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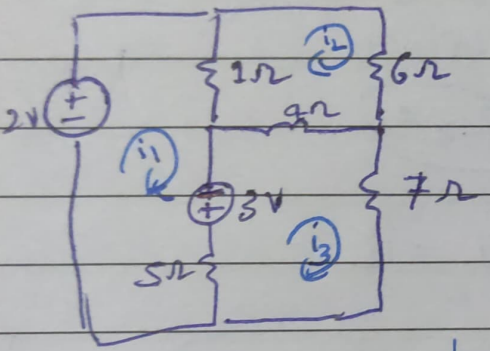
Basic Electronics (ECE 113) (Assignment-1)

A1)



$\Rightarrow (-2) + (i_1 - i_2)1 + (-3) + (i_1 - i_3)5 = 0$

$6i_1 - i_2 - 5i_3 = 5$ — ①

$\Rightarrow 6i_2 + 9(i_2 - i_3) + (i_2 - i_1)1 = 0$

$16i_2 - i_1 - 9i_3 = 0$ — ②

$\Rightarrow 3 + 9(i_3 - i_2) + 7i_3 + 5(i_3 - i_1) = 0$

$3 + 21i_3 - 9i_2 - 5i_1 = 0$ — ③

by solving ①, ②, ③

$5 + i_2 = 6i_1 - 5i_3$

$96i_1 - 80i_3 - 80 - 4i_1 = 0$

$92i_1 - 80i_3 = 80$

$46i_1 - 40i_3 = 40$

$6i_1 - i_2 - 5i_3 = 5$

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$i_1 + 9i_3 = 16i_2$

$3 + 21i_3 = 9i_2 + 5i_1$

$3 + 21i_3 = 9i_2 + 5i_1$

$3(7i_3) = 9i_2 + 5i_1 - 3$

$6 + 18i_2 = 9i_2 + 5i_1 - 3$

$9 = 27i_2 + 5i_1$

$\frac{9 - 5i_1}{2} = 3i_2$

$6i_2 + 7i_3 = 2$

$\frac{9}{5}(1 - 3i_2) = i_1$

$\frac{2}{7}(1 - 3i_2) = i_3$

$6i_1 = 5 + 5i_3 + i_2$

$\frac{54}{5}(1 - 3i_2) = 5 + \frac{10}{7}(1 - 3i_2) + i_2$

$\left(\frac{7 \times 54 - 50}{35}\right)(1 - 3i_2) = 5 + i_2$

$328 - 984i_2 = 175 + 35i_2$

$\frac{328 - 175}{1019} = i_2 = \frac{153}{1019}$

$i_1 = \frac{9}{5}\left(\frac{560}{1019}\right)$

$= \frac{1008}{1019}$

$i_3 = \frac{2}{7}\left(\frac{560}{1019}\right)$

$= \frac{160}{1019}$

$\therefore i_1 = 153/1019$

$i_2 = 1008/1019$

i_3

$\therefore$

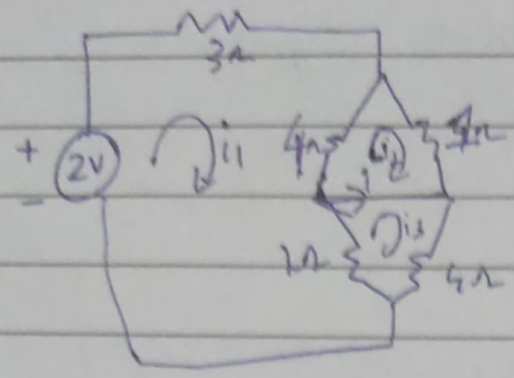
$i_1 = 1008/1019$

$i_2 = 153/1019$

$i_3 = 160/1019$

3 Ω

A2)



