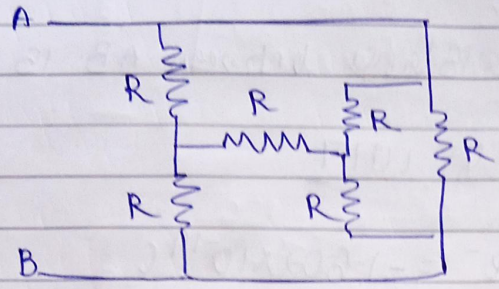
Roll No 20CSE1017

Pg 1

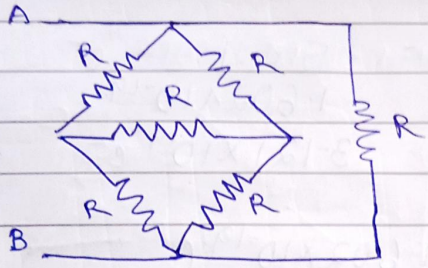
BES Mid Sem Exam

SECTION A

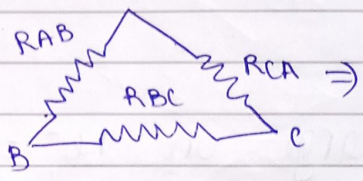
Q1)




Can be simplified as



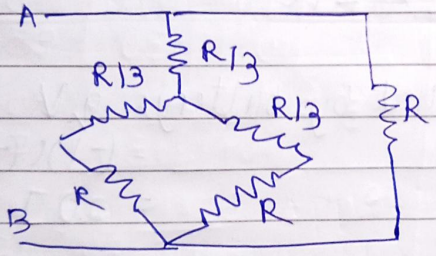

Using Delta to Star transformation



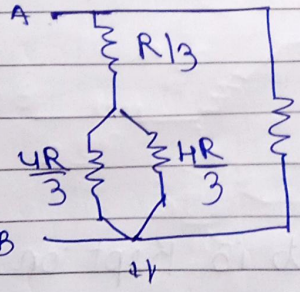

$$R_A = \frac{R_{AB}R_{CA}}{R_{AB}+R_{CA}+R_{BC}} = \frac{R^2}{3R} = \frac{R}{3}$$

$$R_B = \frac{R_{AB}R_{BC}}{R_{AB}+R_{BC}+R_{CA}} = \frac{R^2}{3R} = \frac{R}{3}$$

$$R_C = \frac{R_{CA}R_{BC}}{R_{AB}+R_{BC}+R_{CA}} = \frac{R^2}{3R} = \frac{R}{3}$$

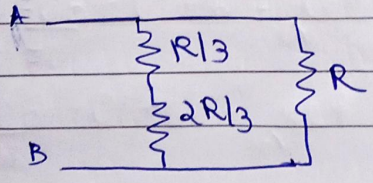


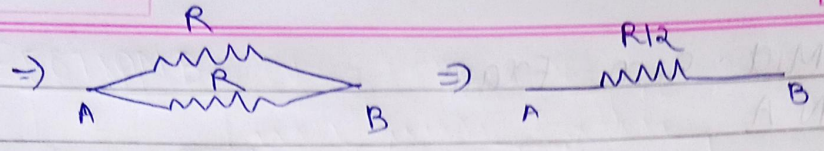

$\frac{R}{3}$ and R are in series $R_{eq_1} = \frac{R}{3} + R = \frac{4R}{3}$




$\frac{4R}{3}$ both are in ||

$$R_{eq_2} = \frac{1}{\frac{3}{4R} + \frac{3}{4R}} = \frac{4R}{6} = \frac{2R}{3}$$






∴ Equivalent resistance between AB is $\frac{R}{2} = \frac{7}{2}\Omega$

$= 3.5\Omega$

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Ans2) Charge on ~~+~~ $1e^- = -1.602 \times 10^{-19}$ C

No of $e^-$ in $-1C = \frac{1}{1.602 \times 10^{-19}}\ e^-$

∴ No of $e^-$ in $-5C = \frac{5 \times 1}{1.602 \times 10^{-19}}\ e^-$

$= 3.121 \times 10^{19}\ e^-$

Ans3) Charge on $1e^- = -1.602 \times 10^{-19}$ C

Charge on $6.28 \times 10^{18}\ e^- = +6.28 \times 10^{+18} \times -1.602 \times 10^{-19}$ C

