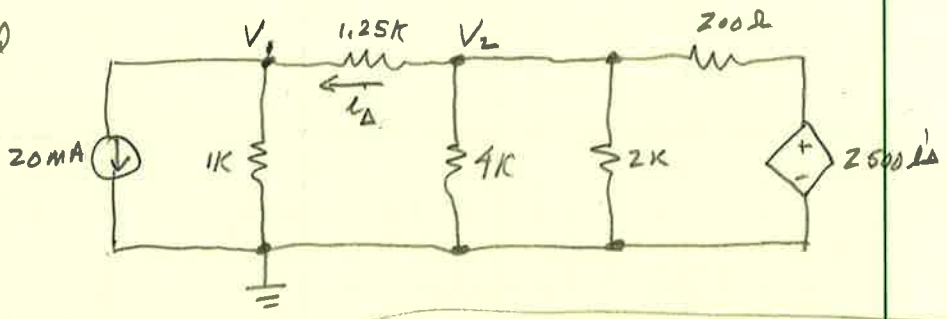
a) Find Power developed using node voltage method

b) Find power absorbed



assign all currents positive down and to the left.

node V_1: $\frac{V_2 - V_1}{1.25K} = \frac{V_1}{1K} + 20mA$

node V_2: $\frac{2500 i_\Delta - V_2}{200} = \frac{V_2}{2K} + \frac{V_2}{4K} + \frac{V_2 - V_1}{1.25K}$

$$i_\Delta = \frac{V_2 - V_1}{1.25K}$$

Solving: $V_1 = 60V$
$V_2 = 160V$
$i_\Delta = 80mA$

FIND P_{dev}.

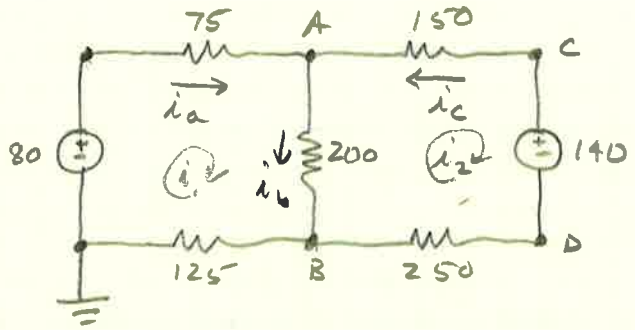
$P_{20mA} = 60(.02) = 1.2W$ (absorbed)

$V_{DS} = 2500 i_\Delta = 200$

$i_{ds} = \frac{200 - 160}{200} = 0.2A \uparrow$

$P_{dev} = (.2)(200) = 40W$ developed or $\boxed{-40W}$

a) use node-voltage method to find i_a, i_b, i_c



1) assign reference node
2) Super node problem

NODE A : $i_a + i_c = i_b$

$$\frac{80 - V_A}{75} + \frac{V_C - V_A}{150} = \frac{V_A - V_B}{200} \quad (1)$$

NODE V_B : $i_b = i_a + i_c$

$$\frac{V_A - V_B}{200} = \frac{V_B}{125} + \frac{V_B - V_D}{250} \quad (2)$$

Super node : $i_c = i_c$ (3)

$$\frac{V_B - V_D}{250} = \frac{V_C - V_A}{150}$$

Super node equation : $V_C = V_D + 140$ (4)

