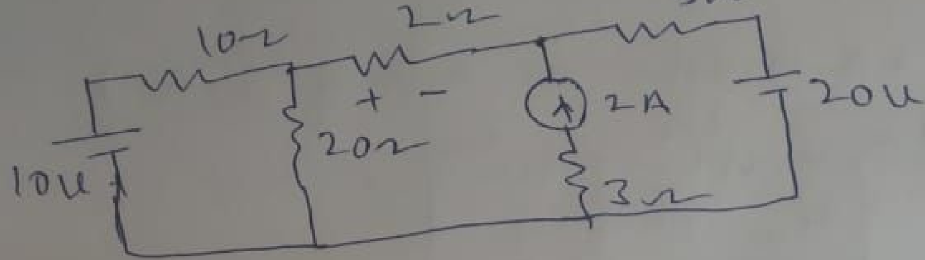
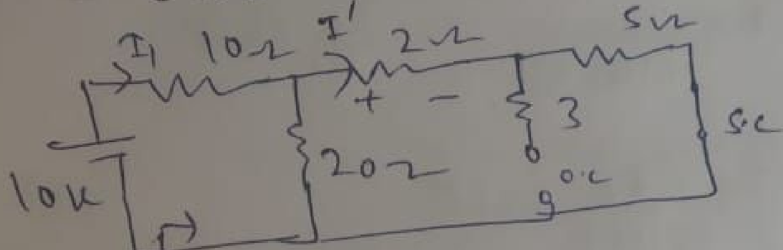
Tutorial-5 (Solution)

Q. 1



Case 1 (10V source is acting alone)



$$R_{eq} = (5+2)\,||\,20 + 10$$

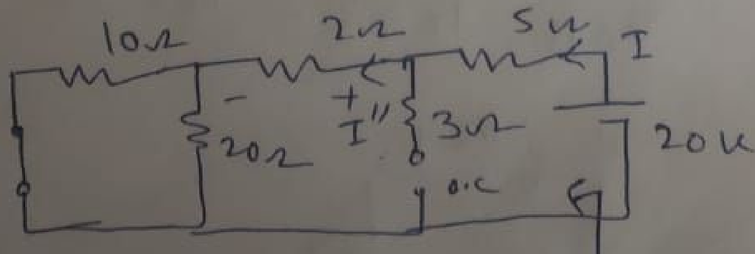
$$= \frac{7 \times 20}{27} + 10 = \frac{140+270}{27} = \frac{410}{27}\,\Omega$$

$$I_1 = \frac{10 \times 27}{410} = \frac{27}{41}\text{ Amp}$$

$$I' = \frac{27}{41} \times \frac{20}{20+7} = \frac{20}{41}\text{ Amp}$$

$$\boxed{V'_{2\Omega} = \frac{20}{41} \times 2 = \frac{40}{41}\,V}$$

Case 2 (20V source is acting alone)



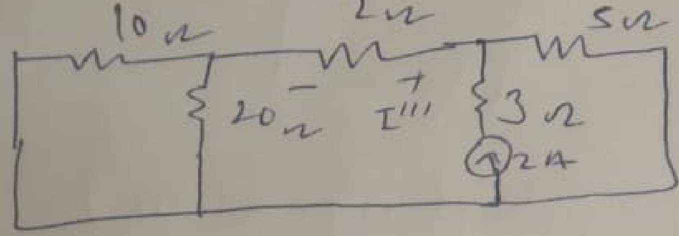
$$R_{eq} = 10\,||\,20 + 7 = \frac{200}{30} + 7 = \frac{410}{30}\,\Omega$$

$$I = \frac{20 \times 3}{41} = \frac{60}{41}\text{ Amp}$$

$$\boxed{I = I''}$$

$$V''_{2\Omega} = -\frac{2\times 60}{41} = -\frac{120}{41} \text{ volt}$$

Case 3 (2A source is acting alone)

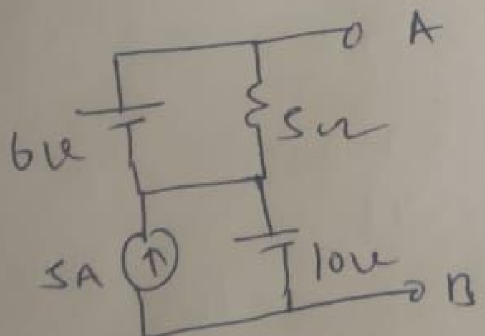


$$I''' = \frac{2\times 5}{10\|20+7} = \frac{30}{41} \text{ Amp}$$

$$V'''_{2\Omega} = -\frac{60}{41} \text{ Volt}$$

$$\underline{\underline{V_{2\Omega}}} = \frac{40}{41} - \frac{120}{41} - \frac{60}{41} = -\frac{140}{41} = \underline{\underline{-3.41 \text{ Volt}}}$$

