Sound))) → Transducer → Modulator

Circuit fits you in a specific band when you talk in a phone. A frequency spectrum will be allocated. All is done by electric circuit.

→ Remote generate unlicensed frequency.

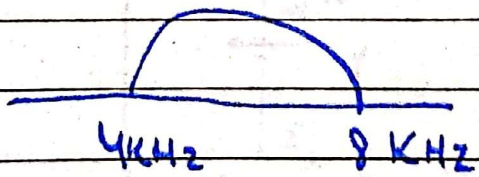
SNR → Signal Noise Ratio

Shannon Capacity

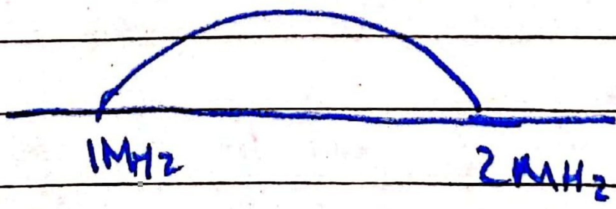
$$C = B \ln(1 + SNR)$$

B → Bandwidth

Bits/sec



Bandwidth = 4 KHz



Bw = 1 MHz

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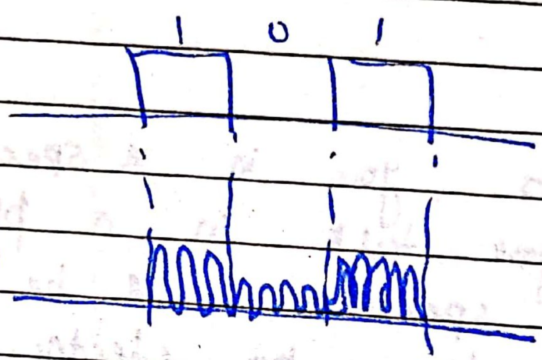
→ Filter → Accepts one particular channel frequency and rejects all other.

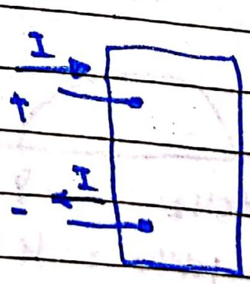


→ Frequency Shifting

→ Voltage and current

$V = \frac{dw}{dq}$ → rate of change of expended energy per unit charge

$I = \frac{dq}{dt}$



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$I = 0 \quad t < 0$

$I = 20 e^{-5000t}$

$q = ?$

$$\frac{dq}{dt} = 20 e^{-5000t}$$

$$\int dq = \int 20 e^{-5000t} dt$$

$$q = 20 \int_0^\infty e^{-5000t} dt$$

$$= 20 \left. \frac{e^{-5000t}}{-5000} \right|_0^\infty$$

$$q = \frac{1}{\alpha^2} - \left(\frac{t}{\alpha} - \frac{1}{\alpha^2} \right) e^{-\alpha t} \cos$$

$\alpha = 0.0369 \sec^{-1}$

$$q = \frac{1}{\alpha^2} - \left(\frac{\alpha t - 1}{\alpha^2} \right) e^{-\alpha t}$$

$$\frac{dq}{dt} = \frac{d}{dt} \left[\frac{t e^{-\alpha t}}{\alpha} - \frac{e^{-\alpha t}}{\alpha^2} \right]$$

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→ The output of a circuit may be non-electrical.
So we also study other paramaters of a circuit i-e
Power and energy.

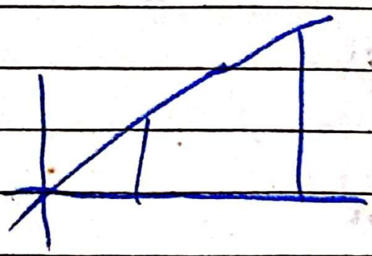
$$P = \frac{dW}{dt}$$

$S(t)$

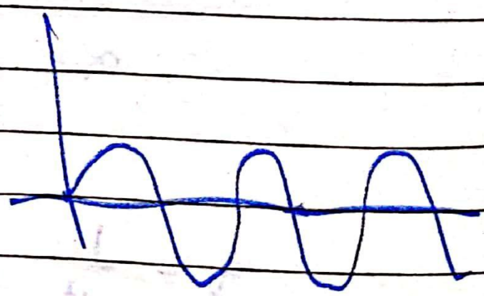
$$\text{Energy of signal} = \int_{-\infty}^{\infty} S^2(t)\, dt$$

$$\text{Power " "} = \frac{1}{T}\int_{-T/2}^{T/2} S^2(t)\, dt$$

→ Signal can be → Energy Signal
→ Power "