Solving, $V_A = 72.5V$
$V_B = 12.5V$
$V_C = 102.5V$
$V_D = -37.5V$

b) Solve using mesh currents

mesh i_1 : $-80 + 75i_1 + 200(i_1 - i_2) + 125 i_1 = 0$

mesh i_2 : $140 + 250(i_2) + 200(i_2 - i_1) + 150 i_2 = 0$

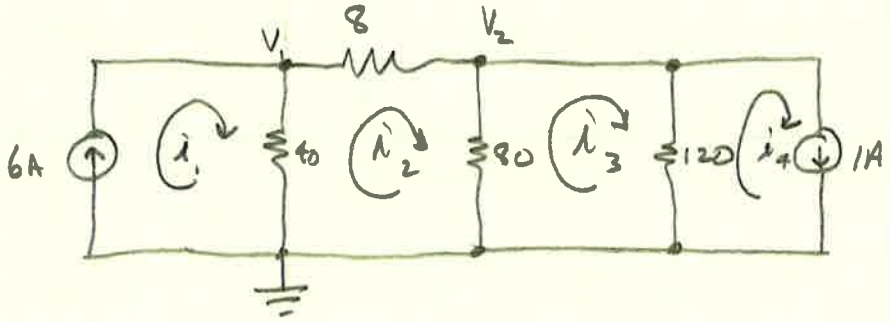
$$400 i_1 - 200 i_2 = 80$$
$$-200 i_1 + 600 i_2 = -140$$

$i_1 = 0.1A$
$i_2 = -0.2A$

So, $V_A = 80 - 75 i_1 = 72.5V$
$V_B = 0 + 125(i_1) = 12.5V$
$V_C = V_A + (-i_2)(150) = 102.5V$
$V_D = V_C - 140 = -37.5V$
also, $V_D = V_B + (i_2)(250) = -37.5V$

Find v_1 and v_2 using the mesh current method.

1) Pick Reference
2) assign mesh currents
3) solve



$i_1 = 6A$

① mesh i_2: $40(i_2 - i_1) + 8i_2 + 80(i_2 - i_3) = 0$

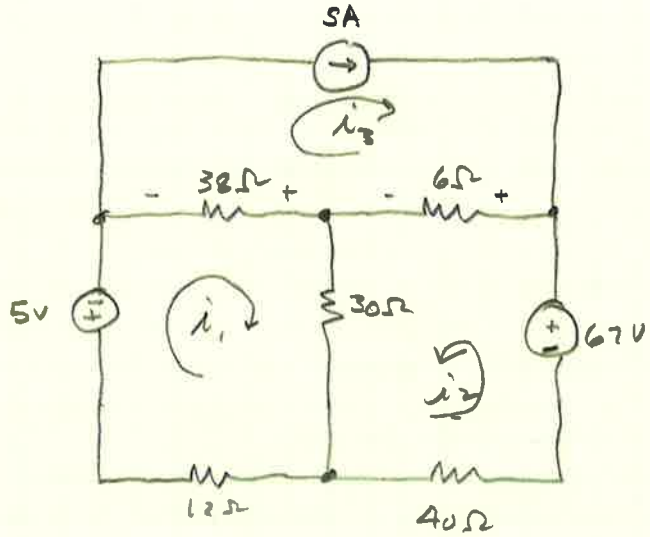
② mesh i_3: $80(i_3 - i_2) + 120(i_3 - i_4) = 0$

$i_4 = 1A$

Solving ① + ②: $\boxed{\begin{array}{l} i_2 = 3A \\ i_3 = 1.8A \end{array}}$

$v_1 = 40(i_1 - i_2) = 40(6-3) = \underline{120\,V}$

$v_2 = v_1 - 8i_2 = \underline{96\,V}$



a) use mesh-current method to find P_{5A}.

mesh i_1:
$$5 + 38(i_1 - i_3) + 30(i_1 + i_2) + 12 i_1 = 0$$

mesh i_2:
$$-67 + 6(i_2 + i_3) + 30(i_2 + i_1) + 40 i_2 = 0$$

mesh i_3:
$$i_3 = 5A$$

Solving: $i_1 = 2.5A$
$i_2 = -0.5A$
$i_3 = 5A$

$$P_{5A} = VI = (V_{38} + V_6)5A = [38(i_1 - i_3) + 6(i_3 + i_2)]6 = (-122)(5) = -610W$$

