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MADE EASY
ELECTRICAL ENGINEERING
Network Theory
BY-Kiran Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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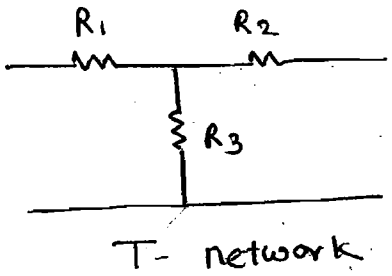
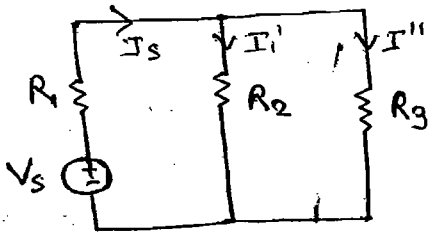
Network



T- network



Network or circuit

Network -

Network is a combination of elements, it may or may not consist of closed path & it may or may not consist of atleast one independent source

e.g wireless - communication system (Internet)

Circuit Circuit is a combination of element it should consist of closed path & it should consist of atleast one independent source.

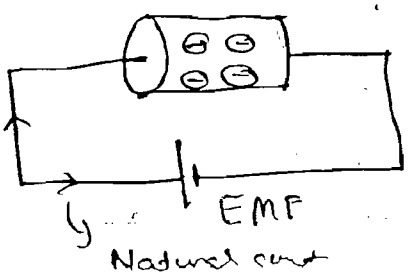
e.g Electrical transmission line

$$Q = \int_{-\infty}^{t} I\,dt \qquad Q = \int_{-\infty}^{0} I\,dt + \int_{0}^{t} I\,dt$$

$$Q = Q_0 + \int_{0}^{t} I\,dt$$

Q_0 ⇓ initial charge (-1.602×10^{-19} coulomb)

$$I = \frac{dQ}{dt} \quad (\text{coulomb/sec or Amp})$$



conventional current

Natural current

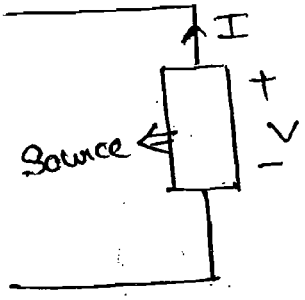
$$V = \frac{dw}{dq} \quad \text{Joule/coulomb} \quad \text{or} \quad (\text{Volts})$$

$$P = \frac{dw}{dt} \quad \text{Joule/sec} \quad \text{or} \quad (\text{watt})$$

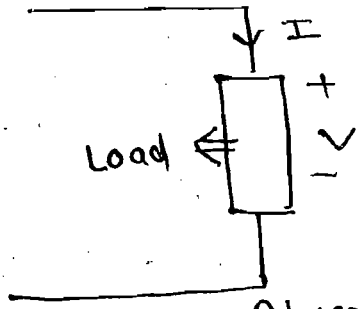
$$P = \frac{dw}{dq} \times \frac{dq}{dt} = V \cdot I$$

(*) $$P = V \cdot I = I^2 R = \frac{V^2}{R} = V^2 G = \frac{I^2}{G}$$

(*) $$G = \frac{1}{R} \text{ mho or siemens}$$



Deliver Power

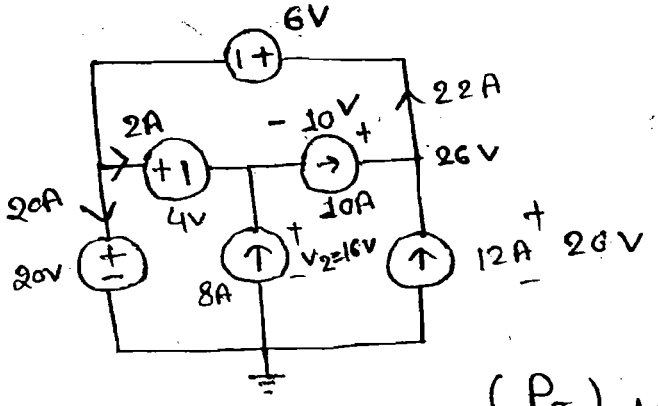


Absorbing Power

Note 1) When the current is leaving from +ve terminal element is delivering power.