$\approx -1C$

Energy used or supplied by battery $= qV$

$= (-1)(-20V)$

$= 20$ J

4) ~~The conductor~~

Ans4) Copper

Ans5) 0K or $-273.15°C$

Ans6) Time for which the bulb is kept on = 12 hours

$= 12 \times 60 \times 60$ s

$= 43,200$ s

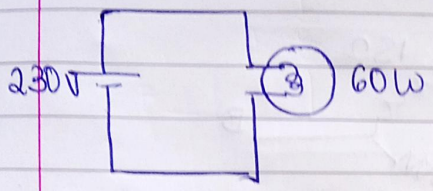
Energy dissipated = $\int P\,dt$

$= Pt$ (For constant Power)

$= 60 \times 43,200$

$= 2,592,000\,J$ or $60 \times 12$ Whr

or ~~20~~ ~~Whr~~ 720 Whr



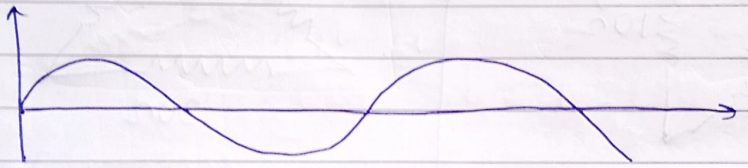

$\because P = VI$

$= V\left(\frac{V}{R}\right)$ $\quad V = iR$

$P = \frac{V^2}{R}$

$60 = \frac{(230)^2}{R} \Rightarrow R = \frac{(230)^2}{60} = 881.66\,\Omega$

Ans7)



$\omega = 2\pi f$

80 Hz means 80 cycles in 1 sec

No of cycles in 1 sec = $\frac{1}{80}$

80 Hz mean 80 cycles in 1 sec

Let the time duration of each cycle be T

$80T = 1\,s$

$T = \frac{1}{80}\,s$

$T = \frac{1000}{80}\,ms$

$= 12.5\,ms$

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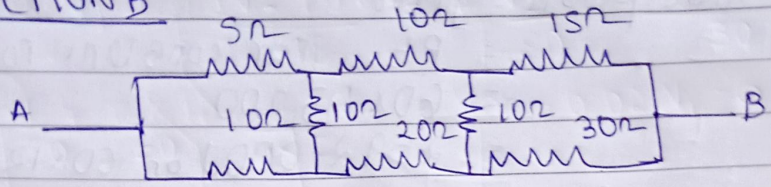
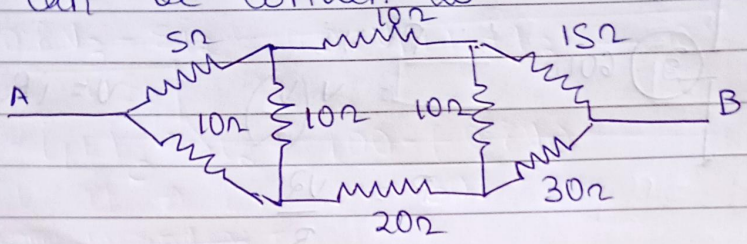
## SECTION B

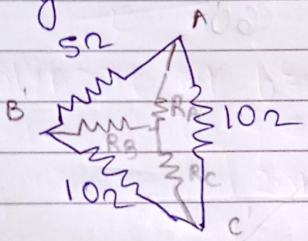
Ans 8)

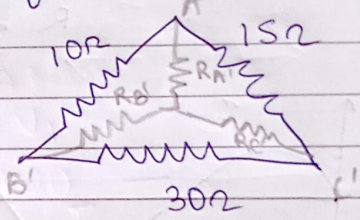



S can be written as




Using delta to star transformations




$R_A = \frac{5 \times 10}{5+10+10} = \frac{50}{25} = 2\Omega$

$R_B = \frac{5 \times 10}{5+10+10} = \frac{50}{25} = 2\Omega$

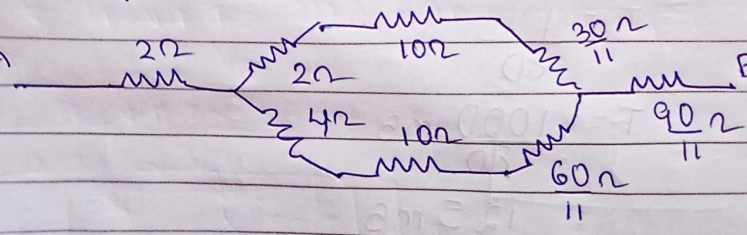
$R_C = \frac{100}{5+10+10} = \frac{100}{25} = 4\Omega$

