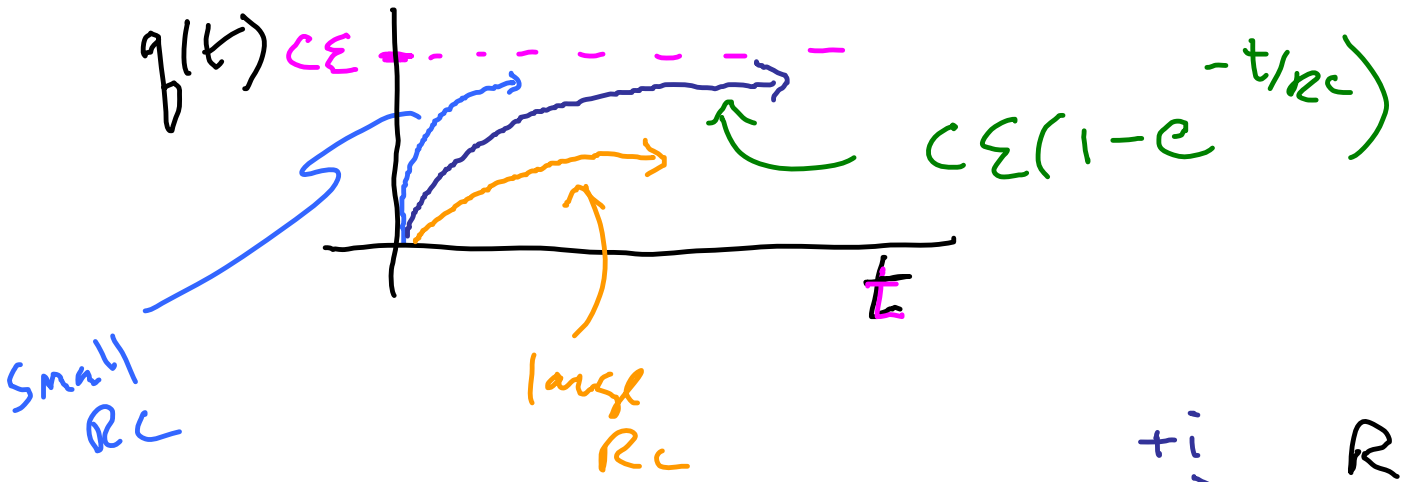
$$q(t) = C\mathcal{E}\left(1 - e^{-t/RC}\right)$$

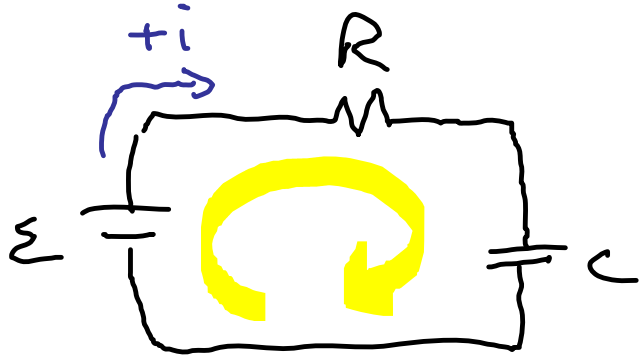




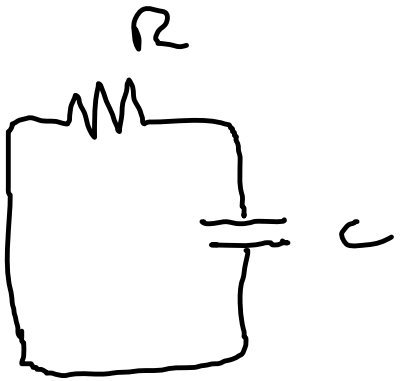








RC = "TIME CONSTANT"