Q.2



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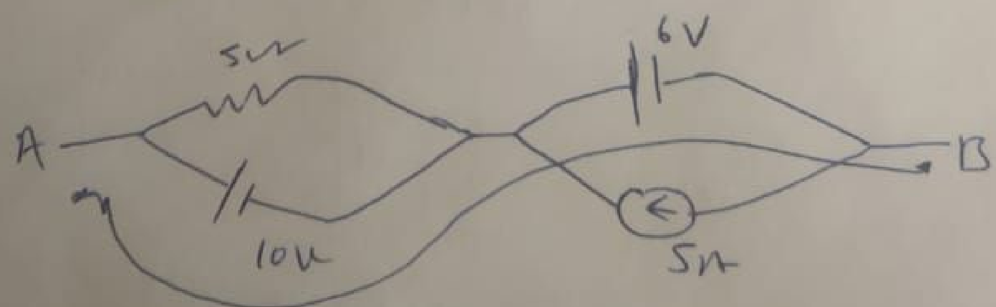
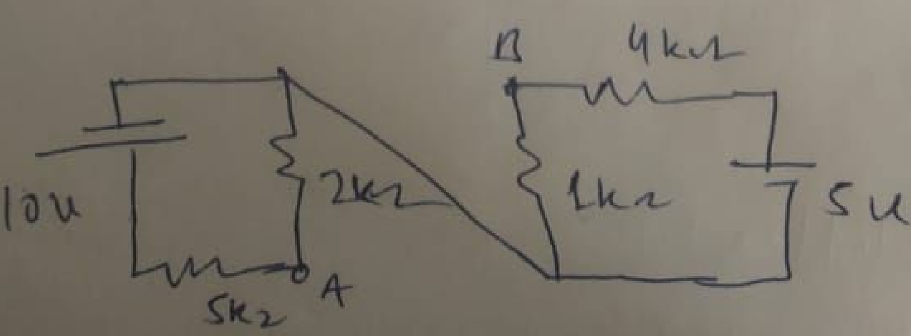
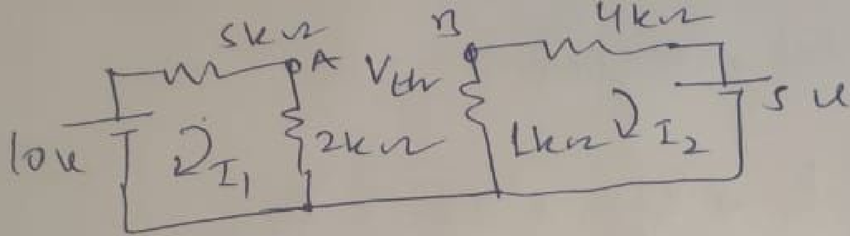


$$V_{AB} = 10+6 = 16 \text{ Volt}$$

Q.3

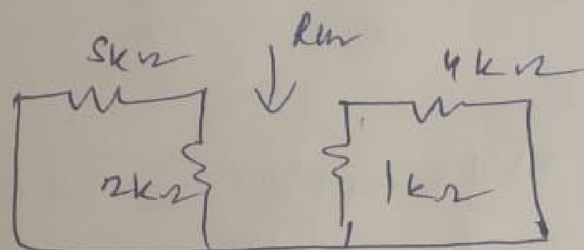




$I_1 = 10/7$ Amp $\quad I_2 = -5/5 = -1$ Amp

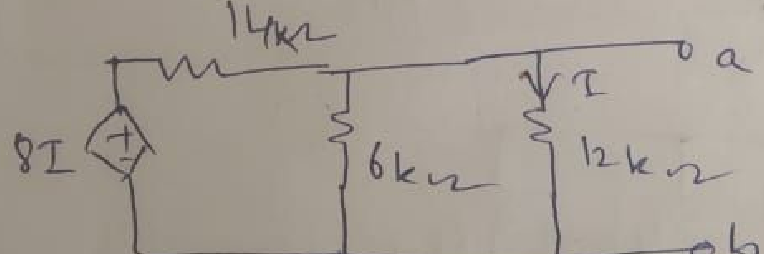
$$\boxed{V_{th} = V_{AB} = 2 \times \frac{10}{7} - 1 = 1.85 \text{ volt}}$$

Rth



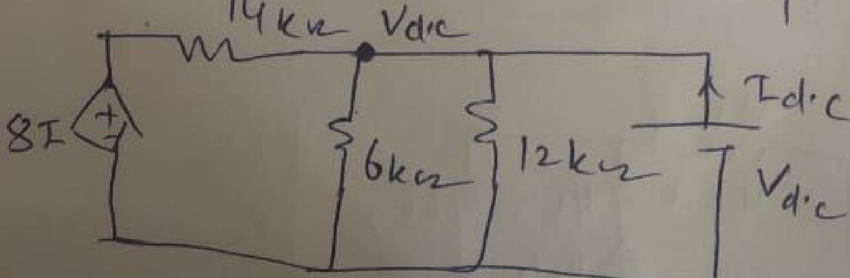
$$\boxed{R_{th} = 5 \| 2 + 4 \| 1 = 2.23 k\Omega}$$