$R_A' = \frac{10 \times 15}{10+15+30} = \frac{150}{55} = \frac{30}{11}\Omega$

$R_B' = \frac{10 \times 30}{10+15+30} = \frac{300}{55} = \frac{60}{11}\Omega$

$R_C' = \frac{30 \times 15}{10+15+30} = \frac{450}{55} = \frac{90}{11}\Omega$

∴ The equivalent ckt is




For series resistors $R_{eq_1} = 2+10+\frac{30}{11} = \frac{162}{11}\Omega$

" " $R_{eq_2} = 4+10+\frac{60}{11} = \frac{214}{11}\Omega$

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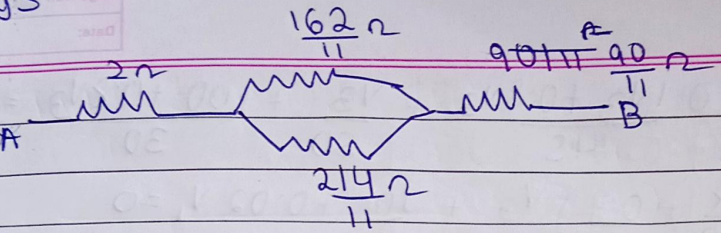
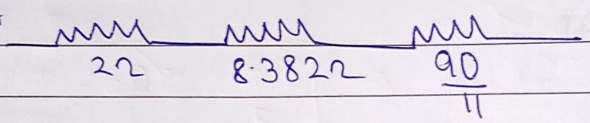



For Parallel resistors $Req_{3} = \frac{1}{\frac{11}{162} + \frac{11}{214}}$

$= \frac{1}{11} \frac{162 \times 214}{(214+162)}$

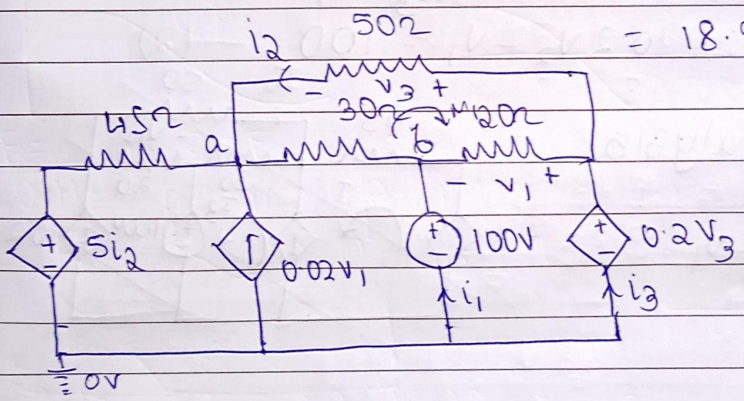
$= 8.382\,\Omega$




∴ Resistance blw A and B = $2 + 8.382 + \frac{90}{11}$ (For sure)

$= 18.564\,\Omega$

Ans)




a) Nodal analysis ~~at a~~

Potential at a = $+0.2V_3 - V_3$

$= -0.8V_3$

∴ Nodal analysis at a

$0.02V_1 + \frac{5i_2 - (-0.8V_3)}{45} + i_2 + \frac{100 - (-0.8V_3)}{30} = 0$

where $\frac{V_3}{50} = +i_2$

$0.1V_3 = 5i_2$

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$$0.02V_1 \quad \frac{0.1V_3 + 0.8V_3}{45} + \frac{V_3}{50} + \frac{100 + 0.8V_3}{30} = 0$$

$$\left(\frac{1}{50} + \frac{0.8}{30} + \frac{0.9}{45}\right)V_3 + \frac{10}{3} + 0.02V_1 = 0$$