2) When the current is entering to +ve terminal element is absorbing power

Q) find Power of each elem



$P_{12A} = 26 \times 12 = 312\ \omega$ (Delivs)

$P_{8A} = 16 \times 8 = 128\ \omega$ (Delivs)

$P_{10A} = 10 \times 10 = 100\ \omega$ (Delivs)

$P_{20V} = 20 \times 20 = 400$ (Absrbs

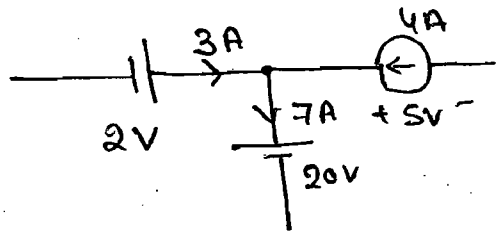
$P_{6V} = 22 \times 6 = 132$ (Absrbs

$P_{4V} = 4 \times 2 = 8\ \omega$ (Absrbs

$(P_T)_{absrb} = (P_T)_{delvd}$

$400 + 132 + 8 = 312 + 128 + 100 = 540$

Q) find total Power absorbing of the figure shown :-



$P_{20} = 20 \times 7 = 140\ \omega$ (absorb)

$P_{2V} = 2 \times 3 = 6\ \omega$ (Delive)

$P_{4A} = 5 \times 4 = 20\ \omega$ (Del

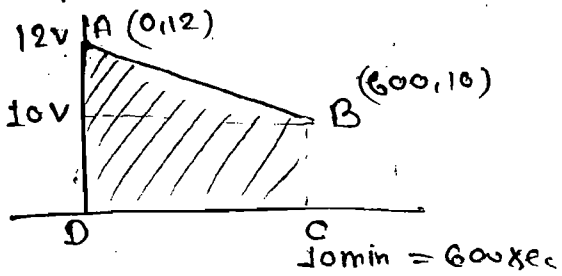
Total absorbing Power

$P_T = 140 - 20 - 6 = 114\ \omega$ (Total Absorbin Power).

$$\omega = \int_0^t P\,dt \quad \text{watt-sec or Joule}$$

ω = Power X Time

Q) A fully charged mobile phone is good for 10 min talk time During talk time battery delivers a a const. current of 2Amp find Energy of the battery during talk time



Method-1

Area ABCD = $\frac{1}{2} \times (12+10) \times 600 = 6600$

$\Rightarrow V \cdot T$

$\omega = P \times t = VIt$

$\omega = 6600 \times 2 = 13200\ J = 13.2\ kJ$

method-2

$$y - y_1 = m(x - x_1)$$

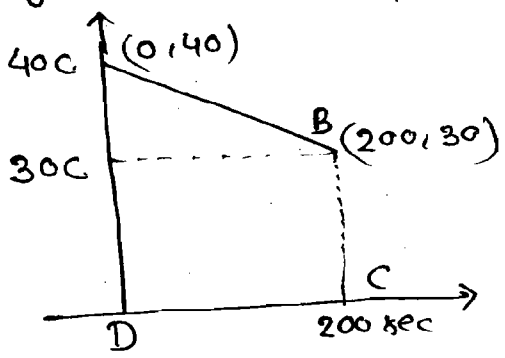
$$V - 12 = \left(\frac{10-12}{600-0}\right) \times (t-0)$$

$$V = \frac{-t}{300} + 12$$

$$\omega = \int_0^{600} P\,dt = \int_0^{600} V i\,dt = \int_0^{600} \left(\frac{-t}{300} + 12\right) 2\,dt$$

