Basics

Charge: $\quad Q \equiv$ constant charge

$\qquad q(t) \equiv$ instantaneous charge

Units = Coulombs [C]

Current: Charge in motion

$\quad I \equiv$ constant current $\qquad$ Units $\equiv$ Amperes

$\quad i(t) \equiv$ instantaneous current $\qquad$ [A]

$\qquad$ "Amps"

$\qquad i(t) = \dfrac{dq(t)}{dt} = \dfrac{\Delta q}{\Delta t} = \dfrac{C}{S}$

To describe a current:

(1) Value (+ or -)

(2) Direction

$\overleftarrow{\quad 8A \quad}$

$\overrightarrow{\quad -8A \quad}$

Jan 6-2:40 PM

Voltage: work done to move charge

$\quad V \equiv$ constant voltage $\qquad$ Units $\equiv$ Volts

$\quad v(t) \equiv$ instantaneous voltage $\qquad$ [V]

$\qquad v(t) = \dfrac{dw}{dq}$

To describe a voltage:

① Value (+ or -) $\qquad\qquad$ V = 5V

② polarity $\quad \pm$ pair $\qquad\qquad$ V = -5V

$V_x = + (5) - (2) = 3V$

$V_y = + (-6) - (4) = -10V$

$V_A = + (-10) - (-2) = -8V$

Jan 6-3:08 PM

Power: rate at which energy is used or created.

$\quad P \equiv$ constant power $\qquad$ Units $\equiv$ Watts $\quad w - 1c$

$\quad p(t) \equiv$ instantaneous power $\qquad$ [W]

$\qquad p(t) = \dfrac{dw}{dt} \qquad v(t) = \dfrac{dw}{dq} \qquad i(t) = \dfrac{dq}{dt}$

$\qquad p(t) = v(t) \cdot i(t) \implies \dfrac{dw}{dq} \cdot \dfrac{dq}{dt} = \dfrac{dw}{dt}$

$\qquad \boxed{P = VI}$

To describe to power:

① value (+ or -)

② Reference $\implies$ delivered (D)

$\qquad\qquad$ or

$\qquad\qquad$ absorbed. (A)

Jan 6-3:17 PM

To solve for power:

① Find the $v \cdot i$ product

② Look at current direction relative to voltage polarity

$+ \; V \; -$

$\rightarrow I$

* when current flows from (+) to (-) $\implies$ Absorbed

$+ \; V \; -$

$\leftarrow I$

* when current flows from (-) to (+) $\implies$ Delivered

$- \; 6V \; +$ $\qquad$ 3A

$P = VI = (6)(3) = 18W, D$

$\qquad$ or $= -18W, A$

$+ \; -3V \; -$ $\qquad$ -1A

$P = VI = (-3)(-1) = 3W, Del$

$- \; 10V \; +$ $\qquad$ -2A

$P = VI = (10)(-2) = -20W, Del$

$\qquad$ or $= 20W, Abs$

Jan 6-3:22 PM

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node

circuit node (ckt)

closed loop
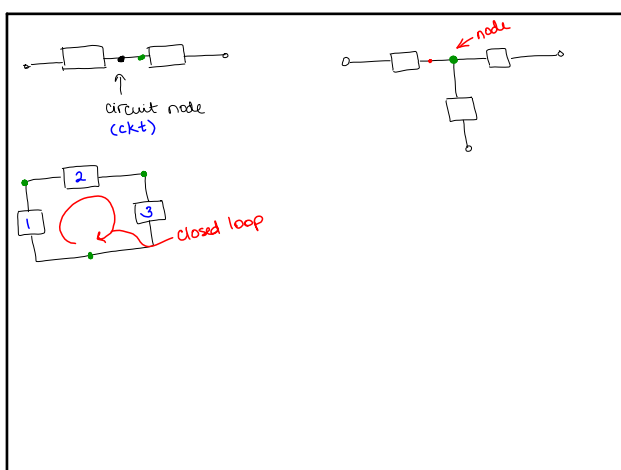
Jan 6-3:32 PM

Kirchoff's Laws

Kirchoff's Current Law (KCL)

Kirchoff's Voltage Law (KVL)

KCL

① All currents entering a node must sum to zero. $\quad -I_1 - I_2 + I_3 + I_4 = 0$

② All currents leaving a node must sum to zero. $\quad I_1 + I_2 - I_3 - I_4 = 0$

③ Currents in = Currents out

$\qquad I_3 + I_4 = I_1 + I_2$

Find I_x using KCL
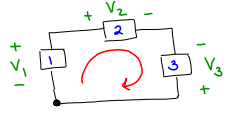
$3 + (-7) = I_x + 4$

$\boxed{I_x = -8A}$

$I_x + 4 + (-3) + (7) = 0$

$\boxed{I_x = -8A}$

Jan 6-3:36 PM

KVL : sum the voltages around a loop

sum must equel = 0

KVL process

① Pick a loop direction
    CW or CCW

② Sign Convention
   relative to the polarities

Active sign convention

Passive sign convention.

Jan 6-3:45 PM