Average is not same



→ Energy is infinite

→

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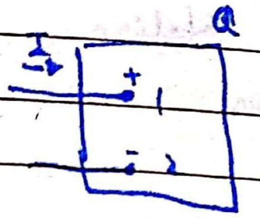
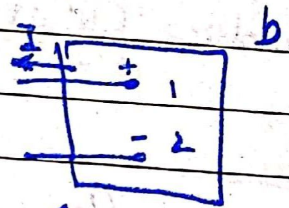
$$P = \frac{dw}{dq} \times \frac{dq}{dt}$$

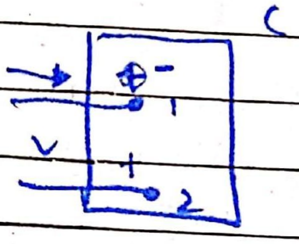
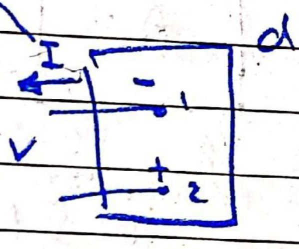
$$P = VI$$

Power may be → absorbing
→ releasing/delivering

Conventional Current   Electronic Current

a    b 

$P = Vi$ $P = V(-i) = -Vi$

c    d 

$P = (-V)i$
$P = -Vi$

$P = (-V)(-i)$
$P = Vi$

$$\boxed{\begin{aligned} I &= 4A \\ V &= -40\,V \end{aligned}}$$

With ref to Box b

$P = -(-40)(4)$

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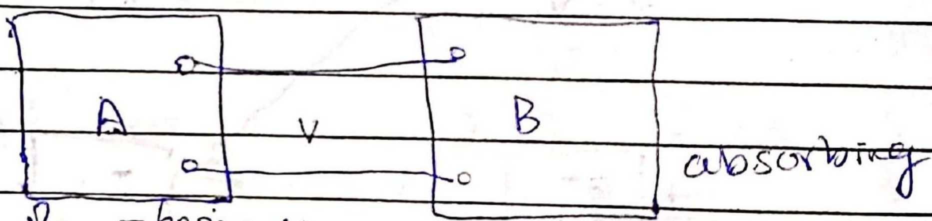
With ref to Box a
the I will be -I

$P = Vi$
$P = (40)(-4) = 160$ watt

+ve power → absorbing the power
-ve power → Extracting " "

Electric Circuit by Nelson
8th Edition

1



$P_A = -600$ watts
delivering

$P_B = 600$ watts

$i = 5A$, $V = 120V$
$i = -8A$ $V = 250V$
$i = 16A$ $V = -150V$
$i = -10A$ $V = -480V$

$i = 30A$

$P_a = Vi = (12)(30)$
$= 360$ watts → absorbing

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②

360×60

$$\begin{array}{r} 3\,360 \\ 60 \\ \hline 000 \\ 2160\times \\ \times \\ \hline 21{,}600 \end{array}$$

$P = 360$ watt

$dw = 360 \int_0^{60\,sec} dt$

$=$

$V = e^{-500t} - e^{-1500t}$ V

$i = 30 - 40e^{-500t} + 10e^{-1500t}$ mA

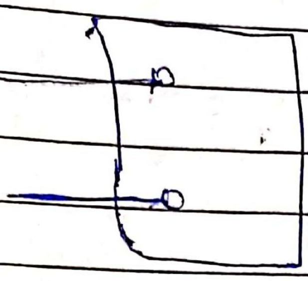
$P = ?$

$P = \frac{dw}{dq}$ $\quad$ $I = \frac{dq}{dt}$

$P = (e^{-500t} - e^{-1500t})(30 - 40e^{-500t} + 10e^{-1500t})$ $\quad$ $\int dq = \int I \cdot dt$

