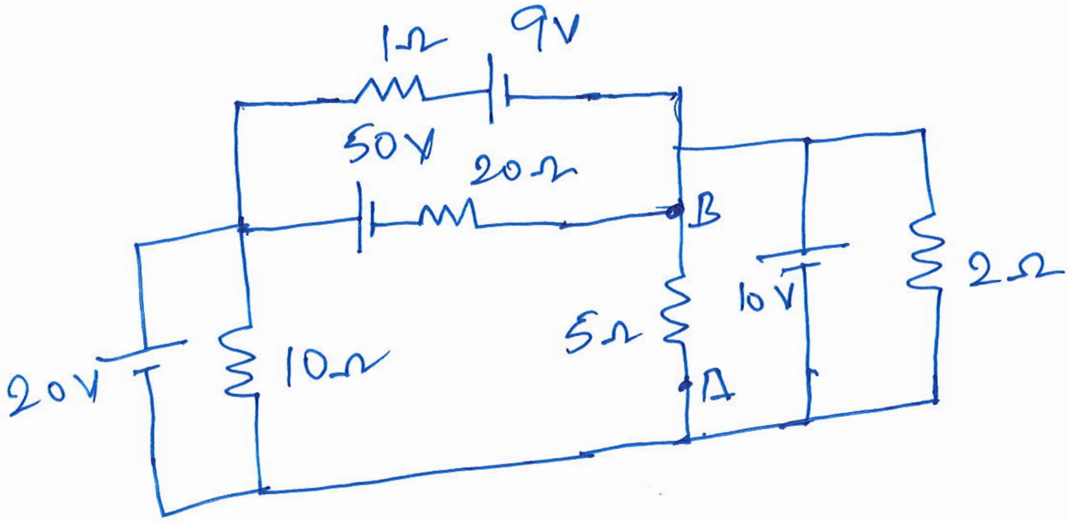
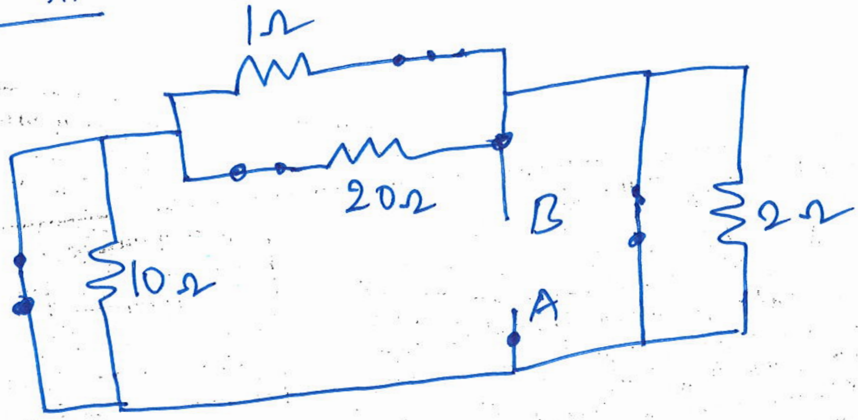
EECE 105L

# SOLUTIONS TO MIDTERM EXAMINATION ①

1.




To find $R_{TH}$:

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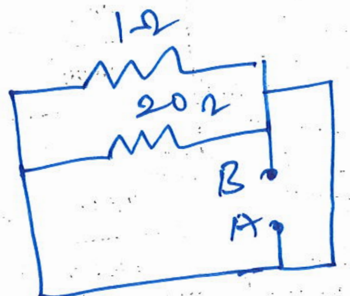
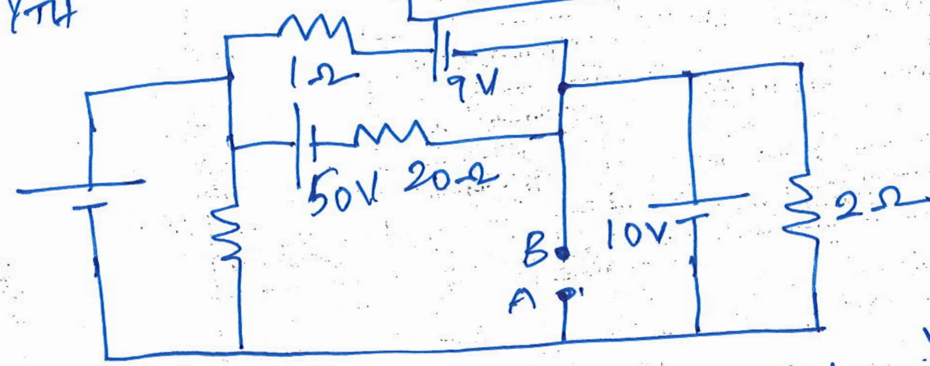