$$\frac{V_3}{15} + \frac{V_1}{50} + \frac{10}{3} = 0 \quad \text{— (1)}$$

$$\frac{-0.8V_3 - 5i_2}{45} = 0.02V_1 + i_1 + i_3 \quad \text{— (2)}$$

$$i_1 + i_3 = i_2 + \frac{100 - (0.8V_3)}{30} \quad \text{— (3)}$$

~~from (1) and (2)~~

$$\frac{-0.9V_3}{45} =$$

Potential at b = +100

$$= +0.2V_3 - V_1$$

$$\therefore 0.2V_3 - V_1 = 100 \quad \text{— (2)}$$

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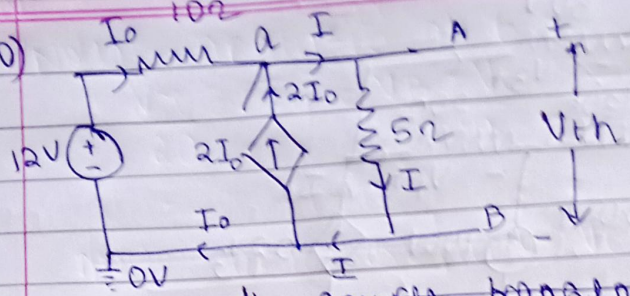
Ans10)




Source transformation

KCL at a

$I_o + 2I_o = I$

$3I_o = I$

KVL in the bigger Mesh

$+12 - 10I_o - 5(3I_o) = 0$

$12 - 10I_o - 15I_o = 0$

$\frac{12}{25} = I_o$

$\therefore V_{th} = 5(3I_o)$

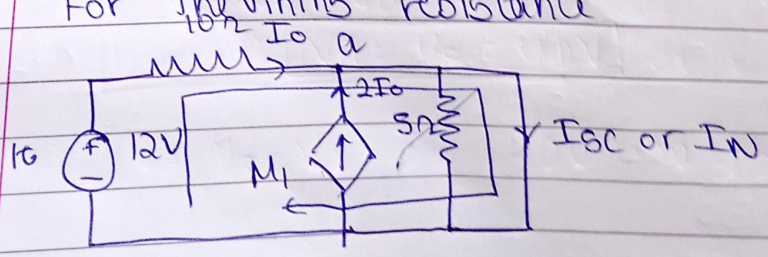
$= 5 \times 3 \times \frac{12}{25}$ V

$= \frac{36}{5}$ V

$V_{th} = 7.2$ V

For Thevinins resistance (or) short circuit voltage

For Thevinins resistance



KCL at a

$I_o + 2I_o = 3I_o = I_{sc}$

$\therefore I_{sc} = 3I_o$

KCL in $M_1$

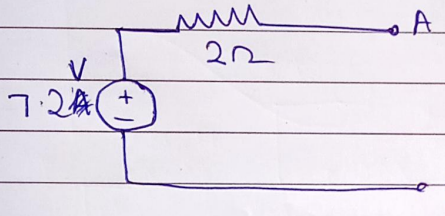
$+12 - 10I_o = 0$

$\frac{12}{10} A = I_o$

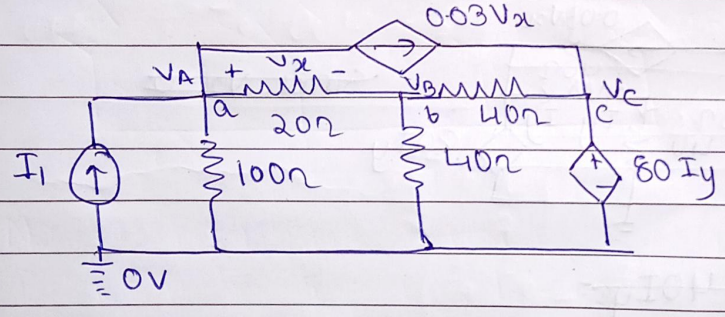
$\therefore I_{sc} = 3I_o = 3\left(\frac{12}{10}\right) = 3.6\,A$

$\therefore$ Thevinin's resistance $= \frac{V_{th}}{I_N} = \frac{36}{5} \frac{10}{36} = 2\Omega$

$\therefore$ The Thevinin's equivalent is




Ans 11)




$I_1 = 0.4\,A$ $V_A$, $V_B$, $V_x$

Nodal analysis at a

$I_1 = 0.03V_x + \frac{V_A}{100} + \frac{V_A - V_B}{20}$

$0.4 = 0.03V_x + 0.01V_A + 0.05V_x$ (where $V_A - V_B = V_x$)