$Q =$

$P = 30e^{-500t} - 40e^{-1000t} + 10e$



$v = 0, \; i = 0 \quad t < 0$

$v = 400 e^{-100t} \sin 200t \; V \quad t \geq 0$

$I = 5 e^{-100t} \sin 200t \; A$

$t = 10^{-2} s$

$p = (400 e^{-100t} \sin 200t)(5 e^{-100t} \sin 200t)$

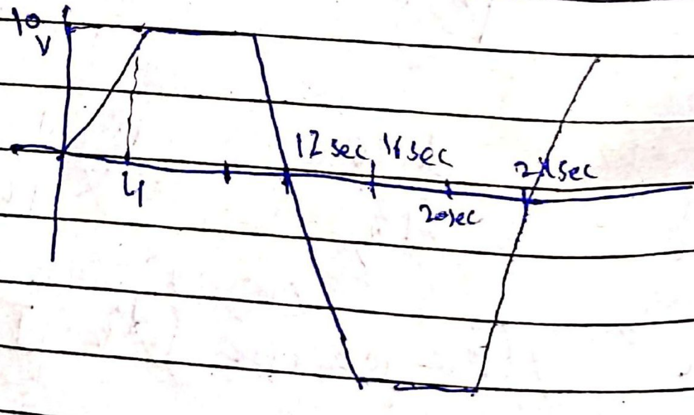
$p = 800 e^{-200t} \sin^2 200t$

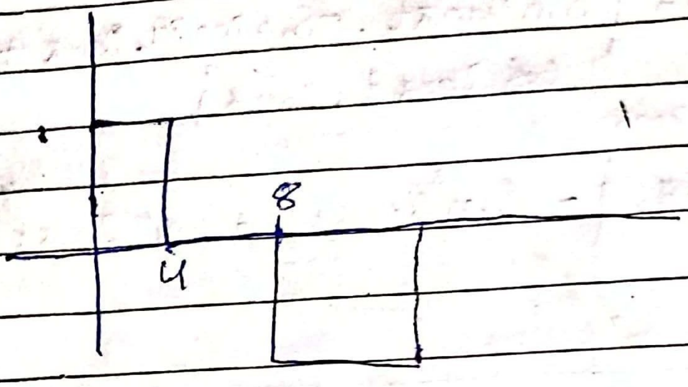
$P = 800 e^{\frac{-200}{100}} \sin^2 \frac{200 \times 10^{-2}}{100}$

$P = 800 e^{-2} \sin^2 2$

$P = 0.974 e^{-2}$

$P = 0.1318$





$$V = 75 - 75e^{-3000t} \text{ volts}$$
$$i = 50e^{-1000t} \text{ mA}$$

$$P_{max} = ?$$

$$P = (75 - 75e^{-3000t})(50e^{-1000t})$$

$$P = 3750e^{-1000t} - 3750e^{-4000t}$$

$$p' = 3750e^{-1000t}(-1000) - 3750(-4000)e^{-4000t}$$

$$p' =$$

$$V = 30 \sin 200\pi t$$
$$I = 20 \cos 200\pi t$$

$$P = \cancel{750}\ 600 \sin 200\pi t \cdot \cos 200\pi t$$

$$P' = 750 \left[\sin 200\pi t \cdot -\sin 200\pi t \cdot 200\pi + \cos 200\pi t \cdot \cos 200\pi t \cdot 200\pi \right]$$