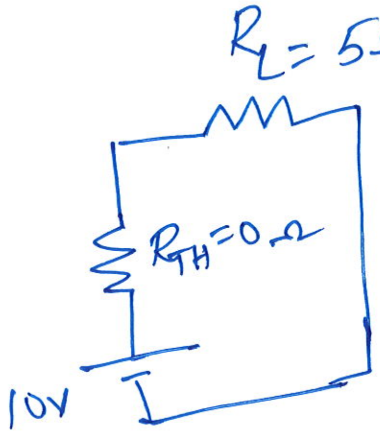

=) $R_{AB} = 0 = \underline{R_{TH}}$

$V_{TH}$




As 10V supply is in parallel, $V_{AB} = 10\,V$

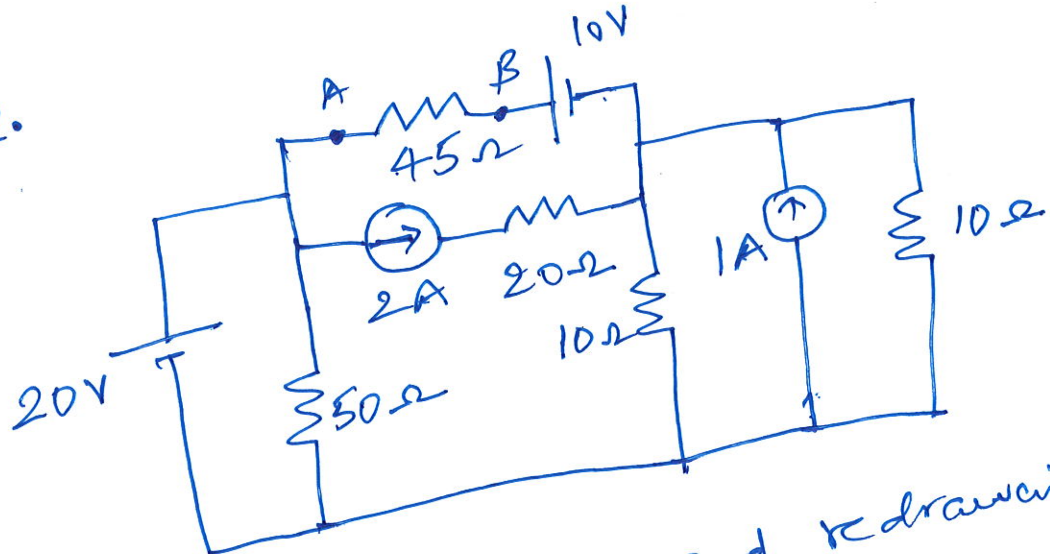
So $V_{TH} = \underline{10V}$



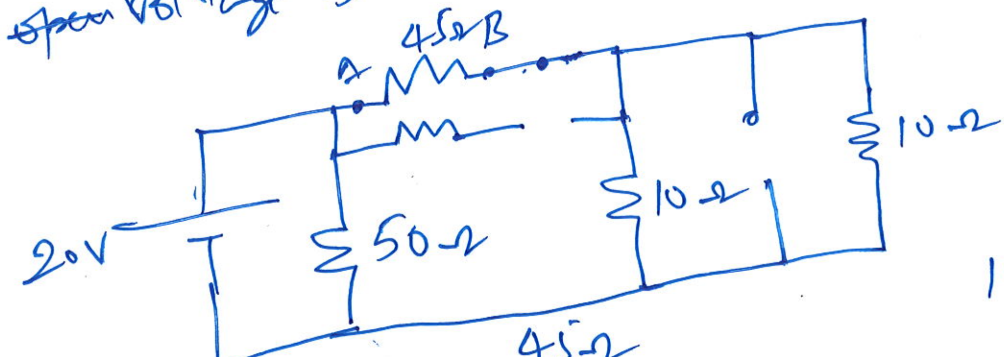

$$I_L = \frac{V_L}{R_L} = \frac{10}{5} = 2A$$

$$P_L = V_L \cdot I_L = 10 \cdot 2 = \underline{\underline{20W}}$$

2.

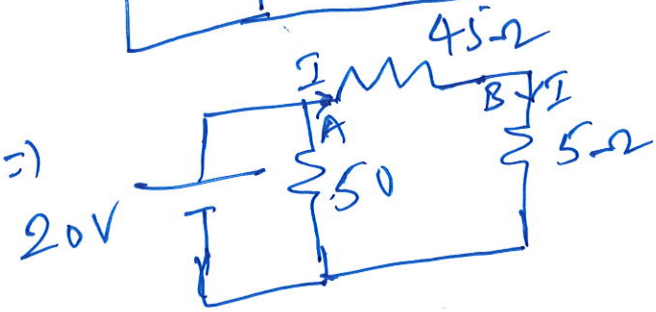



Consider 20V source and redrawing the circuit by opencircuiting current sources and short circuiting ~~open~~ voltage sources.




