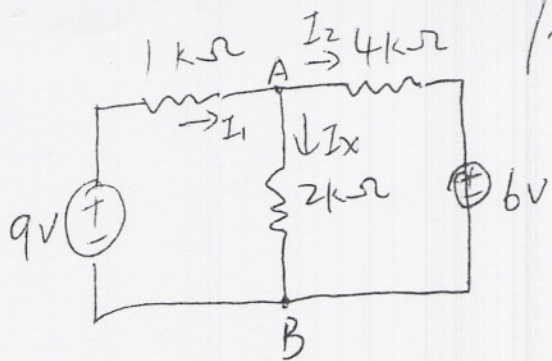


# Answers

3.1



KCL: A:  $I_1 = I_x + I_2$

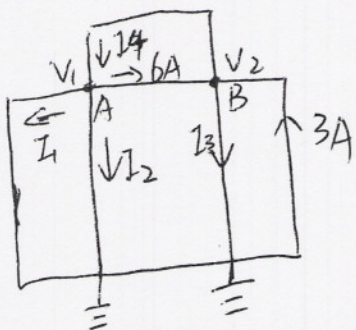
$V_A = V$

$V_B = 0$

$$I_1 = \frac{9-V}{1000}, \quad I_2 = \frac{V-6}{4000}, \quad I_x = \frac{V}{2000}$$

$$\frac{9-V}{1000} = \frac{V}{2000} + \frac{V-6}{4000}, \quad V = 6V, \quad \Rightarrow I_x = \frac{V}{2000} = \boxed{3mA}$$

3.2



KCL: A:  $I_4 = I_1 + I_2 + 6$

B:  $6 + 3 = I_4 + I_3$

$$\frac{V_2 - V_1}{2} = \frac{V_1}{10} + \frac{V_1}{5} + 6$$

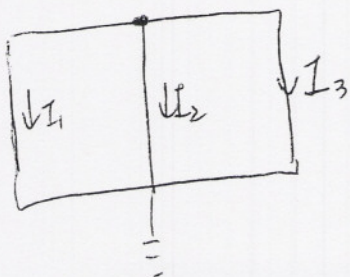
$$9 = \frac{V_2 - V_1}{2} + \frac{V_2}{4}$$

$$5V_2 - 8V_1 = 60$$

$$3V_2 - 2V_1 = 36$$

$$\boxed{V_1 = 0V, \quad V_2 = 12V}$$

3.5



KCL:  $I_1 + I_2 + I_3 = 0$

$$\frac{V_0 - 30}{2000} + \frac{V_0 - 20}{5000} + \frac{V_0}{4000} = 0$$

$$19V_0 = 380$$

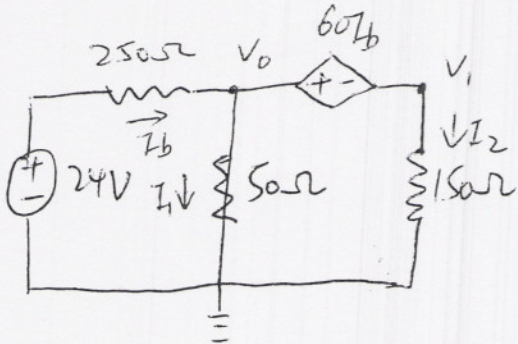
$$\boxed{V_0 = 20V}$$



3.6 KCL:  $I_1 + I_2 + I_3 = 0$

$$\frac{V_0 - 12}{4} + \frac{V_0}{6} + \frac{V_0 - 10}{2} = 0 \quad V_0 = \frac{96}{11} = \boxed{8.73 \text{ V}}$$

3.9.