$750 \cdot 200\pi$

$$P' = \cancel{750} \left[-\sin^2 200\pi t + \cos^2 200\pi t \right]$$

$$P = 600 \sin 200\pi t \cos 200\pi t$$

$$P(t) = 300 \sin 400\pi t$$

$$\omega = 400\pi$$

$$f = ?$$

$$\frac{\cancel{2\pi} f}{\cancel{2\pi}} = \frac{\omega}{2\pi}$$

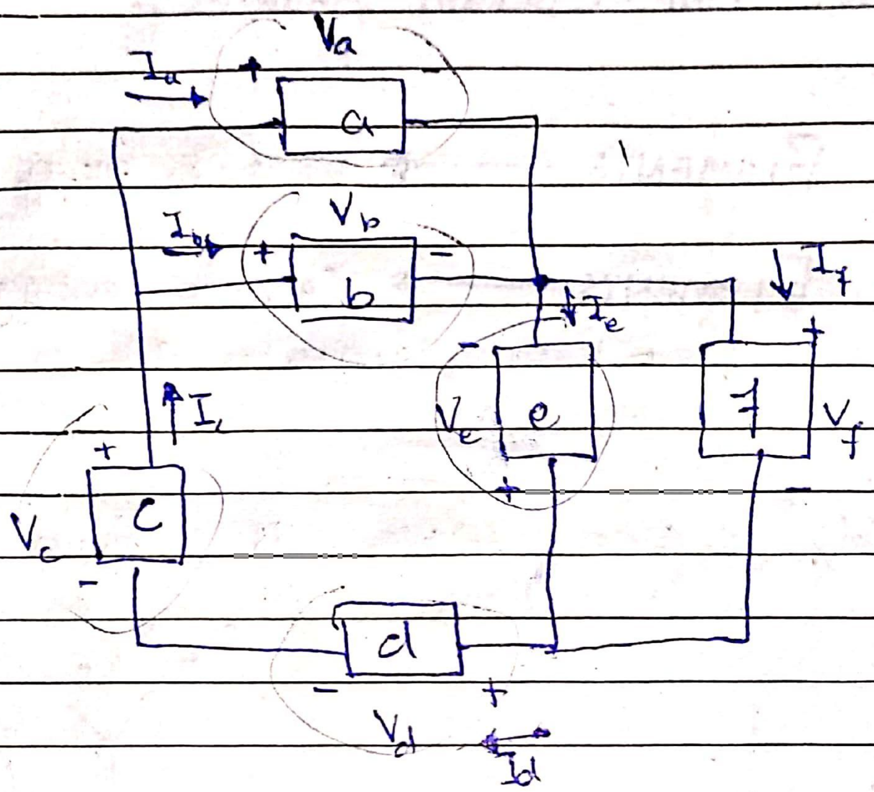
$$f = \frac{400\cancel{\pi}}{2\cancel{\pi}} = 200\,Hz$$

Average value

$$P(0) = 600 \sin 400\pi(0)$$

$$P(0) = 600 \sin(0) = 0$$

$$P(5) =$$



970

	V	i	P
a	150	0.6	$P = (150)(0.6) = 90$ watt
b	150	-1.4	$P = (150)(-1.4) = -210$ watt
c	100	-0.8	$P = (-i)V = (-(-0.8))(100) = 80$
d	250	-0.8	$P = (+v)i = (+250)(-0.8) = -200$
e	300	-2.0	$P = -iV = -(2)(300) = 600$
f	-300	1.2	$P = iV = \boxed{360}$

300
× 1.2
600
300×
3600

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Voltage And Current Sources :-

Active Elements → Provide energy to circuit

Passive Elements → Consume energy from circuit
↳ Resistor, capacitor etc.

→ Ideally sine wave is from $+\infty$ to $-\infty$.

Ideal Voltage Source
↓
The Source which maintain its voltage whatever is the current flowing.

Ideal Current Source
↓
The source which maintain it voltage whatever is the ~~current~~ voltage.

→ Two types of active sources

★ Dependant voltage & current sources
★ Independant " " "

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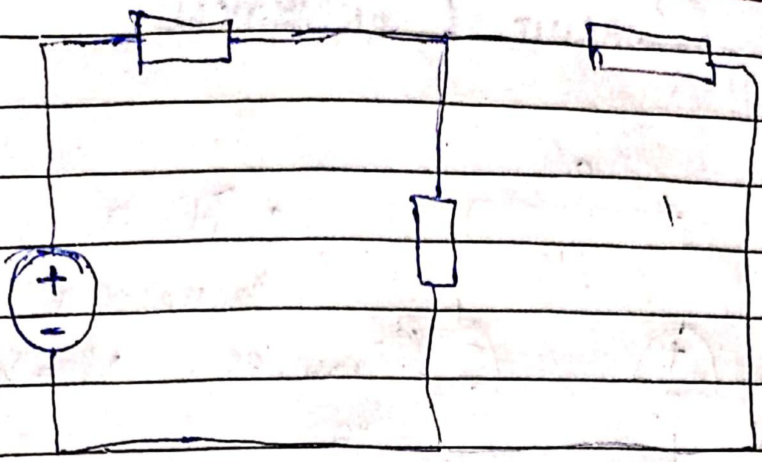
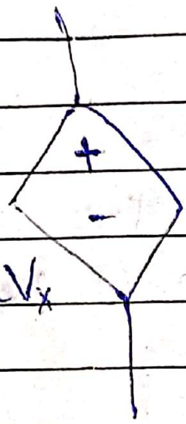
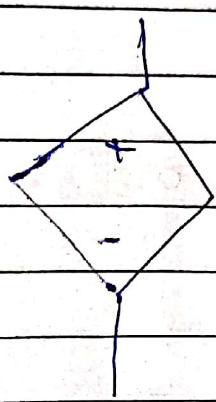