5A source is delivering 610W

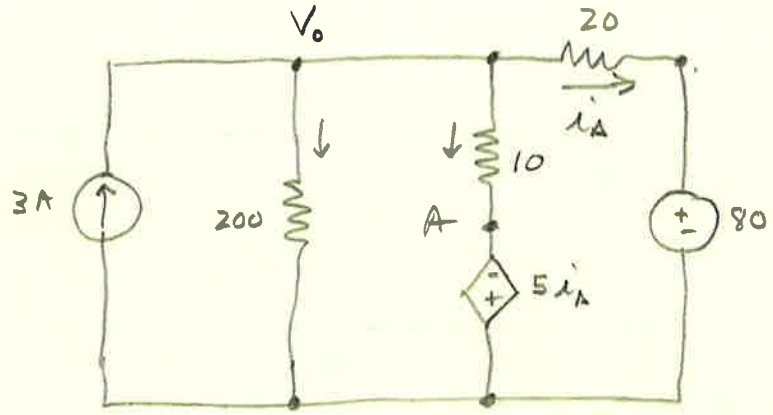
b) $P_{5V} = 5(2.5) = 12.5W$
$P_{67} = .5(67) = 33.5W$

Total power delivered = 610W

c) check that power delivered = power absorbed

$P_{38} = (2.5)^2 38 = 237.5W$
$P_6 = (4.5)^2 6 = 121.5W$
$P_{30} = (2)^2 30 = 120W$
$P_{40} = (.5)^2 40 = 10W$
$P_{12} = (2.5)^2 12 = 75W$

$+12.5W$
$33.5W$
$610W$ ✓



a) FIND V_o

Choose the bottom node as a reference.
assign current direction.

NODE V_o: $\Sigma i_{in} = \Sigma i_{out}$

$$3 = \frac{V_o - 0}{200} + \frac{V_o - (-5i_\Delta)}{10} + \frac{V_o - 80}{20} \quad (1)$$

Dependent Source: $i_\Delta = \frac{V_o - 80}{20}$

Solving, $\boxed{V_o = 50V \quad i_\Delta = -1.5A}$

b) Find Power absorbed by the dependent source

$V_A = -5i_\Delta = -5(-1.5) = 7.5V$

$i_{source} = \frac{V_o - 7.5}{10} = \frac{42.5}{10} = 4.25A$

$P_{source} = 7.5(4.25) = \boxed{31.9W = P_{source}}$

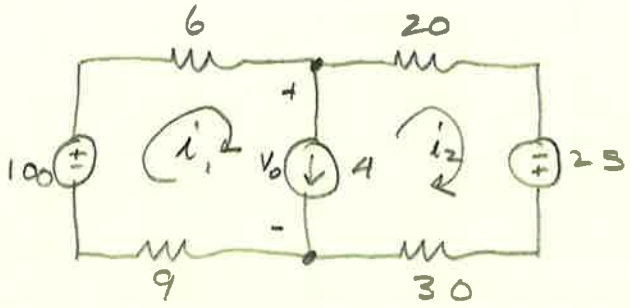
c) Find power developed by the independent sources

$P_{3A} = iV = -3(V_o) = -150W$

$P_{80V} = iV = i_\Delta(80) = -(1.5)(80) = -120W$

$\boxed{\text{Total Power} = -270W \text{ delivered}}$

use mesh currents to find total power dissipated



use outer loop:

$$-100 + 6i_1 + 20i_2 - 25 + 30i_2 + 9i_1 = 0$$
$$i_1 - i_2 = 4$$

$$15i_1 + 50i_2 = 125$$
$$i_1 - i_2 = 4$$

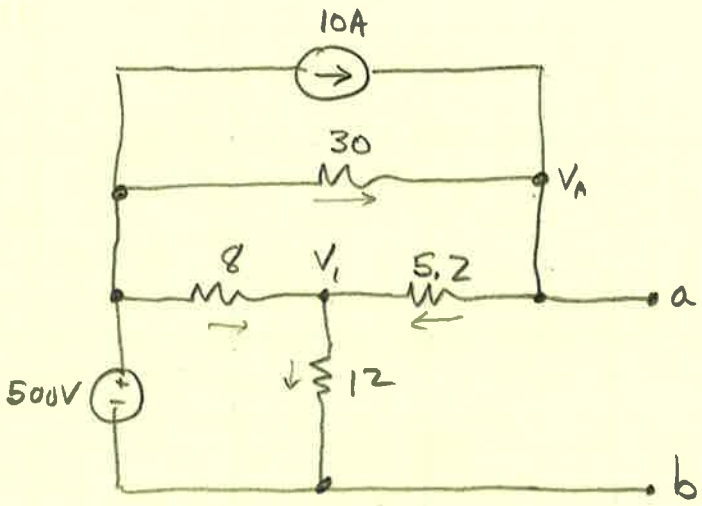
$$\Rightarrow \boxed{\begin{aligned} i_1 &= 5A \\ i_2 &= 1A \end{aligned}}$$