KCL:  $I_b = I_1 + I_2$

$$I_b = \frac{V_0}{50} + \frac{V_1}{150}$$

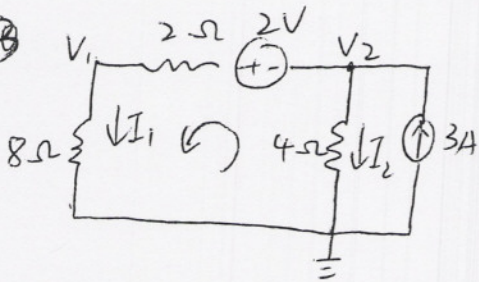
$$V_0 = 24 - 250I_b$$

$$V_1 = \cancel{150} I_2 = V_0 - 60I_b = 24 - 310I_b$$

$$I_b = \frac{24 - 250I_b}{50} + \frac{24 - 310I_b}{150}$$

$$\boxed{I_b = 79.34 \text{ mA}}$$

3.13



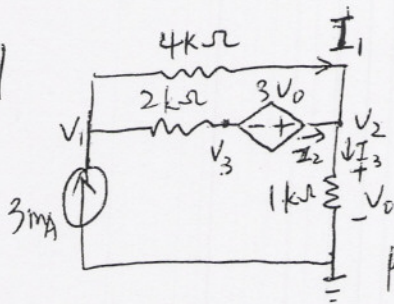
KCL:  $(V_1, V_2) \quad 3 = I_1 + I_2$

$$3 = \frac{V_1}{8} + \frac{V_2}{4} \quad V_1 + 2V_2 = 24$$

KVL:  $-V_2 - 2 + 2\left(\frac{V_1}{8}\right) + V_1 = 0, \quad 5V_1 - 4V_2 = 8$

$$\boxed{V_1 = 8 \text{ V}} \\ \boxed{V_2 = 8 \text{ V}}$$

3.21



$$I_3 = 3 \text{ mA} = \frac{V_0}{1000}$$

$$\boxed{V_0 = V_2 = 3 \text{ V}}$$

KCL:  $I_1 + I_2 = 0.003$

$$I_1 = \frac{V_2 - V_3}{4000} = \frac{3 - V_3}{4000}$$

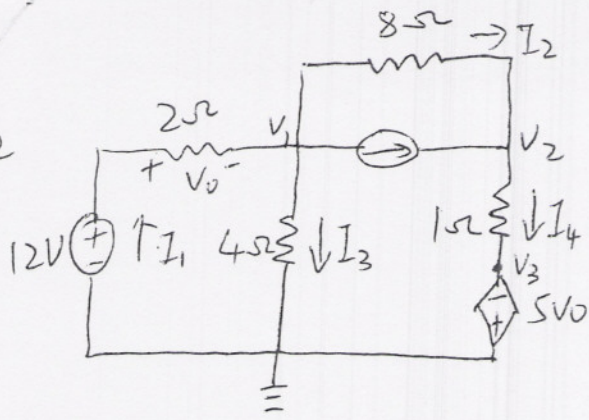
$$I_2 = \frac{V_3 - V_0}{2000}, \quad V_3 = -6$$

$$\frac{V_1 - 3}{4000} + \frac{3 - V_3}{2000} = 0.003$$

$$\boxed{V_1 = -1 \text{ V}}$$



3.22



$$\begin{aligned} V_0 &= V_1 - 12 \\ V_3 &= -5V_0 \\ 24 &= V_2 + 5V_0 \end{aligned}$$

