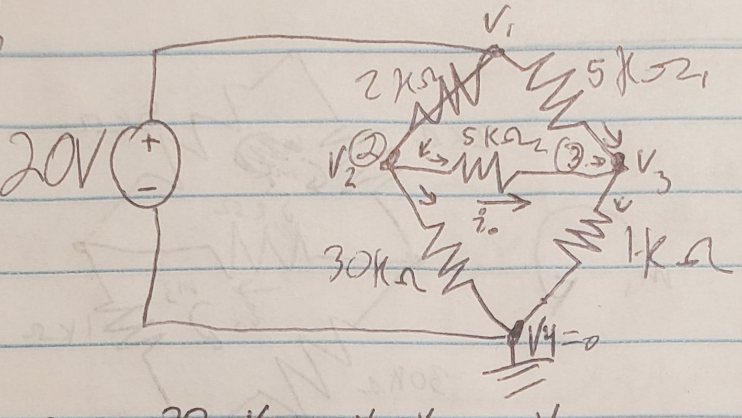
10/7

4.26




$V_1 = 20v$

$V_{2k\Omega} = V_1 - V_2$

$V_{5k\Omega_1} = V_1 - V_3$

$V_{5k\Omega_2} = V_2 - V_3$

$V_{30k\Omega} = V_2$

$V_{1k\Omega} = V_3$

KCL at (2): $\frac{20 - V_2}{2000} = \frac{V_2 - V_3}{5000} + \frac{V_2}{30000}$

KCL at (3): $\frac{V_3}{1000} = \frac{20 - V_3}{5000} + \frac{V_2 - V_3}{5000}$

$5V_3 = 20 - V_3 + V_2 - V_3 \Rightarrow 4V_2 = 20 - 2V_3 \Rightarrow V_3 = 10 - 2V_2$

$$\frac{20 - V_2}{2} = \frac{V_2 - (10 - 2V_2)}{5} + \frac{V_2}{30}$$

$$10 - \tfrac{1}{2}V_2 = \frac{V_2 - 10 + 2V_2}{5} + \frac{V_2}{30}$$

$10 - \frac{1}{2}V_2 = \frac{1}{5}V_2 - 2 + \frac{2}{5}V_2 + \frac{V_2}{30}$

$8 = \frac{6}{30}V_2 + \frac{12}{30}V_2 + \frac{1}{30}V_2 + \frac{15}{30}V_2$

$V_3 = 10 - 2(7.1) = -4.2\,v$

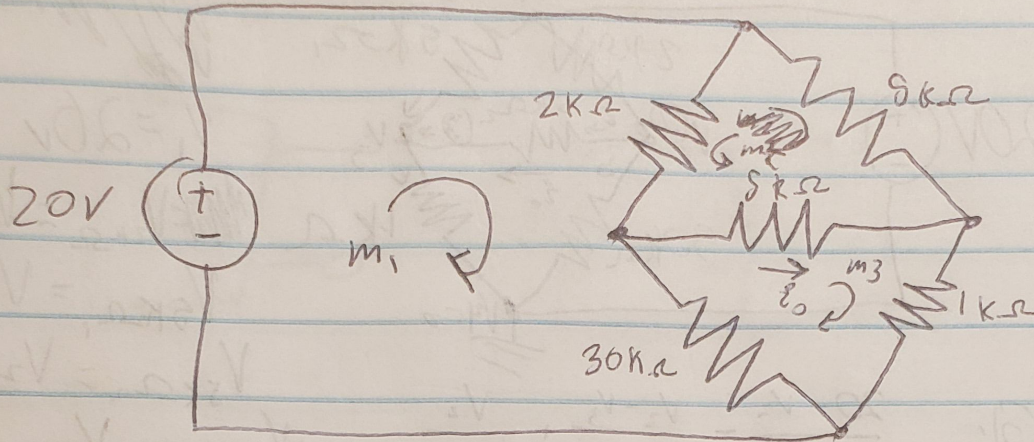
$8 = {}^{34}/_{30}\,V_2 \Rightarrow V_2 = 7.1V$