$$= 13.2 \text{ kJ}$$

Q) find the current by using following figure-



method-1

$$i = \frac{dQ}{dt}$$

$$I = \frac{30-40}{200-0} = \frac{-10}{200}$$

$$I = -\frac{1}{20} A$$

meth-2

$$y - y_1 = m(x - x_1)$$

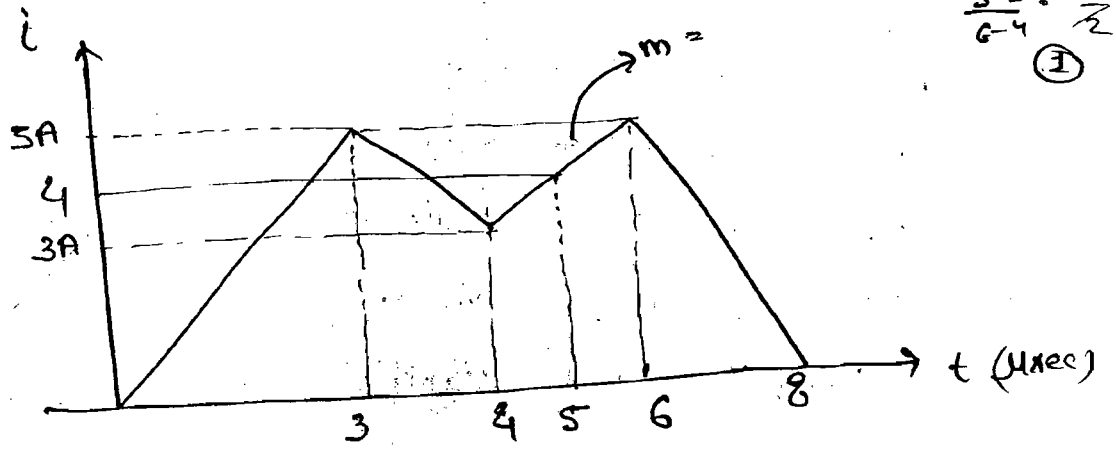
$$Q - 40 = \frac{30-40}{200-0}(t-0)$$

$$Q = \frac{-t}{20} + 40$$

$$I = \frac{dQ}{dt} = -\frac{1}{20} A$$

Q) find charge acquired by capacitor in 5 μsec

$\frac{5-3}{6-4} \cdot \frac{2}{2}$ (1)



$i = \frac{dQ}{dt}$ $\boxed{\int dQ = \int i\,dt}$ ⇒ Area under the curve of i & t characte

$$Q = \int_0^5 i\,dt \Rightarrow \int_0^3 i\,dt + \int_3^4 i\,dt + \int_4^5 i\,dt$$