Q.4



There is no independent source so the V_{th} is zero ($V_{th} = 0$)

for R_{th} (a test source is applied at terminal a&b)



using Nodal analysis

$$\frac{V_{o.c} - 8I}{14} + \frac{V_{o.c}}{6} + \frac{V_{o.c}}{12} = I_{o.c}$$

$$I = V_{o.c}/12$$

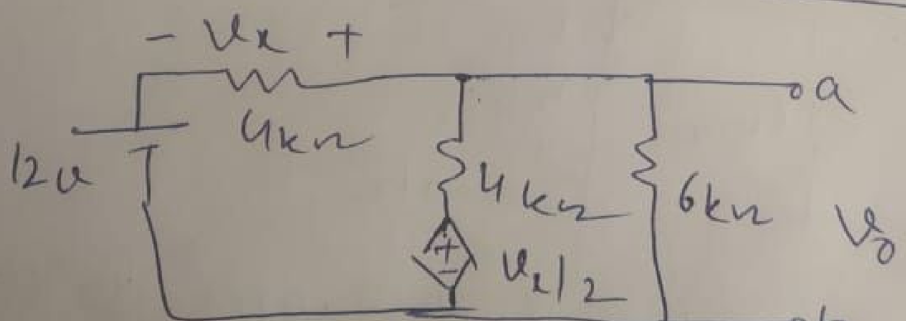
$$\frac{V_{o.c} - \frac{\cancel{8}^{2} V_{o.c}}{\cancel{12}_{3}}}{14} + \frac{V_{o.c}}{6} + \frac{V_{o.c}}{12} = I_{o.c}$$

$$= \frac{V_{o.c}}{42} + \frac{V_{o.c}}{6} + \frac{V_{o.c}}{12} = I_{o.c}$$

$$828 V_{o.c} = 42 \times 6 \times 12 I_{o.c}$$

$$\boxed{R_{th} = V_{o.c}/I_{o.c} = 3.65 k\Omega}$$

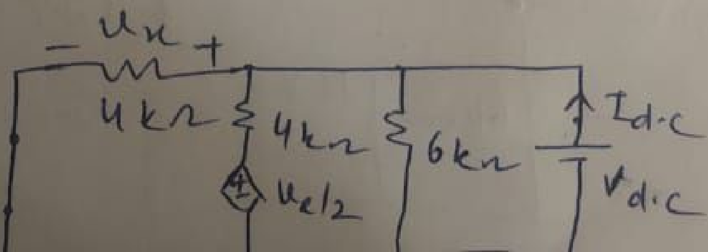
Q.5



v_0 using Norton's theorem

$$\boxed{v_0 = R_{th} \cdot I_{s.c}}$$

for R_{th}



$$\frac{V_{d.c}}{4k} + \frac{V_{d.c} - v_x/2}{4k} + \frac{V_{d.c}}{6} = I_{d.c}$$

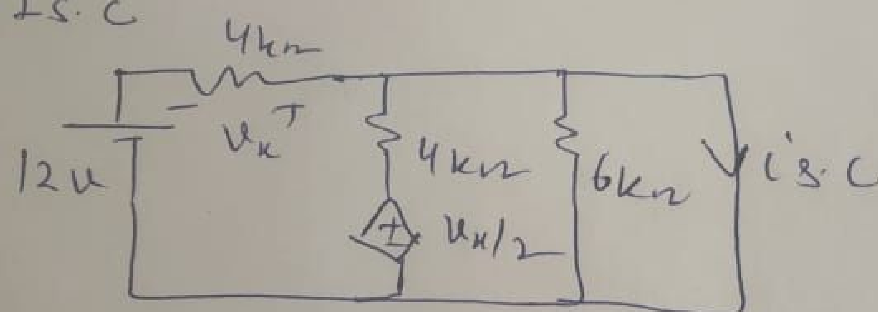
$$\boxed{v_x = V_{d.c}}$$

$$\frac{V_{d.c}}{4k} + \frac{V_{d.c} - .5V_{d.c}}{4k} + \frac{V_{d.c}}{6} = I_{d.c}$$

$$9.5V_{d.c} = 12I_{d.c}$$

$$\boxed{R_{th} = V_{d.c}/I_{d.c} = 12/9.5 \; k\Omega}$$

for $I_{s.c}$



$$= \frac{-12}{4k} + \left(\frac{-v_x/2}{4k}\right) + i_{s.c} = 0$$

$$v_x = -12v$$

$$-3 + 3/2 = -i_{s.c}$$

$$\boxed{i_{s.c} = 3/2}$$

$$v_o = \frac{12}{9.5} \times 3/2 = \frac{36}{19}$$

19

$$\boxed{v_o = 36/19k}$$