$V_{5k\Omega_2} = V_2 - V_3 = 7.1 + (+4.2) = 11.3V$

$i = \frac{V}{R}$

$$\boxed{i_o = \frac{11.3}{5000} = 2.3mA}$$

4.35




$m_1$: $20 = 2000(m_1 + m_2) + 30000(m_1 - m_3)$

$m_3$: $0 = 5000(m_2 + m_3) + 1000 m_3 + 30000(m_3 - m_1)$

$m_2$: $0 = 5000(m_2 + m_3) + 5000 m_2 + 2000(m_1 + m_2)$

$32000 m_1 + 2000 m_2 - 30000 m_3 = 20$

$-30000 m_1 + 5000 m_2 + 36000 m_3 = 0$

$2000 m_1 + 12000 m_2 + 5000 m_3 = 0$

$$\begin{array}{c} m_1 \\ m_2 \\ m_3 \end{array} \left[\begin{array}{ccc|c} 32000 & 2000 & -30000 & 20 \\ -30000 & 5000 & 36000 & 0 \\ 2000 & 12000 & 5000 & 0 \end{array}\right]$$

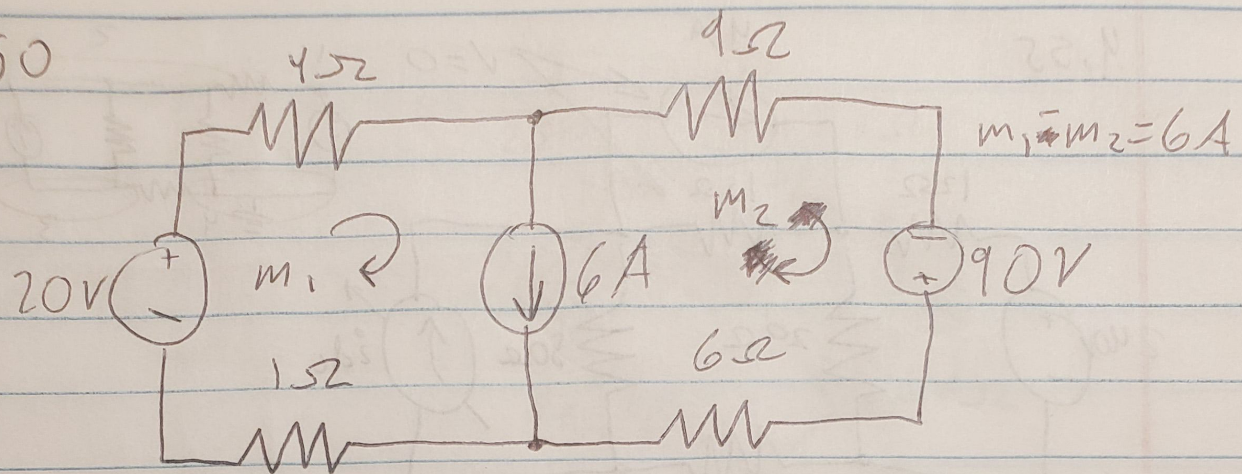
$m_1 = 5.5 mA$

$m_2 = -3 mA$

$m_3 = 5 mA$

$$\boxed{i_o = m_2 + m_3 = 2 mA}$$

4.50




$m_1 - m_2 = 6A$

$m_1: 20 = 4m_1 + \overset{m_1 - m_2}{\cancel{6}} + 1m_1 \quad \overset{20}{\cancel{14}} = 5m_1 \quad m_1 = 4A$

$m_2: 90 = 6m_2 - \overset{m_1-m_2}{\cancel{6}} + 9m_2 \quad \overset{90}{\cancel{96}} = 15m_2 \quad m_2 = 6A$

$90 = 15m_2 - m_1 + m_2 \qquad m_1 = \frac{90 - m_2}{16}$

$20 = 5m_1 + m_1 - m_2 \qquad m_2 = 6m_1 - 20$

$m_1 = \frac{90 - (6m_1 + 20)}{16} \qquad \frac{110}{16} - \frac{m_1}{16} = m_1 \qquad 110 - m_1 = 16m_1$