KCL ( $V_1$ ):  $\dot{I}_1 = I_3 + I_2 + 3$

$$\frac{12 - V_1}{2} = \frac{V_1}{4} + \frac{V_1 - V_2}{8} + 3$$

$$7V_1 - V_2 = 24$$

①

KCL ( $V_2$ ):  $3 + I_2 = I_4$

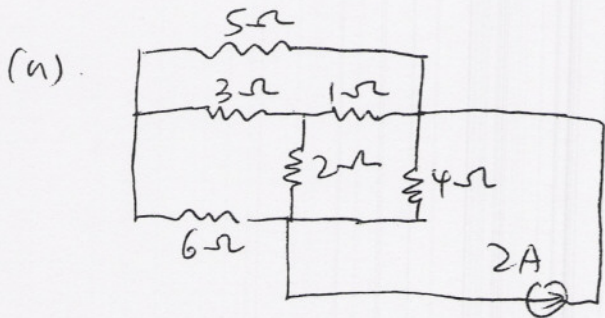
$$3 + \frac{V_1 - V_2}{8} = V_2 - V_3$$

$$24 + V_1 - V_2 = 8V_2 + 40V_0$$

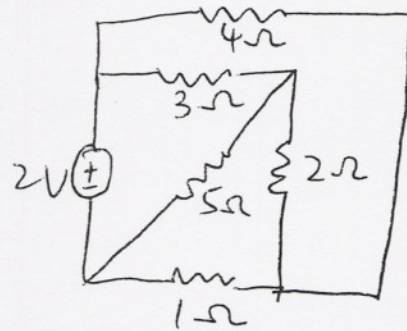
$$39V_1 + 9V_2 = 504 \quad \text{②}$$

$$\begin{aligned} V_1 &= 7.06V \\ V_2 &= 25.4V \end{aligned}$$

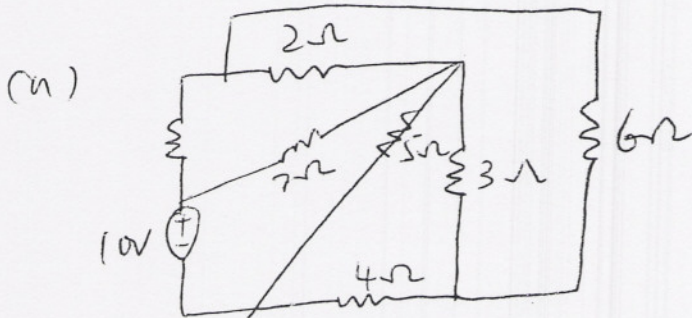
3.33. (a), (b) are both planar



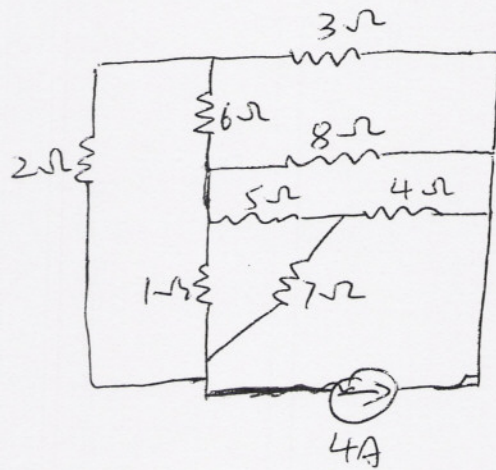
(b)



3.34. (a), (b) are both planar

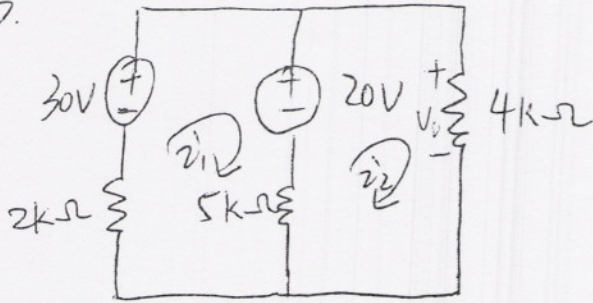


(b)





35.



$$\text{KVL, } (i_1): 2000 i_1 - 30 + 20 + 5000 (i_1 - i_2) = 0$$

$$(i_2): 4000 i_2 + 5000 (i_2 - i_1) - 20 = 0$$

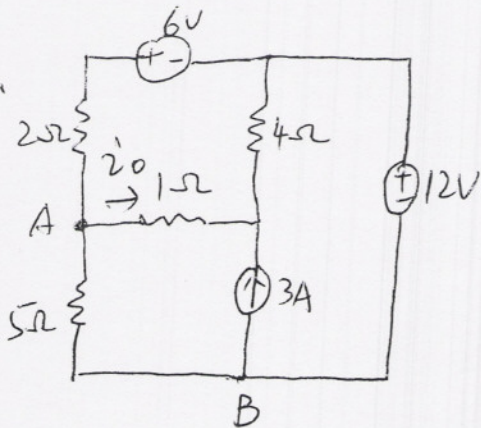
$$i_1 = 5 \text{ mA}$$

$$i_2 = 5 \text{ mA}$$

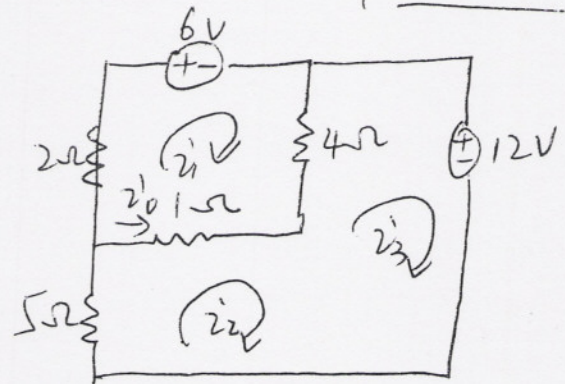
$$V_o = i_2 (4000)$$

$$= 20 \text{ V}$$

44.



Supernode



$$\text{KVL, } 2i_1 + 6 + 4(i_1 - i_3) + (i_1 - i_2) = 0$$

$$4(i_3 - i_2) + 12 + 5i_2 + (i_2 - i_1) = 0$$

$$\text{KCL, (B)} i_3 = 3 + i_2$$

$$i_1 = -4 \text{ A}, \quad i_2 = -4.4 \text{ A}$$

$$\text{KCL, (A)} i_2 = i_0 + i_1$$

$$i_0 = -0.4 \text{ A}$$

$$46. \text{ KVL: } -12 + 3i_1 + 8(i_1 - i_2) = 0$$

$$6i_2 + 2V_o + 8(i_2 - i_1) = 0$$

$$V_o = 3i_1$$

$$\Rightarrow \begin{cases} i_1 = \frac{84}{69} = 1.22 \text{ A} \\ i_2 = \frac{12}{69} = 0.174 \text{ A} \end{cases}$$

$$i_2 = \frac{12}{69} = 0.174 \text{ A}$$