$-2+3i_1+4(i_1-i_2)+1(i_1-i_3)=0$

$8i_1-4i_2-i_3=2$ — ①

~~$i_1+i_2+i_3=2$~~

$i_2+4(i_2-i_1)=0$

$5i_2=4i_1$ — ②

$4i_3+[i_3-i_1]=0$

$5i_3=i_1$ — ③

~~$8i_1-5i_1-4\left(\frac{4i_1}{5}\right)=2$~~

~~$3i_1-\frac{16i_1}{5}=2$~~

~~$-i_1=2$~~

by solving ①, ② & ③

$8i_1-4\left(\frac{4i_1}{5}\right)-\frac{i_1}{5}=2$

$\frac{23i_1}{5}=2$

$i_1=\frac{10}{23}$ A

$i_3=\frac{2}{23}$ A

$i_2=\frac{8}{23}$ A

$i+i_2=i_3$

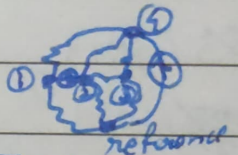
$\therefore i=i_3-i_2$

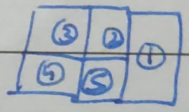
$=\frac{2}{23}-\frac{8}{23}$

$=-\frac{6}{23}$

$\therefore i=\frac{-6}{23}=(-0.260\,869\,565\,21)$ A

$\therefore I = \frac{-12}{5\Omega}$

A3) (a) 4 eqⁿ(s) are required →  ∴ 4 eqⁿs

(b) 5 eqⁿ(s) are required →  ∴ 5 eqⁿ(s)

(c) ~~earlier~~ I would have used Node analysis here, ~~now, and also~~ ~~now~~ I earlier as well as now.

∴ No My preffered method would not change because in Nodal analysis, ~~we would easily~~ we directly get Node voltages, from which we can directly compute voltage but if we use ~~Nodal~~ Mesh analysis first I would calculate current through 7Ω Resistor then voltage,

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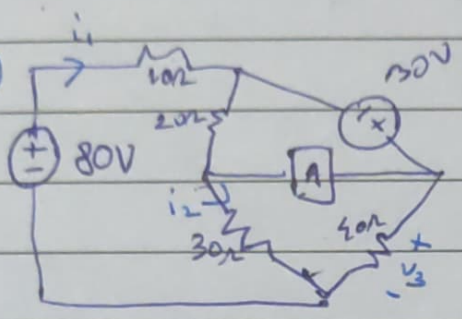
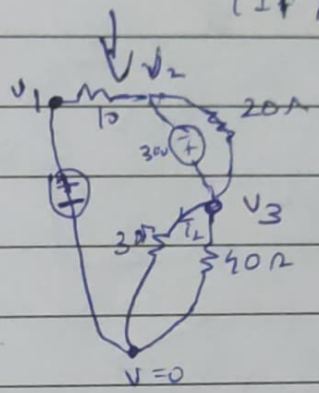
So we obtain desired Result with lesser computation ∴ I would prefer Nodal analysis for this one as well.

Ans (g)



Nodal analysis will be better
(If A → short circuit)



→ clearly $V_1 = 80$ V

∴ applying KCL at super Node V_2 & V_3

$$\frac{V_3}{30} + \frac{V_3}{40} + \frac{V_2 - 80}{10} = 0 \quad \text{(1)}$$

also $V_3 - V_2 = 30$ (2)

$$\frac{7V_3}{12} + V_2 - 80 = 0 \quad \text{(1)}$$

$$\frac{7V_3}{12} + (V_3 - 30) - 80 = 0$$

$$V_3\left(\frac{7}{12} + 1\right) = 110$$

$$V_3 = \frac{1320}{19}$$

$$i_2 = \frac{V_3}{30} \Rightarrow i_2 = \frac{44}{19} \text{ A}$$

LTspice XVII - Draft4

File Edit Hierarchy View Simulate Tools Window Help

Draft4 Draft4

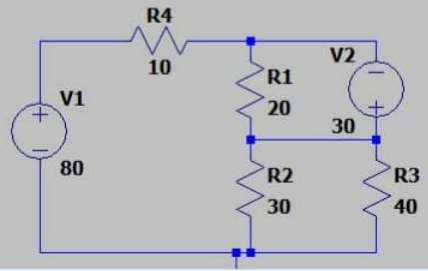
Draft4

I(R2)

2.315815A
2.315810A
2.315805A
2.315800A
2.315795A
2.315790A
2.315785A
2.315780A
2.315775A
2.315770A
2.315765A
2.315760A

112.28378µs

Draft4



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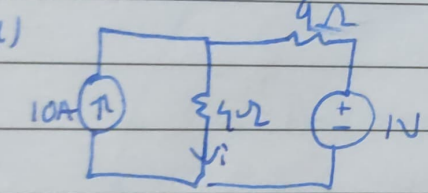
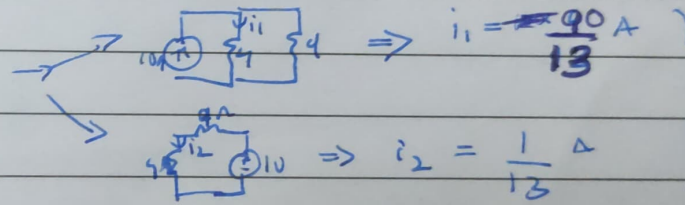
A5) (a)