$V = \mu V_x$

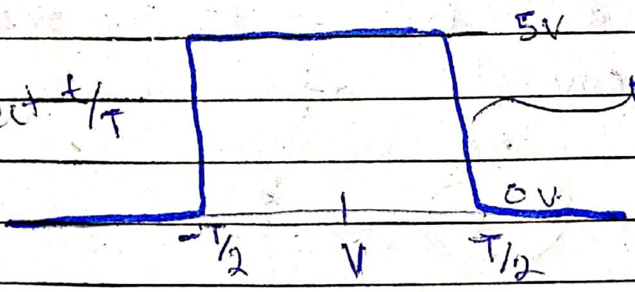
Voltage dependant Voltage source



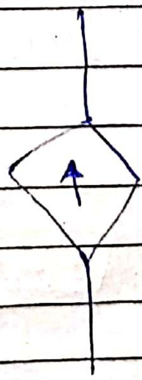
Current dependant voltage source

$i = \beta i_x$

Rect t/T



$i = \alpha V_x$



$i = \beta i_x$

→ These symbols are constant values.

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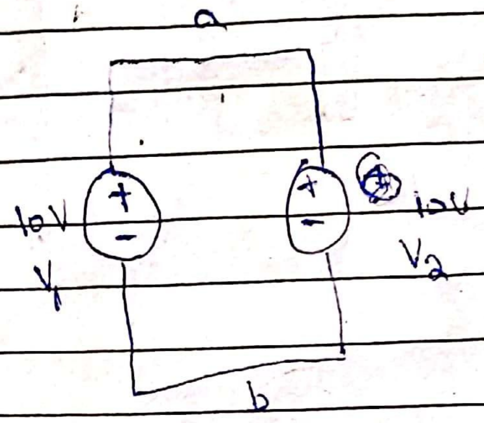
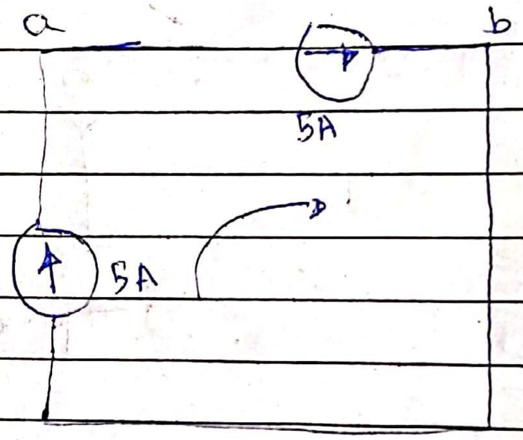
Circuit Connections

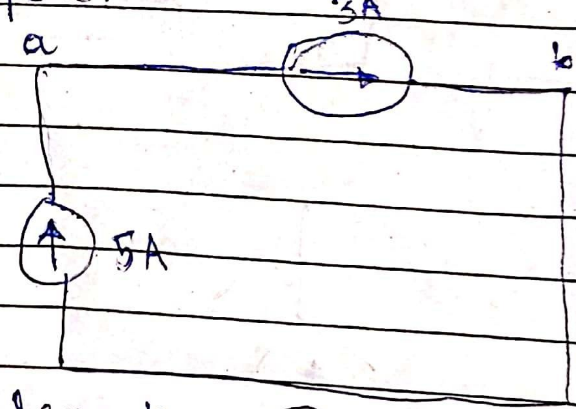


• It is a valid connection as long as $V_1 = V_2$



★ Here current won't be added.

★ It is a loop and in one loop same amount of current will flow.



Not valid

Line Elements ← $\boxed{R, L, C}$

↳ Line losses b/c of these elements.

