1 SI Units

Monday, January 7, 2019 3:04 PM

- EE deals with systems that produce, transmit, and measure electronic signals.
  - Five major categories

    Computer system, Control system, Power system, Signal processing system

    ...

- SI Units (The International System of Units)

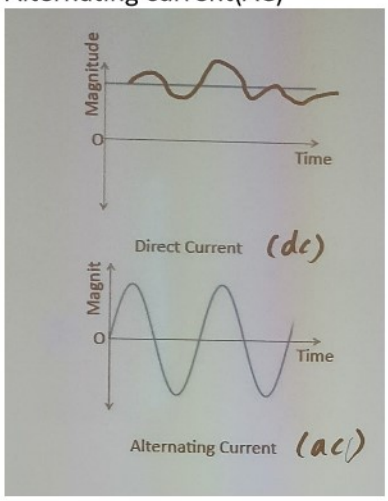
Quantity	Basic Unit	Symbol
Mass	kilogram	kg
Time	second	s
Length	meter	m
Temperature	Kelvin	K
Luminous intensity	Candela	cd
Electric current	ampere	A
Amount of substance	mole	mol

  - There're also derived units in SI

2

Wednesday, January 9, 2019 2:30 PM

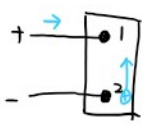
- Electric charge, unit: Coulomb C
- Current I = charge/s
  Charge of an electron: 1.6*10^-19
- Ideal circuit component
  - Def: a mathematical model of an actual electrical component
- Physical prototype
  - An actual electric system
- Electric Charge
  - Electric Charge is discrete, quantized
  - Smallest unit of electric charge = 1.6*10^-19 C
  - Consequence of charges in motion: Electric fluid(current) -> Magnetic field
  - Bipolar "+" or "-"
  - To separate charges - Electric force(voltage)
- Electric Current
  - Def: the time rate of transfer of electric charges across a specific boundary
  - I(t) = dq/dt
  - Unit: Ampere(A) or Coulomb(C)/Second(s)
  - Direct current(DC): current flow in one direction
    Alternating current(AC)



- $q = 10 - 10e^{-2t}$ mC, find i at t = 1.0 s.

t=0, q=0 $i = \frac{dq}{dt} = 20e^{-2t} = 20e^{-2}$ mC/s $= 20e^{-2}$ mA

- Voltage: the energy per unit charge created by the separation
  - $v_{12} = v_{1} - v_{2}$



  - Voltage: Energy needed to move one unit of positive charge from the negative

terminal to the positive terminal

- V = dW/dq
  W: joules(J)
  q: Coulombs(C)
- E.g. An energy source forces a constant current of 2A for 10 s to flow through a light bulb, resulting in 2.3 kJ that is given off in the form of light and heat energy. Calculate the voltage drop across the light bulb.

$q = it = 2A \cdot 10s = 20As$

$V = \frac{2.3 \times 10^3 J}{20As} = 115V$

- Ideal Basic circuit element
  - Def:
    - Has only two terminals, which are points of connection to other circuit components
    - Cannot be subdivided into other elements
    - Can be described mathematically in terms of current &/| voltage
  - Five ideal basic circuit elements
    - Ideal voltage source
    - Ideal current source
    - Resistor
    - Capacitor
    - Inductor
- Passive Sign Convention
  - Whenever the reference direction for the current in an element is in the direction of the reference voltage drop across the element, use a '+' in any expression that relates the voltage to the current. Use '-' otherwise.

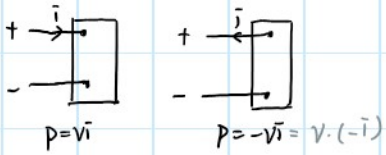
3. power

Thursday, January 10, 2019 7:49 PM

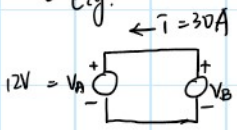
- $p = \frac{dw}{dt} = vi = \left(\frac{dw}{dq} \cdot \frac{dq}{dt}\right)$
- When using passive sign convention, $p = vi$

  When current reference is in the direction of a reference voltage rise, $p = -vi$
- Interpreting p.
  - $p > 0$, power is delivered to the circuit element. (dissipating power)

    $p < 0$, power is being extract from the circuit element. (generating power)



- e.g.



Power goes from A to B.

P_A = 3DA * 12V

HW1

Wednesday, January 16, 2019 12:58 PM

Review | Constants

The numerical values for the currents and voltages in the circuit in (Figure 1) are given in the table below.

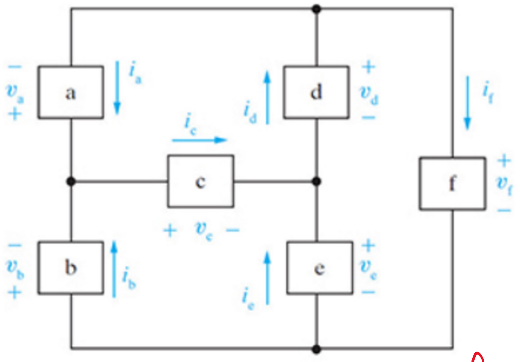
Element	Voltage (V)	Current (mA)
a	-18	-86
b	-18	45
c	2	-41
d	20	-55
e	16	-14
f	36	31

Review | Constants

The numerical values for the currents and voltages in the circuit in (Figure 1) are given in the table below.

Element	Voltage (V)	Current (mA)
a	-18	-86

Figure 1 of 1



magnitude of the power generated or the power dissipated.

Part A

Find the total power developed in the circuit.

Express your answer to three significant figures and include the appropriate units.

View Available Hint(s)

$p =$ 2440 mW

Rem: add up the values with the same sign.

Submit Previous Answers

Correct

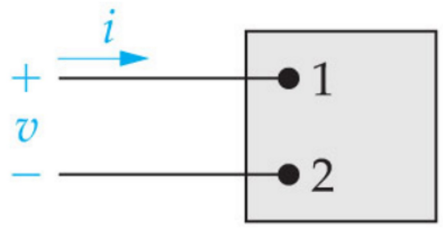
Here we learn how to determine the total power developed in the circuit using the power equa convention.

Review | Constants

The voltage and current at the terminals of the circuit element in (Figure 1) are zero for $t < 0$.

$v = (1500t + 1)e^{-750t}$ V, $t \geq 0$;
$i = 50e^{-750t}$ mA, $t \geq 0$.

Figure 1 of 1



p_{max} = 50.0 mW

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✔ Correct

$P = vi = 75te^{-1500t} + 0.05e^{-1500t}$

$\because P \downarrow$

$\therefore t = 0,\ P_{max} = 0.05W$

Part C

Find the total energy delivered to the circuit element in microjoules.

Express your answer using three significant figures.

w = 66.7 μJ

Submit Previous Answers

✔ Correct

$W_{tot} = \int_0^\infty (75te^{-1500t} + 0.05e^{-1500t})dt$

$= \frac{75te^{-1500t}}{-1500} - \frac{75e^{-1500t}}{1500^2} + \frac{0.05e^{-1500t}}{-1500}\Big|_0^\infty$

$= \frac{75}{1500^2} + \frac{0.05}{1500} = 66.7\,\mu J$

	te^{-1500t}	e^{-1500t}
t	+	$\frac{e^{-1500t}}{-1500}$
1	−	$\frac{e^{-1500t}}{1500^2}$
0		

$\lim_{t\to\infty} \frac{t}{e^{1500t}} = \frac{1}{1500e^{1500t}} = 0$