$V_0 = 20i_2 - 25 + 30i_2$
$= 25V$

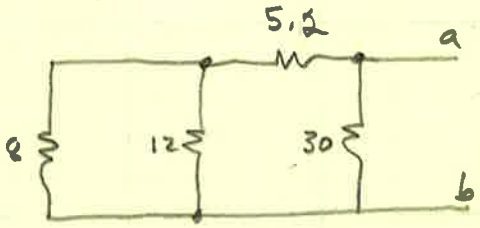
$P_{100V} = -100i = -500W$ generated
$P_{4A} = 4(25) = 100W$
$P_{25} = -(1)(25) = -25W$ generated
$P_6 = i^2R = 150W$
$P_9 = i^2R = 225W$
$P_{20} = i^2R = 20W$
$P_{30} = i^2R = 30W$

Power generated $= -25 - 500 = -525W$
Power absorbed $= 100 + 150 + 225 + 20 + 30 = 525W$

Find Thevenin equivalent at terminals a-b.



Find R_{th}: $i \rightarrow$ open
$v \rightarrow$ short



$$R_{th} = [(8 \| 12) + 5.2] \| 30$$
$$= \boxed{7.5\,\Omega}$$

Find V_{th}:

Node V_A: $\sum i_{in} = \sum i_{out}$

$$10 + \frac{500 - V_A}{30} = \frac{V_A - V_1}{5.2}$$

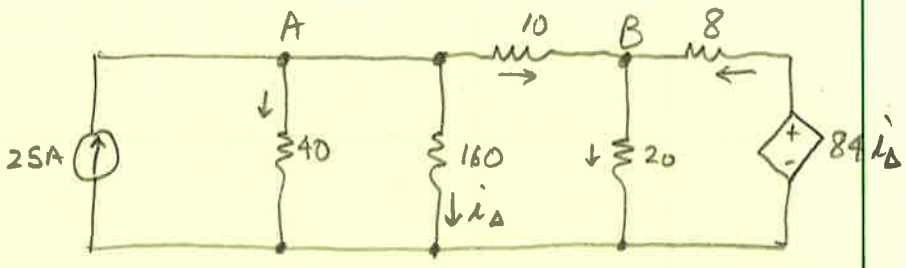
Node V_1: $\frac{500 - V_1}{8} + \frac{V_A - V_1}{5.2} = \frac{V_1}{12}$

$$\boxed{V_A = V_{th} = 425V}$$

$$V_1 = 360V$$

a) use node-voltage to find total Power developed

b) ^ absorbed power.



NODE A: $\Sigma i_{in} = \Sigma i_{out}$

$$25 = \frac{V_A}{40} + \frac{V_A}{160} + \frac{V_A - V_B}{10} \Rightarrow 21V_A - 16V_B = 4000$$

NODE B: $$\frac{V_A - V_B}{10} + \frac{84i_\Delta - V_B}{8} = \frac{V_B}{20} \Rightarrow 4V_A - 11V_B + 420i_\Delta = 0$$

Dependent Source: $$i_\Delta = \frac{V_A}{160} \Rightarrow V_A = 160\, i_\Delta$$

Solving:
$V_A = 352V$
$V_B = 212V$
$i_\Delta = 2.2A$

$V_{84i_\Delta} = 184.8V$
$i_{84i_\Delta} = -3.4A$

$P_{25A} = 25(352) = -8800W$ (generating)
$P_{84i_\Delta} = (184.8)(3.4) = 628.32W$ (absorbing)