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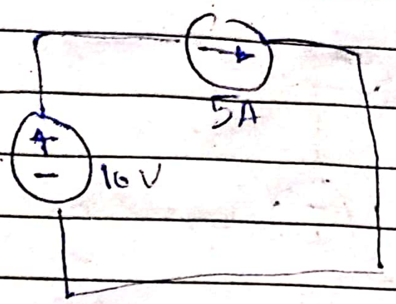
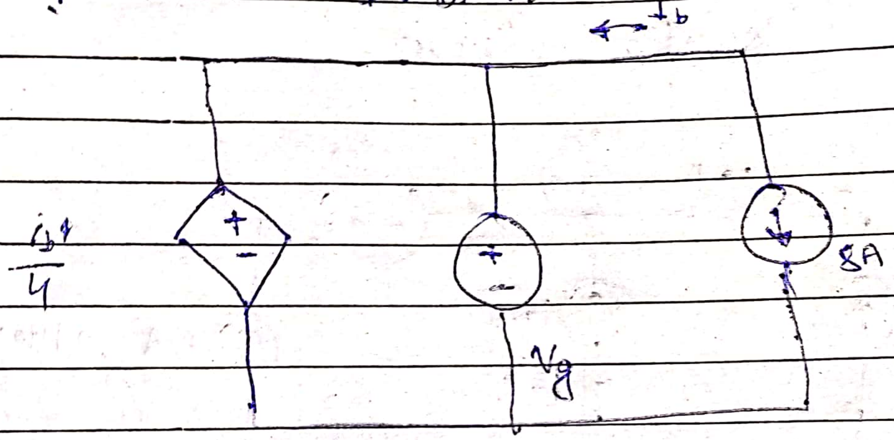


By definition
It is a valid connection.

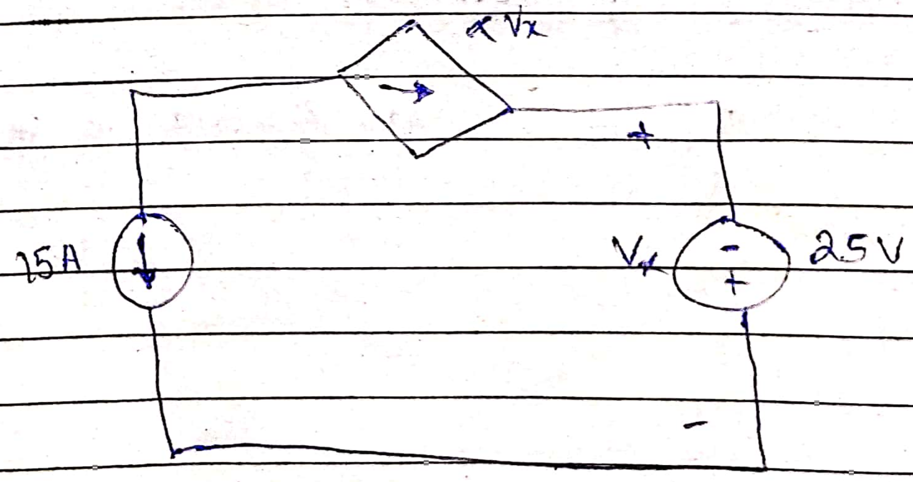
Assessment Problem.



$V = -\frac{8}{4} = -2$ Volts

$P = Vi = -2 \times 8 = -16$ Watts

$\alpha V_x = 25$



Scanned with CamScanner

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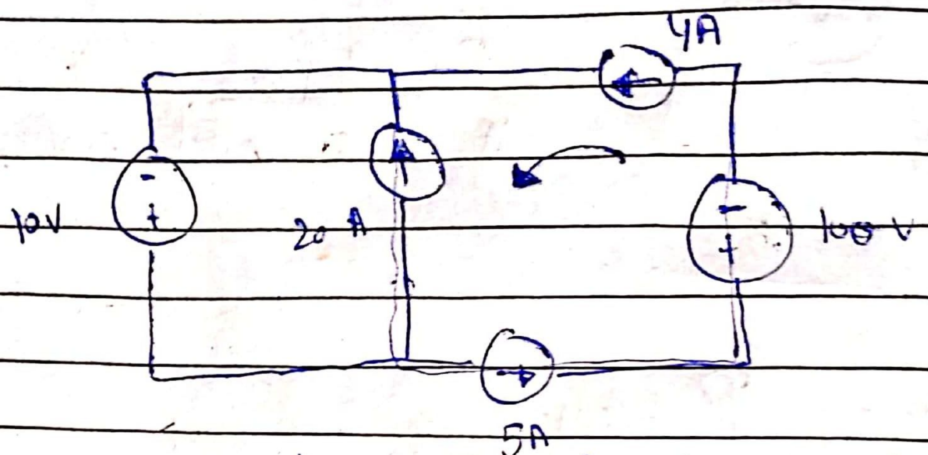
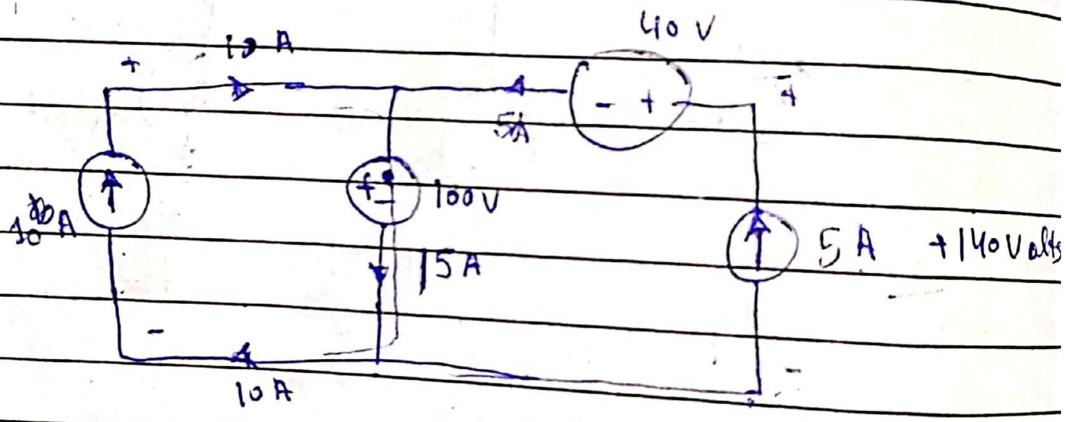