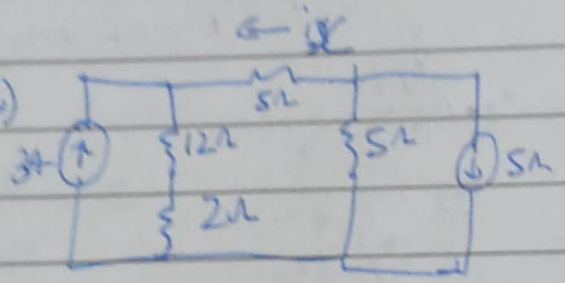


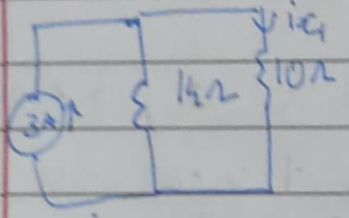
(b) %Contribution $= \frac{i_2}{i} \times 100 = \frac{1/13}{91/13} \times 100 = \frac{100}{91}\% \simeq 1.099\%$

(c) $\frac{1}{13} = \frac{i_s \times 9}{13} \Rightarrow i_s = \frac{1}{9}\ A$

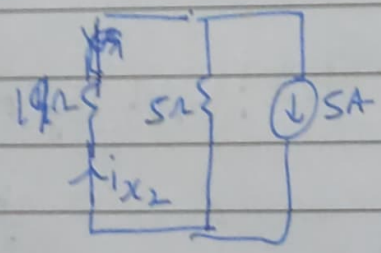
$\therefore$ if instead of 10 A $i_s = \frac{1}{9}$ A then 1V and i_s will contribute equally to i.

A6) (d)





$i_{x_1} = 3 \times \frac{14}{24}$



$i_{x_2} = 5 \times \frac{5}{24}$

$\therefore i_x = (-i_{x_1}) + (-i_{x_2})$

$= -\left(\frac{42+25}{24}\right) = -\frac{67}{24}$ A

(b)

$\frac{14\Omega}{24} = + \frac{i \times 5}{24}$

$\therefore i_4 = \frac{42}{5} = 8.4$ A

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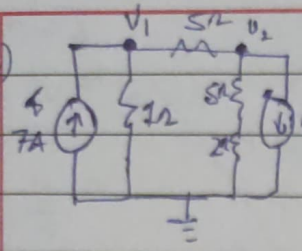
A7) (d)



For I_1

$$\frac{V_1'}{1} + \frac{V_1' - V_2'}{5} = 7 \quad \& \quad \frac{V_2'}{7} + \frac{V_2' - V_1'}{5} = 0$$

$$6V_1' - V_2' = 35 \qquad 12V_2' = 7V_1'$$

$$V_1'\left(6 - \frac{7}{12}\right) = 35 \Rightarrow V_1' = \frac{12 \times 35}{65} = \frac{84}{13}$$

For I_2

$$\frac{V_1''}{1} + \frac{V_1'' - V_2''}{5} = 0$$

$$4 + \frac{V_2''}{7} + \frac{V_2'' - V_1''}{5} = 0$$

$$6V_1'' = V_2''$$

$$4 + \frac{V_2''}{7} + V_1'' = 0$$

$$28 + 6V_1'' + 7V_1'' = 0$$

$$\frac{-28}{13} = V_1''$$

$$V_1 = V_1' + V_1''$$

$$V_1 = \frac{84 - 28}{13} = \frac{56}{13}$$

$$\frac{-6 \times 4}{13}$$

(b)

$$P_T = (i_1 + i_2)^2 2 = \left(\frac{V_2'}{7} + \frac{V_2''}{7}\right)^2 \times 2 = \left(\frac{7}{13} + \frac{-24}{13}\right)^2 \times 2$$

$$= \left(\frac{-17}{13}\right)^2 \times 2$$

$$P_1 = i_1^2 \times 2 = \left(\frac{7}{13}\right)^2 \times 2$$

$$P_2 = i_2^2 \times 2 = \left(\frac{-24}{13}\right)^2 \times 2$$

$$\% \text{ Contribution of } 1 = \frac{P_1}{P_T} \times 100 = \left(\frac{70}{17}\right)^2 \simeq 16.955017$$

$$\% \text{ contribution of } 2 = \frac{P_2}{P_T} \times 100 = \left(\frac{240}{17}\right)^2 \simeq 199.30795$$