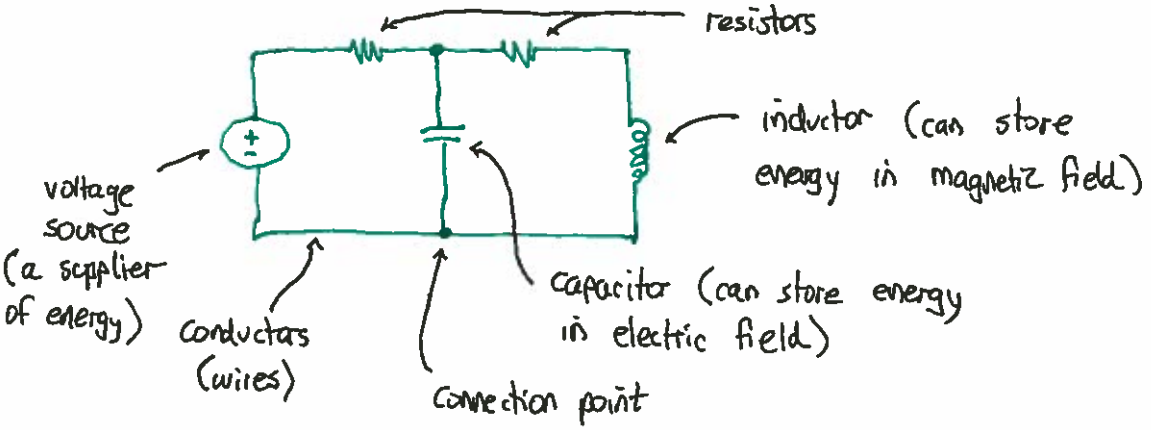
ENGG 225

Wednesday, January 14, 2015

Circuits, Currents, Voltages

Electric circuit – an interconnection of circuit elements connected in closed paths by conductors



The concept of electrical charge is the basis for describing all electrical phenomena.

- charge exists in discrete quantities at integer multiples of

1.6022×10^{-19} Coulombs — charge on one electron.

Two fundamentally important electrical quantities: current and voltage.

Electrical current

Current – rate of flow of electrical charge

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

$i(t)$ = current in Amperes (A)
$q(t)$ = charge in Coulombs (C)
t = time in seconds (s)

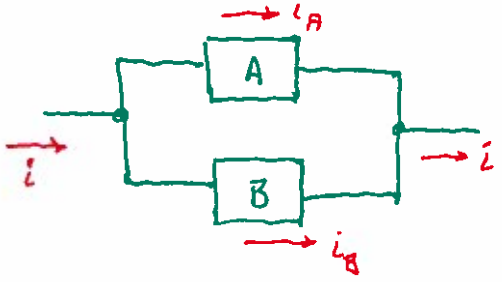
$$1\ A = 1\ C/s$$

Given $i(t)$, one can also find total charge $q(t)$

$$q(t) = \int_{t_0}^{t} i(t)\,dt + q(t_0)$$

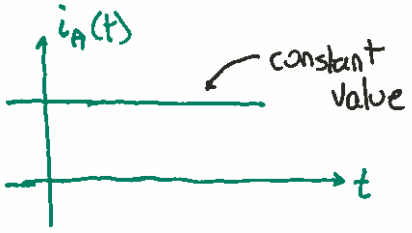
$q(t_0)$ ← some initial constant value

We normally assign reference directions for current.

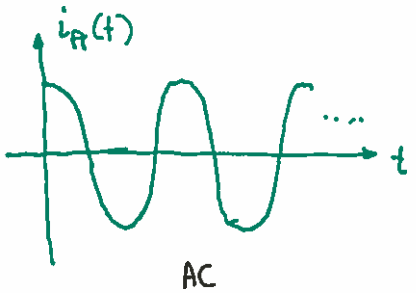


- can choose reference directions arbitrarily — if current flow is actually in the opposite direction, the value of i is opposite in sign.

We can have direct current (DC) and alternating current (AC)

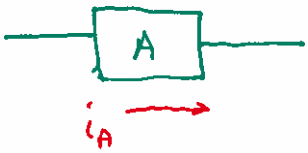


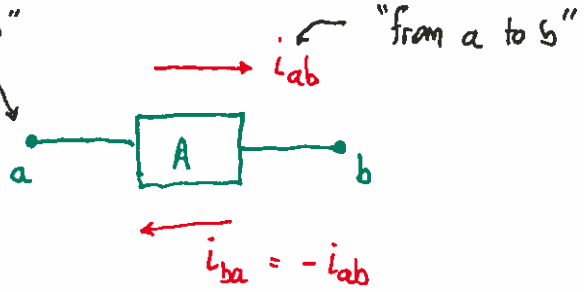
DC
(e.g., battery power)



AC
(e.g., house current)

Some common notation:





Voltages

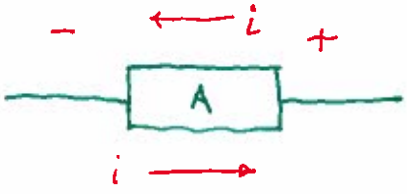
Voltage – energy transfered to a circuit element per unit of charge flow through it.

$$v(t) = \frac{dw(t)}{dq(t)}$$

$v(t)$ = voltage in Volts (V)
$w(t)$ = energy in Joules (J)
$q(t)$ = charge in C.

1 V = 1 J/C

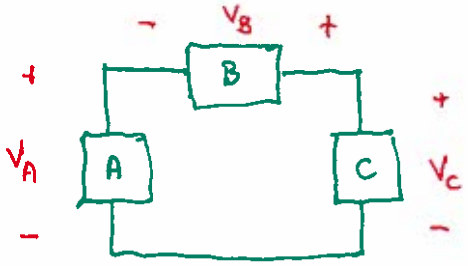
Voltages are assigned polarities to indicate direction of energy flow.



(energy absorbed by A)

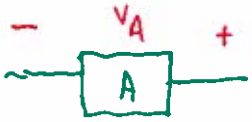
(energy supplied by A)

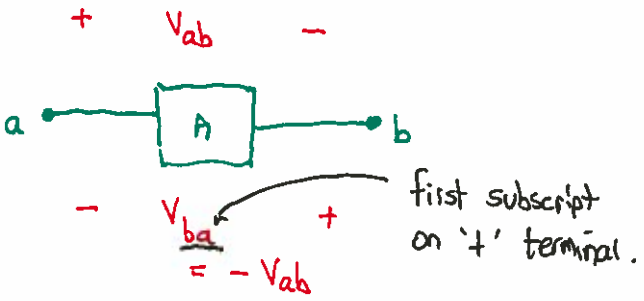
For analysis purposes, we assign reference polarities



- can choose reference polarities arbitrarily – if polarity is opposite, the value of V is opposite in sign.

Some common notation:





Ideal Basic Circuit Elements

Here, we will talk about conductors, sources, resistors. Later, will bring in inductors and capacitors.