Invalid Circuit



$P_{10A} = (-10)(100) = -\cancel{1400}\ 1000$

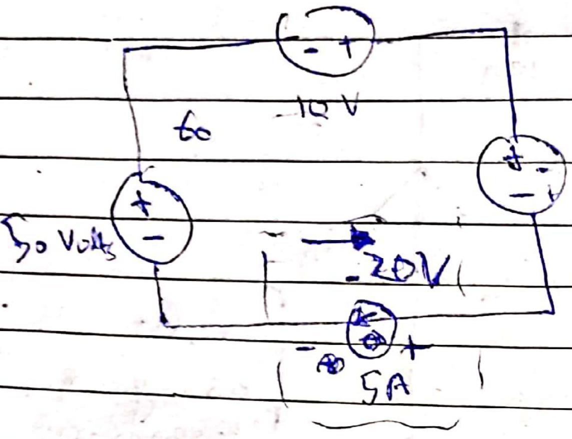
$V = IR$

$P_{5A} = -(140)(5)$

$= -700$ watts

$P_{100V} = Vi = 100 \times 15 = 1500$ watts

P

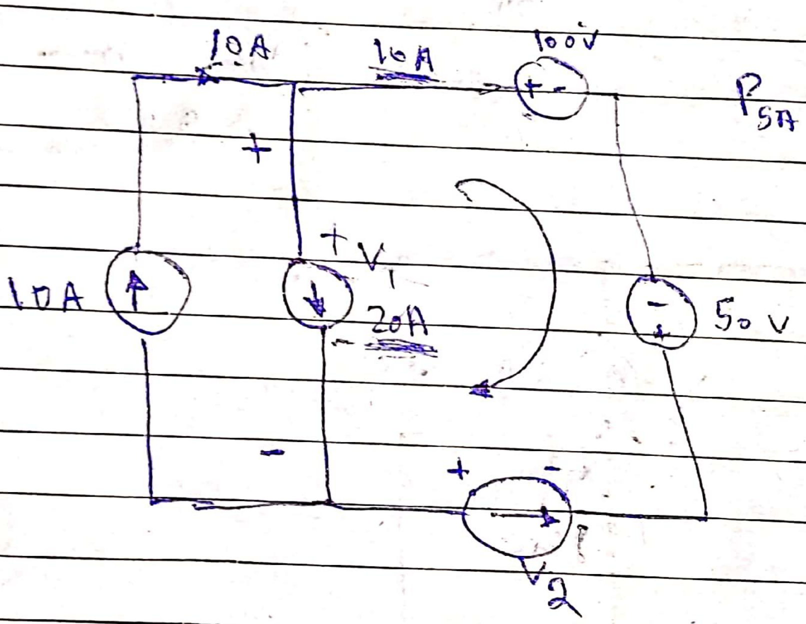


$= (40)(5)$

$= \boxed{200}$

$= (20\,V)(-5)$