$3V_x + 5V_x + V_A = 40$

$8V_x + V_A = 40$ —— (1)

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Nodal analysis at -b

$$\frac{V_x}{20} = I_y + \frac{V_B - V_C}{40} \quad \text{— (2)}$$

~~Nodal analysis at c~~ $V_c = 80 I_y$ — (3)

~~$0.03V_x$~~

$$\frac{V_B}{40} = I_y \quad \text{— (4)}$$

$$V_C = 2V_B \quad \text{— (5)}$$

From (2) (5)

$$\frac{V_x}{20} = \frac{V_B}{40} + \frac{-V_B}{40}$$

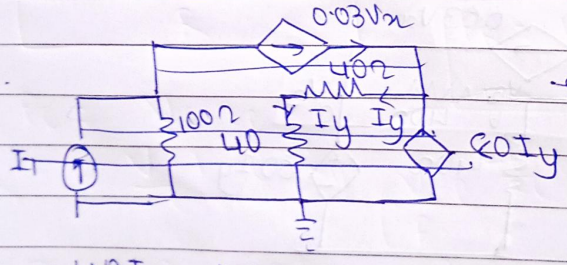
$$\frac{V_x}{20} = 0$$

$$\boxed{V_x = 0}$$

From (1)

$$8(0) + V_A = 40$$

$$\boxed{V_A = 40}$$




~~Since Vx=0~~

~~$+40I_y + 40I_y =$~~

Since $V_A - V_B = V_x$

$$V_A - V_B = 0$$

$$\boxed{V_A = V_B = 40V}$$

$\therefore$ $V_A, V_B, V_x$ are 40V, 40V and 0V

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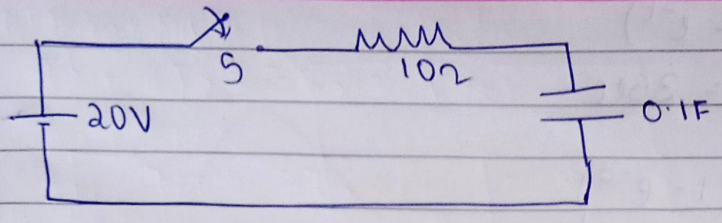
Ans 12)




Ans i) $i(t) = \frac{V}{R} e^{\frac{-t}{RC}}$ (Current as a Fⁿ of time)

$\therefore \tau$ = Time constant = $RC = 10 \times 0.1 = 1s$

$\therefore i(t) = \frac{20}{10} e^{-\frac{t}{1}} = 2e^{-t}$

~~t = 0s~~ $i(0) = 2e^{-0} = 2A$ at $t = 0+$ sec

ii) At $t = 2\tau$
$= 2(1s)$
$= 2s$

$\therefore i(t) = 2e^{-t} =$
$\therefore$ At $t = 2\tau$ $i = 2e^{-2}$
$= \frac{2}{e^2}$
$i = 0.2706 A$

Ans iii) Voltage across capacitor

~~$V_c = V e^{-\frac{t}{RC}}$~~

$V_c = V\left(1 - e^{-\frac{t}{RC}}\right)$
$= 20(1 - e^{-t/1})$
$\boxed{V_c = 20(1 - e^{-t})}$

Voltage across resistor

$V_R = V e^{-\frac{t}{RC}}$
$= 20e^{-t/1}$
$\boxed{V_R = 20e^{-t}}$

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iv)

Ans: $V_C = 20(1 - e^{-t})$

At $t = 3\tau = 3sec$

$V_C = 20(1 - e^{-3})$

$\boxed{V_C = 19.004\ V}$

$V_R = 20e^{-t}$

At $t = 3\tau = 3sec$

$V_R = \frac{20}{e^{+3}} = 0.9957\ V$

$\boxed{V_R = 0.9957\ V}$

Ans: ~~$P_R = V_R i_R R\ (t) R$~~

$= \frac{V}{R} \times e^{-\frac{t}{RC}} \times R$

$P_R = V_R i_R$

$= V e^{-\frac{t}{RC}} \frac{V}{R} e^{-\frac{t}{RC}}$

$\boxed{P_R = \frac{V2}{R} e^{-\frac{2t}{RC}}}$

For resistor

$\boxed{P_R = \frac{400}{10} e^{-\frac{2t}{1}} = 40 e^{-2t}}$

ii) $P_C = V_C i_C$

$= V(1 - e^{-\frac{t}{RC}}) \left(\frac{V}{R} e^{-\frac{t}{RC}}\right)$

$P_C = \frac{V2}{R} \left(e^{-\frac{t}{RC}} - e^{-\frac{2t}{RC}}\right)$

$P_C = \frac{400}{10} \left(e^{-\frac{t}{1}} - e^{-\frac{2t}{1}}\right)$ $RC = 1$