$10\Omega \parallel 10\Omega = 5\Omega$

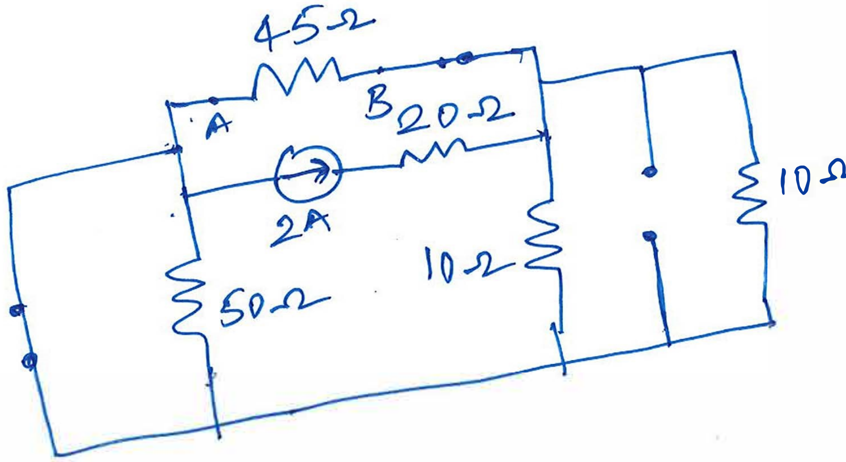
=)



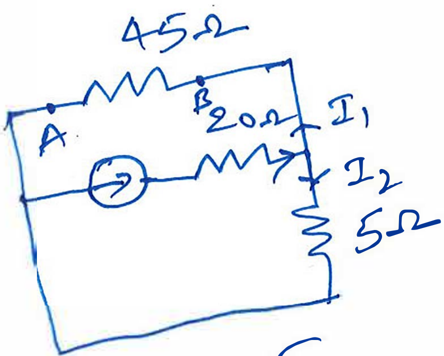

Voltage across ($45\Omega + 5\Omega$) is 20V.

$\therefore I = \frac{20}{45+5} = \frac{20}{50} = 0.4\,A$ (from A to B)

Considering 2A source




$\Rightarrow$




$I_1 + I_2 = 2A$

$I_1 = \frac{2 \times 5}{45+5} = 2 \times 0.1 = 0.2A$ (B to A)

$I_{net} = 0.4 - 0.2 = 0.2\,A$ (A to B)

$P = I^2 R_L = (0.2)^2 \times 45 = \underline{1.8\,W}$

3. $f(t) = 10 \sin(\omega t + 20^\circ)$

$g(t) = 10 \cos(\omega t - 80^\circ) = 10 \sin(\omega t + 90^\circ - 80^\circ)$

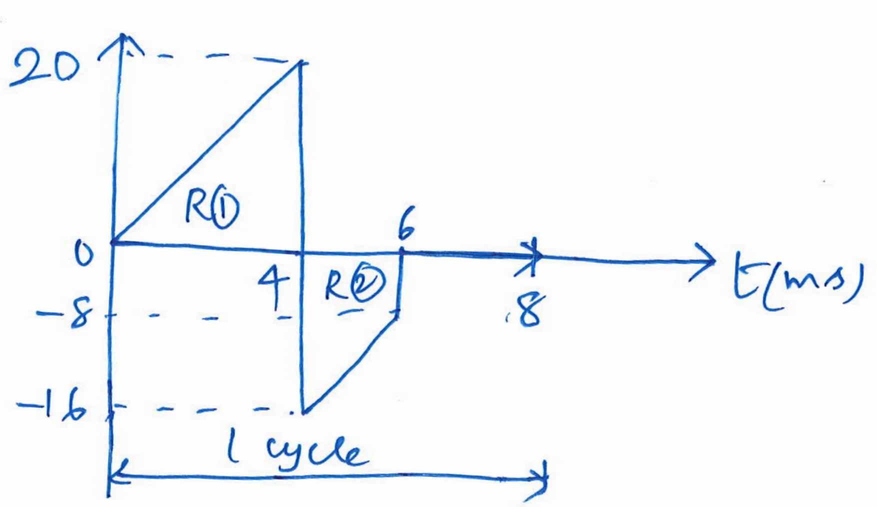
$= 10 \sin(\omega t + 10^\circ)$

$(\omega t + 20^\circ) - (\omega t + 10^\circ) = 10^\circ$

$f(t)$ leads $g(t)$ by $10^\circ$ (or)

$g(t)$ lags $f(t)$ by $10^\circ$

4.