$110 = 17m_1 \quad m_1 = \frac{110}{17} = 6.5v$

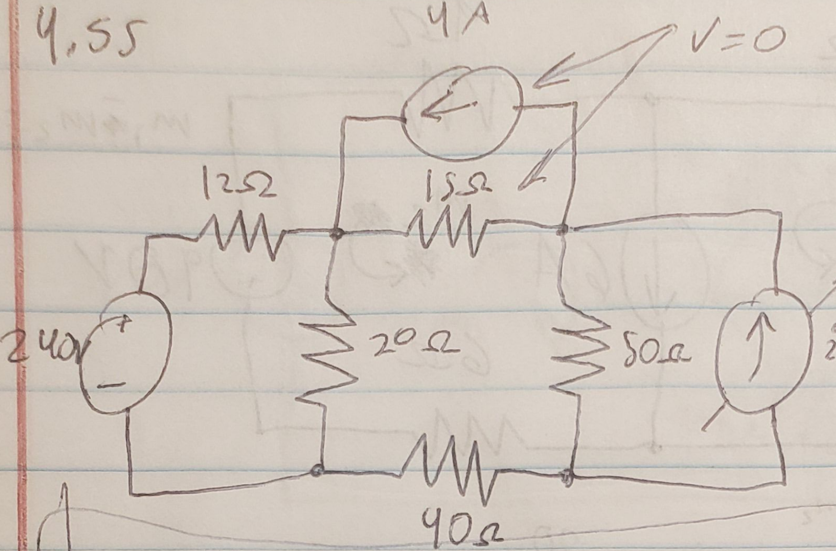
$m_2 = \frac{660}{17} - 20 = 18.8v$

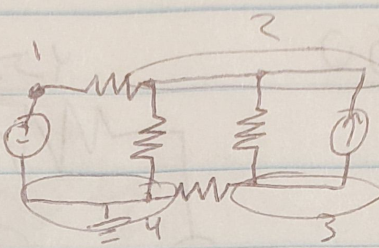
$V = IR$

| | V | I | P |
|---|---|---|---|
| $V_{4\Omega}$ | 26v | 6.5A | 169w |
| $V_{1\Omega}$ | 6.5v | 6.5A | 42.25w |
| $V_{9\Omega}$ | 169.2v | 18.8A | 3,181w |
| $V_{6\Omega}$ | 112.8v | 18.8A | 2,121w |

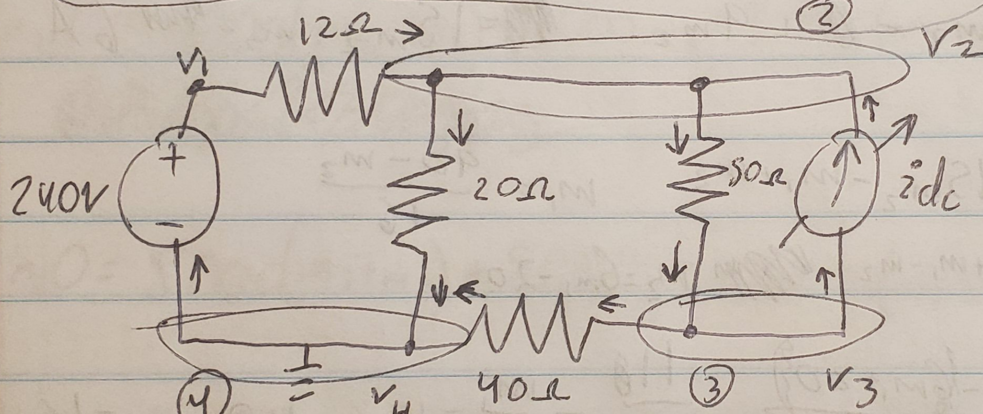
$\boxed{5,513.25w}$

4.55




a) ~~[illegible]~~ node voltage because it has 4 easily recognizable nodes.




$V_1 = 240\,v$

$V_4 = 0\,v$

(2): $\frac{240 - V_2}{12} + i_{dc} = \frac{V_2}{20} + \frac{V_2 - V_3}{50}$

$-\frac{8}{50}V_3 - \frac{960}{6000} \;:\; -\frac{800}{6000} - \frac{120}{6000}\frac{16}{120} - \frac{1}{50}$ $\quad -\frac{1}{12}V_2 - \frac{1}{20}V_2 - \frac{1}{50}V_2 + \frac{1}{50}V_3 + i_{dc} = -20$