$\boxed{P_C = 40\ (e^{-t} - e^{-2t})}$ For Power of capacitor

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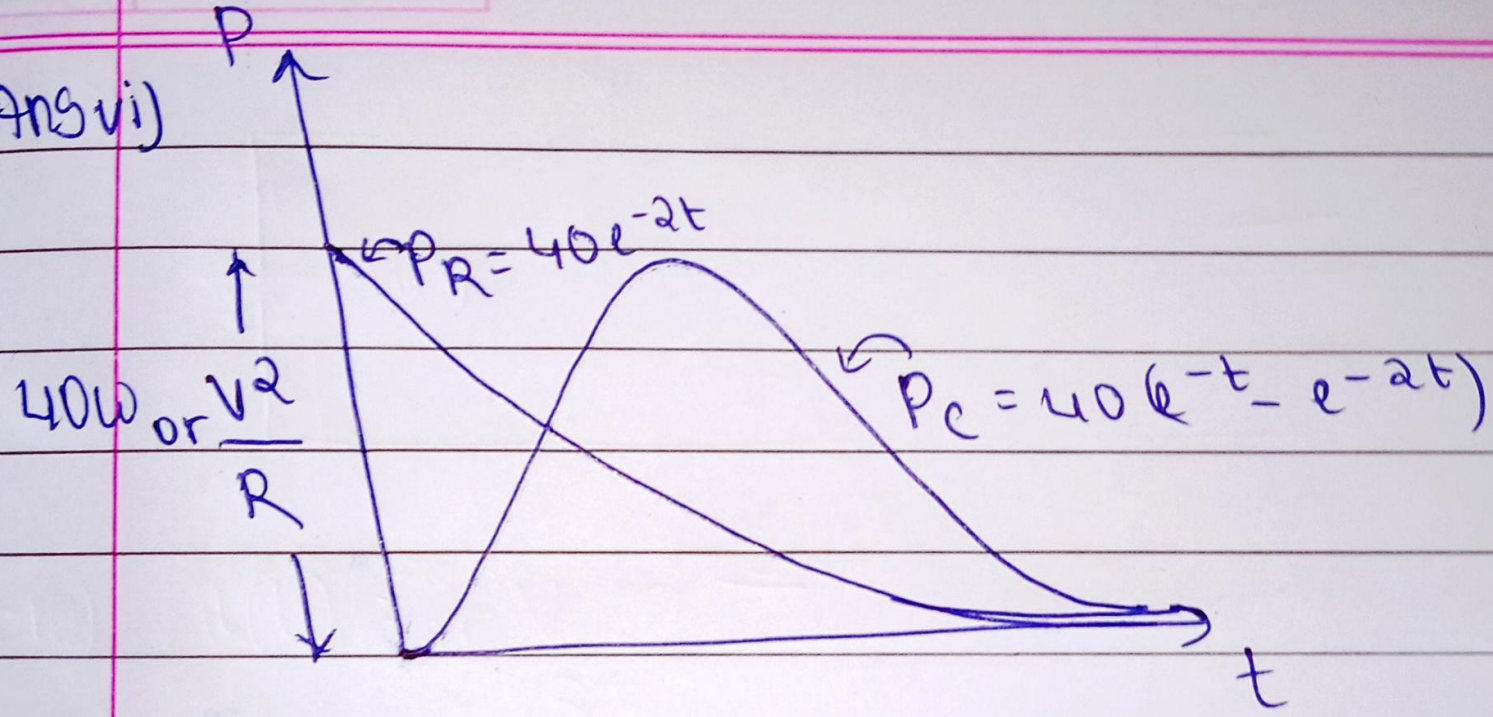
Ans vi)



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Q9 b) Mesh Analysis