$P_{developed} = 8800W$

$P_{40\Omega} = \frac{352^2}{40} = 3097.6W$

$P_{160\Omega} = \frac{352^2}{160} = 774.4W$

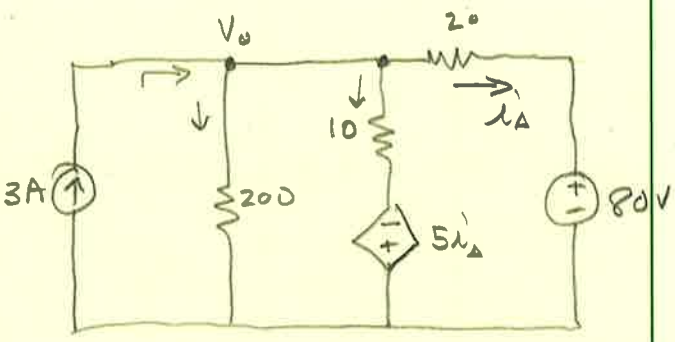
$P_{10\Omega} = \frac{(352-212)^2}{10} = 1960W$

$P_{20\Omega} = \frac{(212)^2}{20} = 2247.2W$

$P_{8\Omega} = \frac{(184.8-212)^2}{8} = 92.48W$

$P_{ABS} = 8800W = P_{gen}$

a) FIND V_o



at node V_o:

$\Sigma i_{IN} = \Sigma i_{OUT}$

① $3 = \frac{V_o - 0}{200} + \frac{V_o - (-5i_\Delta)}{10} + \frac{V_o - 80}{20}$

② $i_\Delta = \frac{V_o - 80}{20}$

Solving ① + ②,

$V_o = 50V$

$i_\Delta = -1.5A$

b) FIND the Power of the independent source

$i_{5i_\Delta} = \frac{V_o + 5i_\Delta}{10} = 4.25A$

$V_{5i_\Delta} = 5i_\Delta = -7.5V$

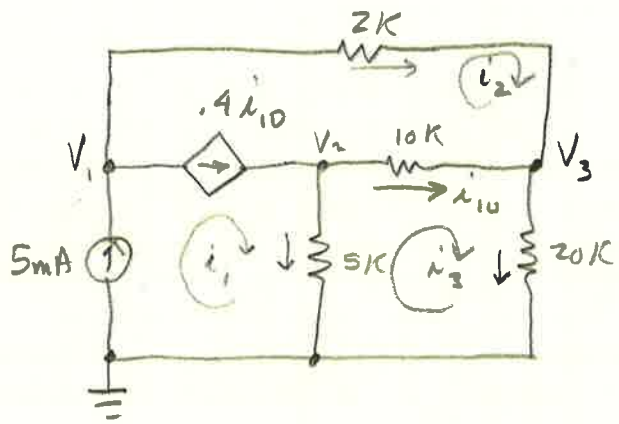
$P = 31.875W$ dissipating

c) FIND Power of independent Sources

$P_{3A} = (3)(V_o) = 150W$ generating

$P_{80V} = (80)(1.5) = 120W$ generating

Find i_{10}



NODE ANALYSIS

node V_1: $5mA = .4i_{10} + \frac{V_1 - V_3}{2K}$

node V_2: $.4i_{10} = \frac{V_2}{5K} + \frac{V_2 - V_3}{10K}$

node V_3: $\frac{V_1 - V_3}{2K} + \frac{V_2 - V_3}{10K} = \frac{V_3}{20K}$

dependent eq: $i_{10} = \frac{V_2 - V_3}{10K}$

Solving: $V_1 = 65.2V$, $V_2 = 12V$, $V_3 = 52V$

$$i_{10} = -4.0\,mA$$

MESH ANALYSIS

mesh i_1: $i_1 = 5mA$

mesh i_2: $.4i_{10} = i_1 - i_2$

mesh i_3: $5K(i_3 - i_1) + 10K(i_3 - i_2) + 20K(i_3) = 0$

$i_{10} = i_3 - i_2$

Solving: $i_1 = 5mA$, $i_2 = 6.6mA$, $i_3 = 2.6mA$

$$i_{10} = -4.0\,mA$$