$= \boxed{\cancel{-100\ watt}}$

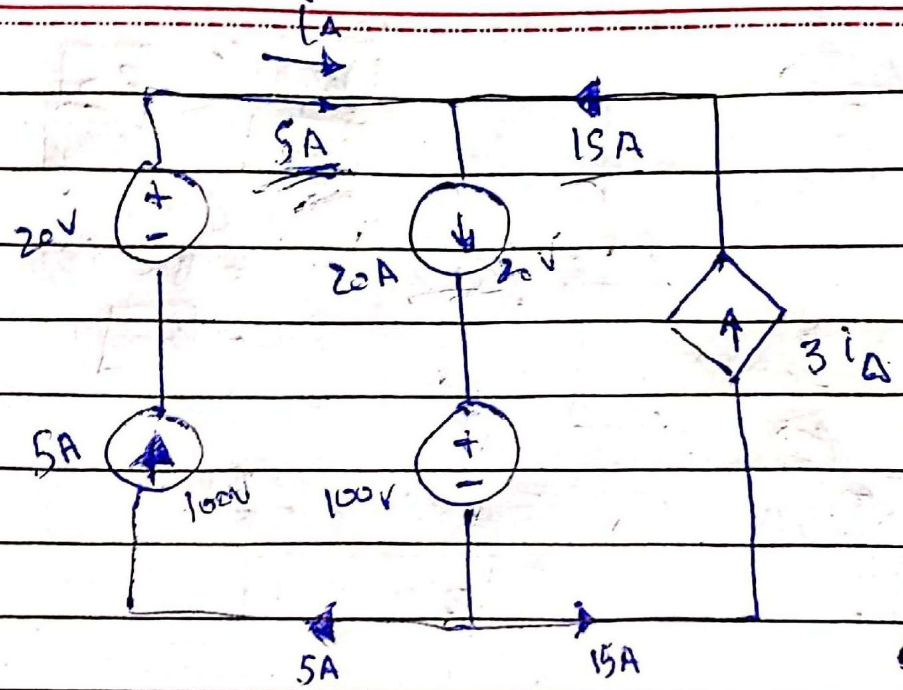


$P_{5A} =$

$100\,V - 50\,V - V_2 - V_1 = 0$

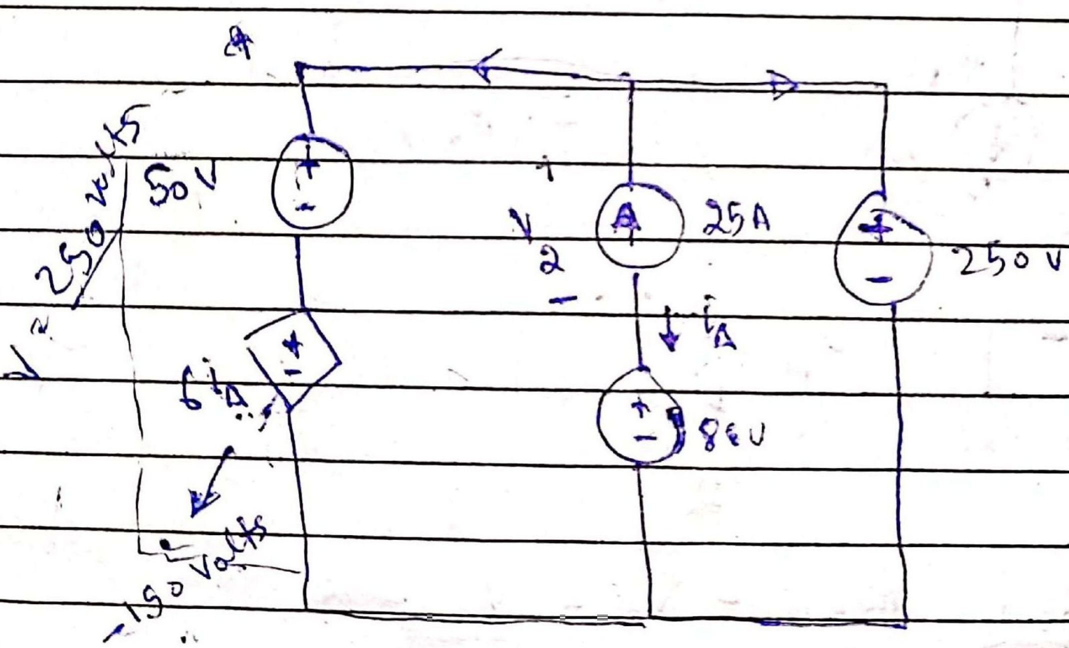
$50\,V = V_1 + V_2$

Doesn't have unique solution.
Infinite solutions.



Solve it as your assignment

Next week B quiz



The circuit is invalid