In region-I $f_1(t) = mt + c$

at $t=0$ $f_1(t)=0 \Rightarrow C=0$

at $t=4$ $f_1(t)=20 \Rightarrow 20 = m\cdot 4 \Rightarrow m = 5\,V/ms$

$$f_1(t) = 5t \quad \text{— (A)}$$

In region-II $f_2(t) = mt + c$

at $t=4$, $f_2(t) = -16 \Rightarrow -16 = 4m + c$ — (1)

at $t=6$ $f_2(t) = -8 \Rightarrow -8 = 6m + c$ — (2)

from (1) & (2) $m = 4\,V/ms$, $C = -32\,V$

$$f_2(t) = 4t - 32$$

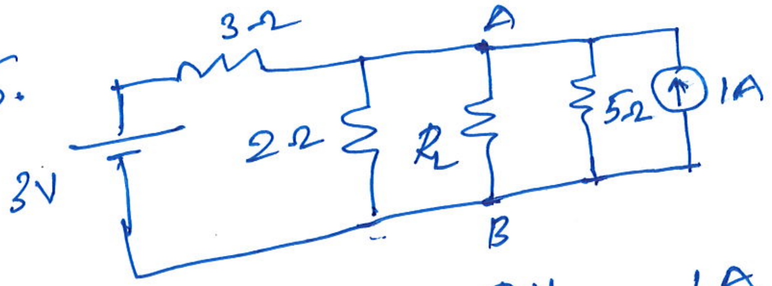
$$V_{RMS} = \sqrt{\frac{\int_0^4 (5t)^2\,dt + \int_4^6 (4t-32) + \int_6^8 0\cdot dt}{8-0}}$$

$$= \sqrt{\frac{\frac{25t^3}{3}\Big|_0^4 + \frac{16t^3}{3} - \frac{256}{2}t^2 + 1024t\Big|_4^6}{8}} =$$

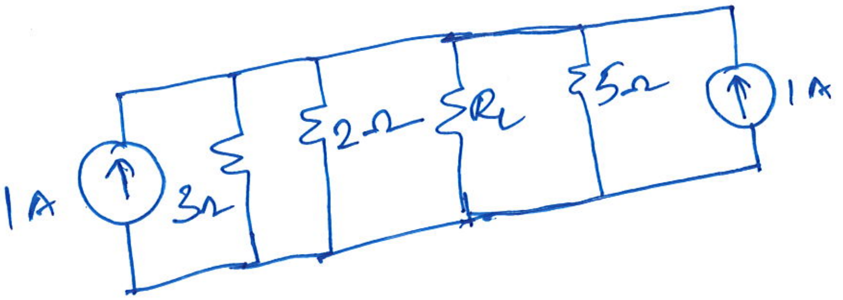
$$= \sqrt{\frac{\frac{25}{3}(4)^3 + \frac{16}{3}(6^3-4^3) - \frac{256}{2}(6^2-4^2) + 1024(6-4)}{8}}$$

$$= \left(\frac{\frac{1600}{3} + \frac{2432}{3} - 2560 + 2048}{8}\right)^{1/2} \simeq 2\sqrt{26}\,V$$

5.




$$I_s = \frac{V_s}{R_s} = \frac{3\,V}{3\,\Omega} = 1\,A$$




$3 \| 2 \| 5 =$

$= 0.97\,\Omega$

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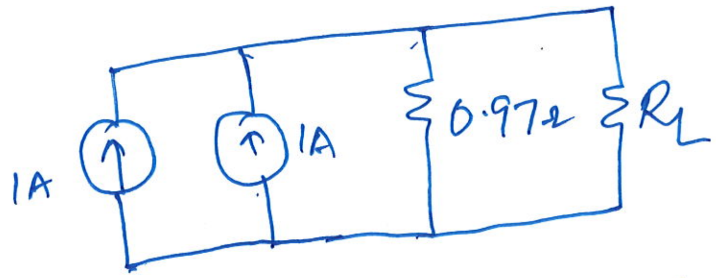


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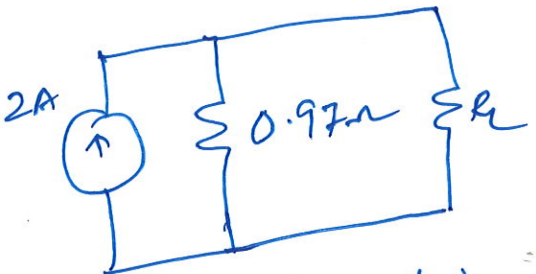


$R_L$ for which maximum power is transferred is

<u>$0.97\,\Omega$</u>