(3): $\frac{V_2 - V_3}{50} = \frac{V_3}{40} + i_{dc}$ $\quad \frac{1}{50}V_2 \underbrace{- \frac{1}{50}V_3 - \frac{1}{40}V_3}_{-\frac{9}{200}V_3} - i_{dc} = 0$

(4): $\frac{V_2}{20} + \frac{V_3}{40} = \frac{240 - V_2}{12}$ $\quad \frac{1}{12}V_2 + \frac{1}{40}V_3 + \frac{1}{12}i_{dc} = 20$

$$\left[\begin{array}{ccc|c} \frac{1}{12} & \frac{1}{40} & \frac{1}{12} & 20 \\ \frac{1}{50} & -\frac{9}{200} & -1 & 0 \\ -\frac{8}{50} & \frac{1}{50} & 1 & -20 \end{array}\right]$$

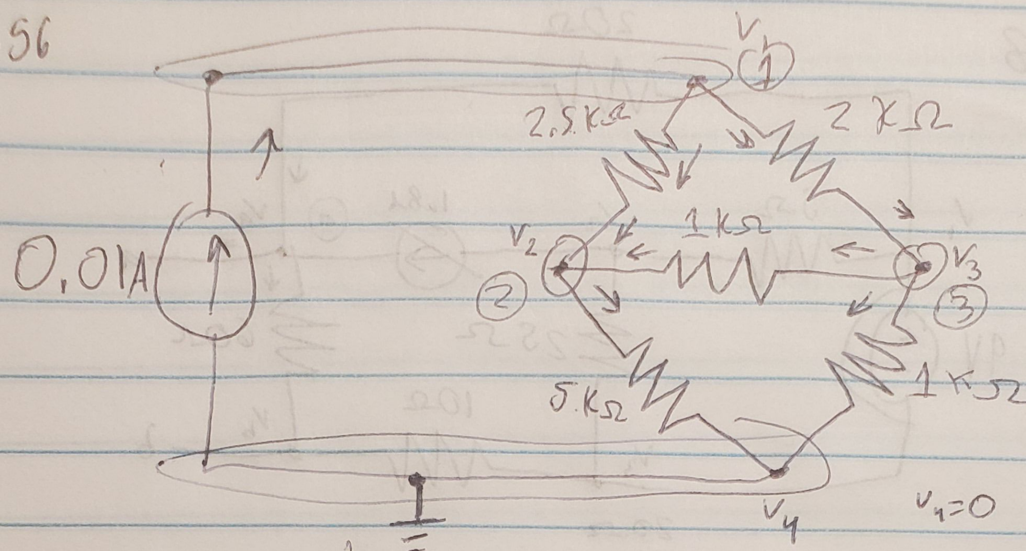
$V_2 = -0.0882\,v$

$V_3 = 1.2941\,v$

$\boxed{i_{dc} = -0.06\,A}$

b)

4.56




a) node-voltage because I don't have a defined voltage

$$1: 0.01 = \frac{V_1 - V_2}{2500} + \frac{V_1 - V_3}{2000} \Rightarrow \frac{V_1}{2500} + \frac{V_1}{2000} - \frac{V_2}{2500} - \frac{V_3}{2000} = 0.01$$

$$\frac{4V_1}{10000} + \frac{5V_1}{10000}$$

$$2: \frac{V_1 - V_2}{2500} + \frac{V_3 - V_2}{1000} - \frac{V_2}{5000} = 0 \Rightarrow \frac{V_1}{2500} - \frac{16V_2}{10000} - \frac{V_3}{2000} = 0$$

$$-\frac{4V_2}{10000} \quad -\frac{10V_2}{10000}$$

$$3: -\frac{V_1}{2000} + \frac{V_3}{2000} - \frac{V_3 - V_2}{1000} - \frac{V_3}{1000} = 0 \Rightarrow -\frac{V_1}{2000} + \frac{V_2}{1000} - \frac{3V_3}{2000} = 0$$

$$\frac{V_3}{2000} - \frac{2V_3}{1000} - \frac{2V_3}{2000}$$

$$\left[\begin{array}{ccc|c} \frac{9}{10000} & -\frac{1}{2500} & -\frac{1}{2000} & 0.01 \\ \frac{1}{2500} & -\frac{1}{625} & -\frac{1}{2000} & 0 \\ -\frac{1}{2000} & \frac{1}{1000} & -\frac{3}{2000} & 0 \end{array}\right]$$