Fully charged C at $t=0$

$$Q_0 = C\mathcal{E}$$

discharging RC circuit

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

$\mathcal{E} \to 0$

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

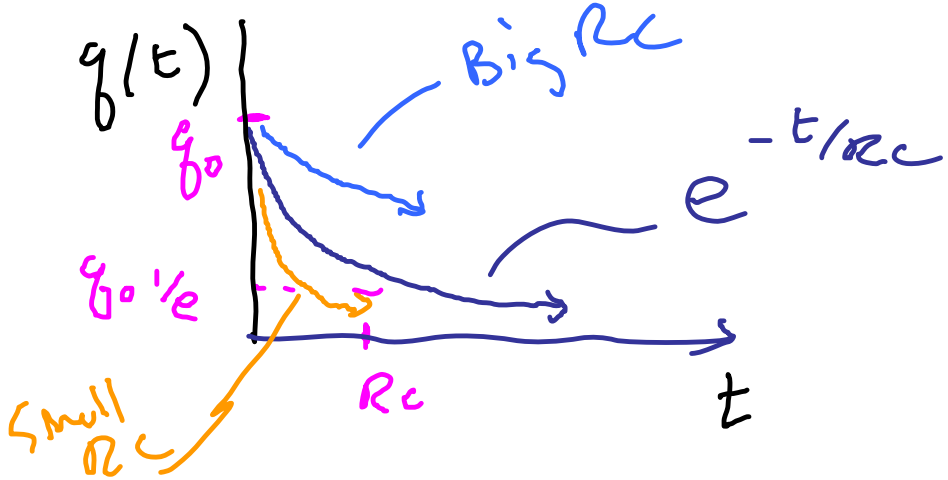
$$\frac{dq}{q} = -\frac{1}{RC}\,dt$$

$$\int_{q_0}^{q(t)} \frac{dq}{q} = \int_0^t \left(-\frac{1}{RC}\right) dt$$

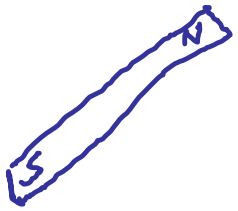
$$\ln \frac{q}{q_0} = -\frac{t}{RC}$$

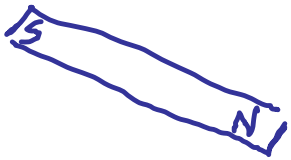
$$\frac{q}{q_0} = e^{-t/RC}$$

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


q(t)
Big RC
$e^{-t/RC}$
q_0
$q_0 \cdot 1/e$
Small RC
Rc
t

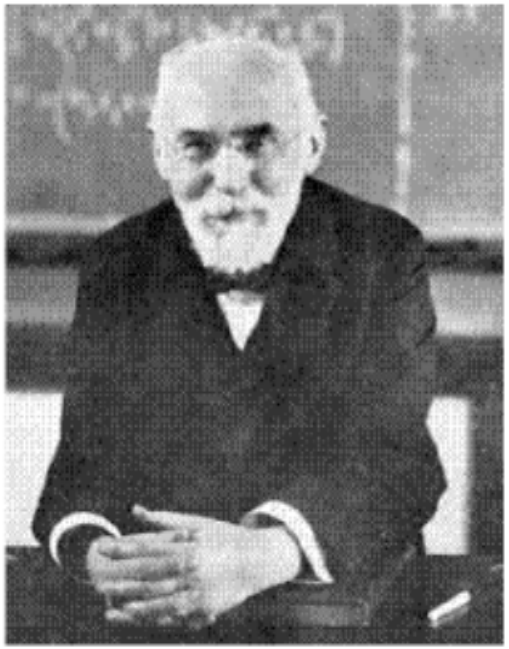
Magnetism





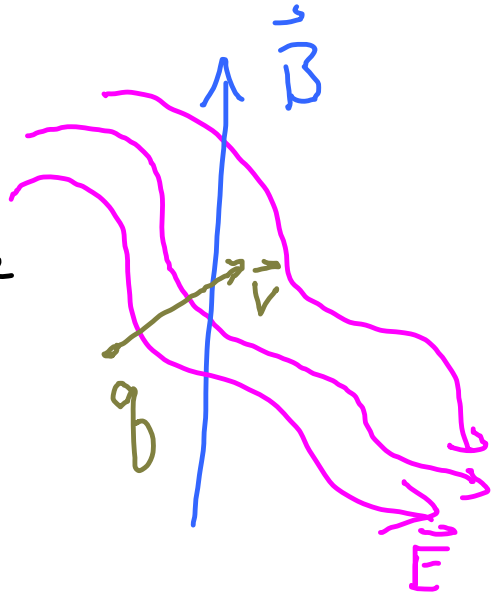
Lorentz Force law

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



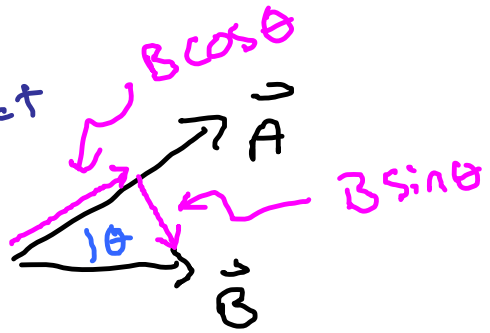
Hendrik Antoon Lorentz
(1853 - 1928)

Dutch - 1902 Nobel Prize



What is a "cross-product", i.e., $\vec{V} \times \vec{B}$

dot product

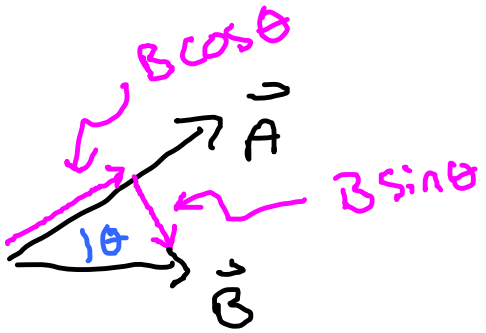


$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}|\cos\theta$$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Scalar

#, NOT a vector



, AND B

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

Vector direction is given by right-hand rule