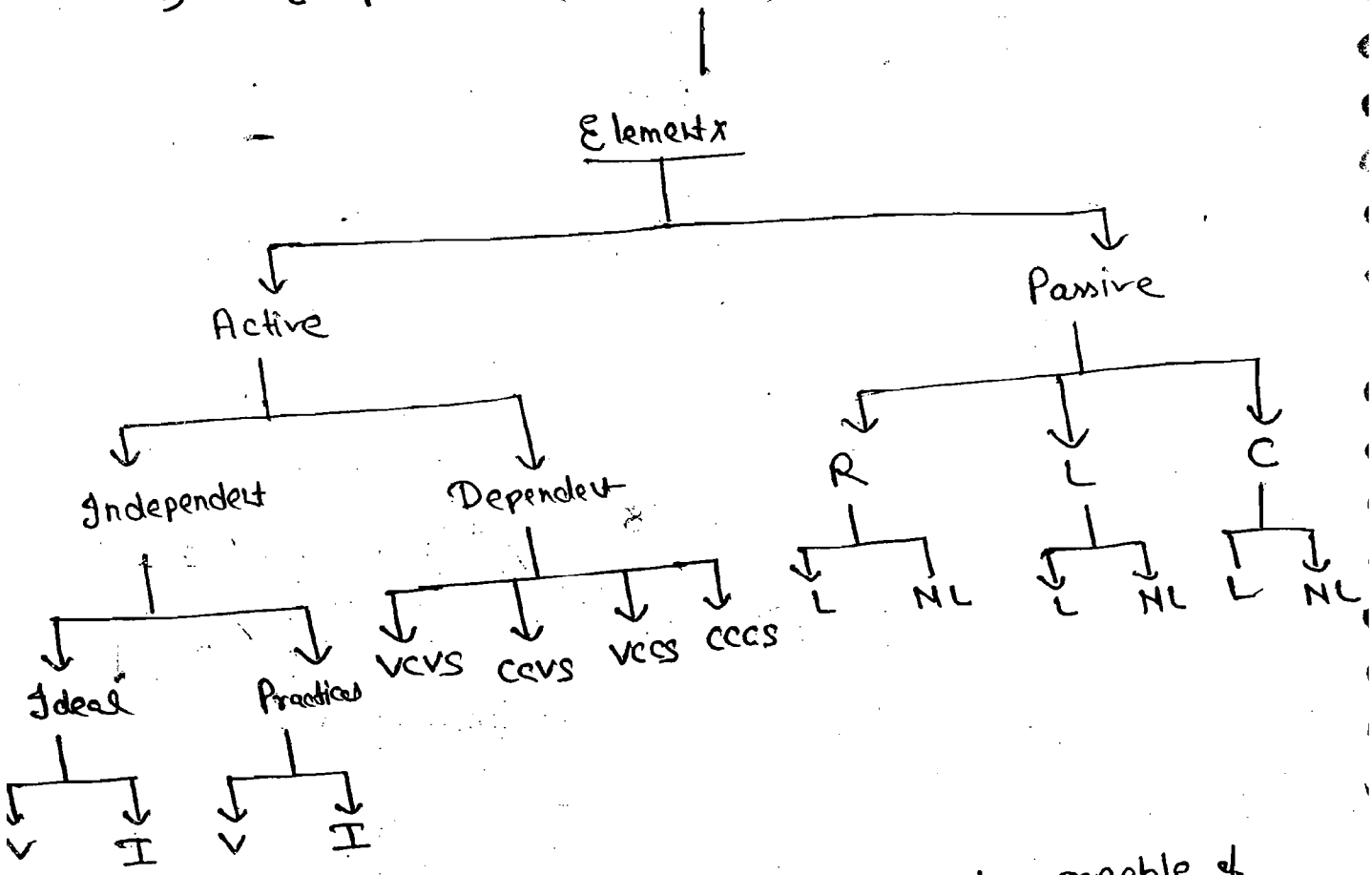
$$\Rightarrow \frac{1}{2} \times 3 \times 5 + \frac{1}{2}(5+3) \times 1 + \frac{1}{2}[3+4]\,1$$

$$\Rightarrow \frac{15}{2} + \frac{8}{2} + \frac{7}{2} \Rightarrow$$ Coulon

$$\Rightarrow 7.5 + 4 + 3.5 = 15\ \mu C.$$

Classification of elements :-

1) Active and Passive
2) Linear & Non-Linear
3) Unidirectional & Bidirectional
4) Time Variant & time invariant
5) Lumped and Distributed.

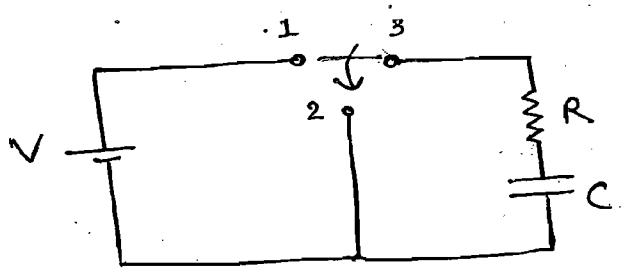


Active element :- When the element is capable of delivering energy independently for long time (Almost ∞ time)