$V_1 = 11.7409V$

$V_2 = 3.4413V$

$V_3 = -1.6194V$

b) $P_{1k\Omega} = \frac{V^2}{R} = \frac{(V_3 - V_2)^2}{R} = \frac{25.61}{1000} = 0.02561\ w$

c) no, I would sum the power dissipated by each resistor

$P_{R2.5k} = \frac{(V_1 - V_2)^2}{R} = \frac{68.88}{2500} = 0.02755\ w$

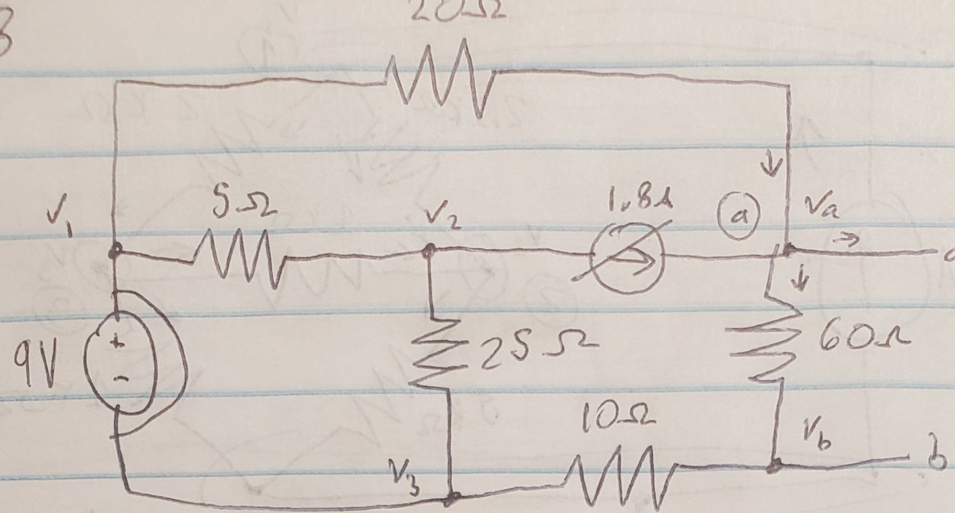
$P_{R2k} = \frac{(V_1 - V_3)^2}{R} = \frac{178.5}{2000} = 0.08925\ w$

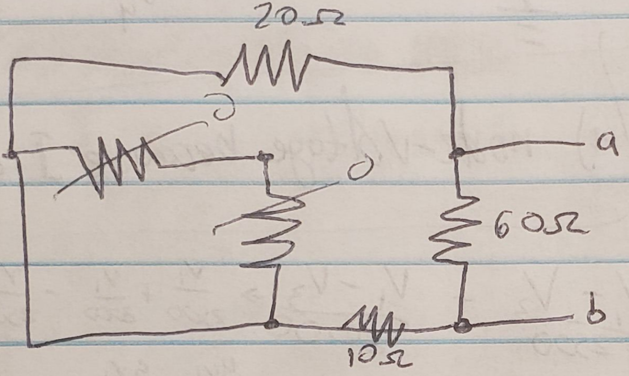
d) $\boxed{P_s = 0.12179\ w}$

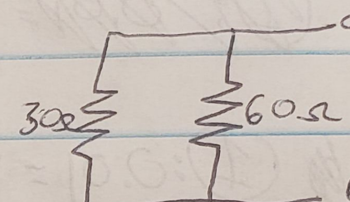
$P_{R5k} = \frac{V_2^2}{R} = \frac{11.84}{5000} = 0.00237\ w$

$P_{R1k} = \frac{V_3^2}{R} = \frac{2.622}{1000} = 0.00262\ w$

4.78

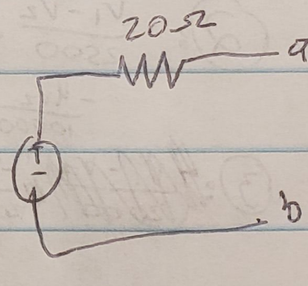



$R_t = 20\Omega$

Ⓐ: $1.8 + \frac{9 - V_a}{20} = i_a + \frac{V_a - V_b}{60}$




$\boxed{R_t = 30\Omega}$

b)