OR

When the element is having property of internal amplification then it is known as Active element

e.g. Voltage source, current source (for dependent source) (transistor & op-amp dependent source)



$t>0$ C ⇒ Discharging

Note →

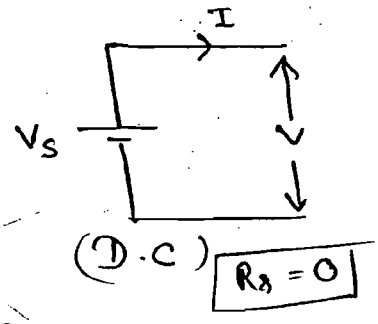
During discharging capacitor can deliver the energy independently for short time & capacitor is not having internal amplification property.

Passive element :- When the element is not capable of delivering energy independently then it is known as passive element

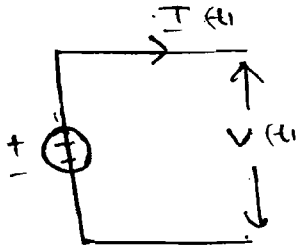
e.g. 1) Resistor
2) Bulb
3) Transformer $[V_1 I_1 = V_2 I_2]$
↳ Inductor

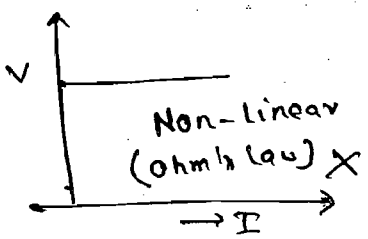
Voltage -

Ideal :-

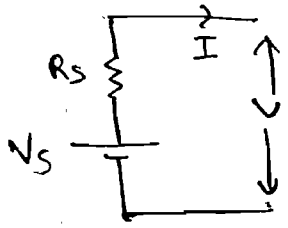


(D.C) $R_s = 0$

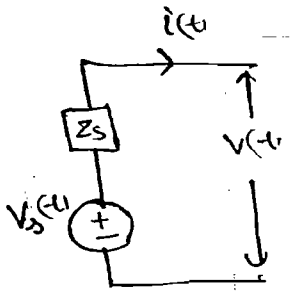


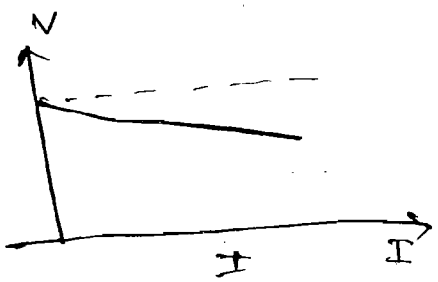


Practical :-



(D.C)





$$V_s = V - IR_s$$

$$\boxed{V = V_s - IR_s}$$

1) Ideal Voltage source delivers energy at specified voltage which is independent on current delivered by the source.

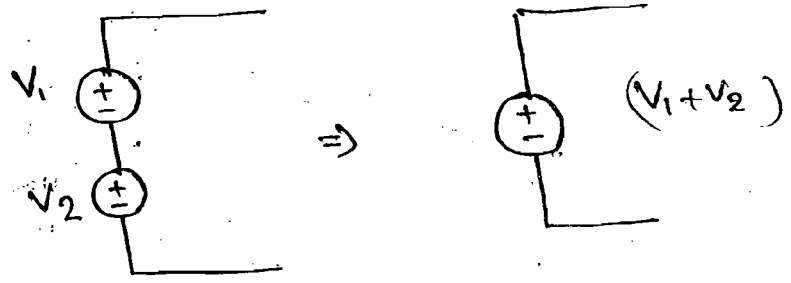
2) Internal resistance of ideal voltage source is equal zero.

3) Practical voltage source delivers energy at specified voltage (V) which depends on current delivered by the source

e.g. 1) Battery
2) Generator.

4) Independent Voltage source does not obeys the ohms law
∴ V-I characteristic is non-linear.

1)



2)