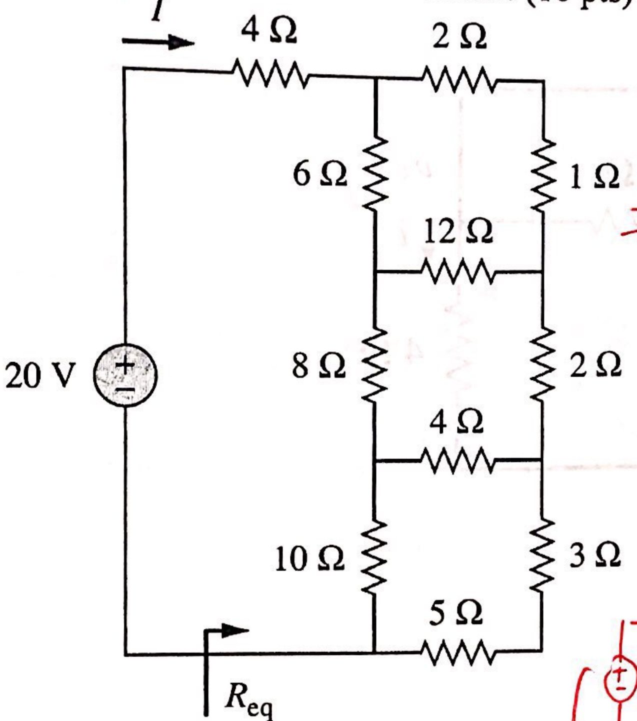
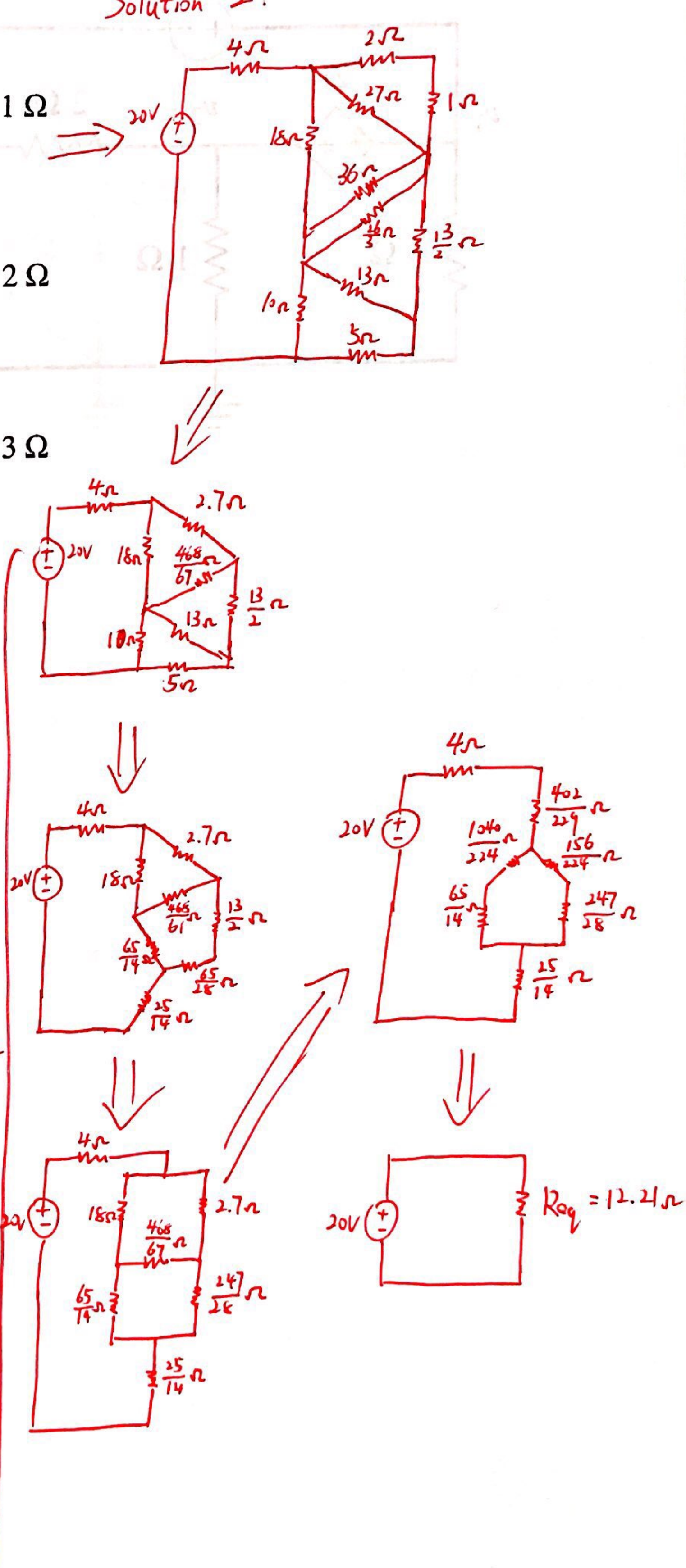
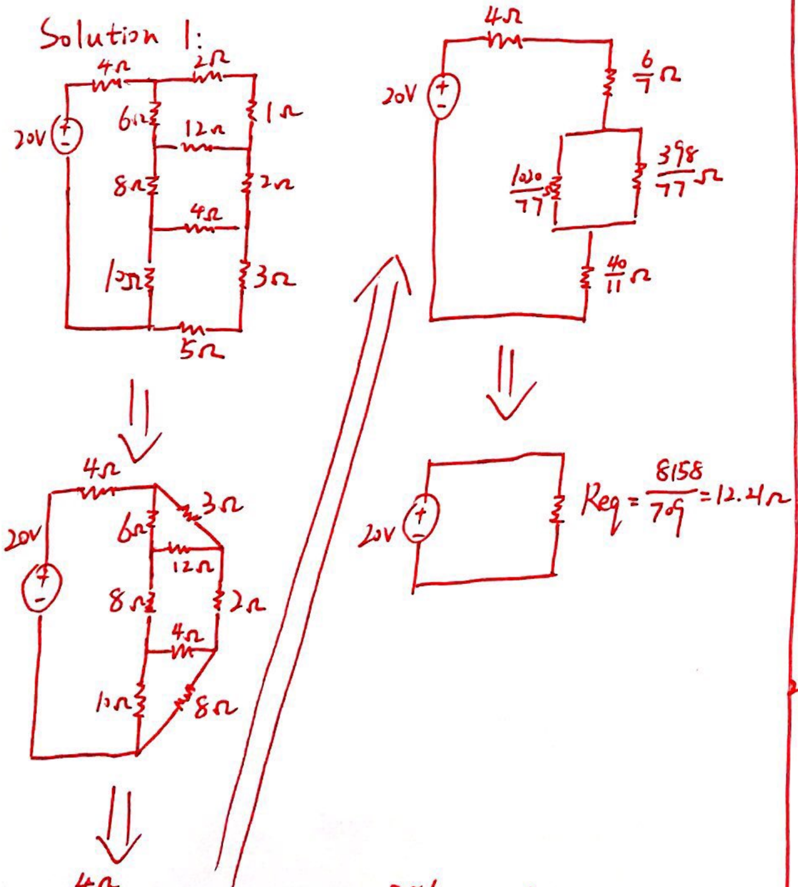
1. Find R_{eq} and I in the circuit below. (16 pts)

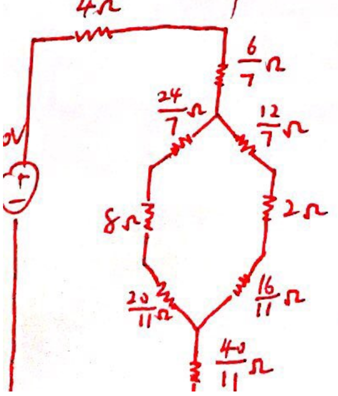


Solution 2:



Solution 1:





$$\frac{3\times6}{3+12+6} = \frac{6}{7}\Omega$$

$$\frac{3\times12}{3+12+6} = \frac{12}{7}\Omega$$

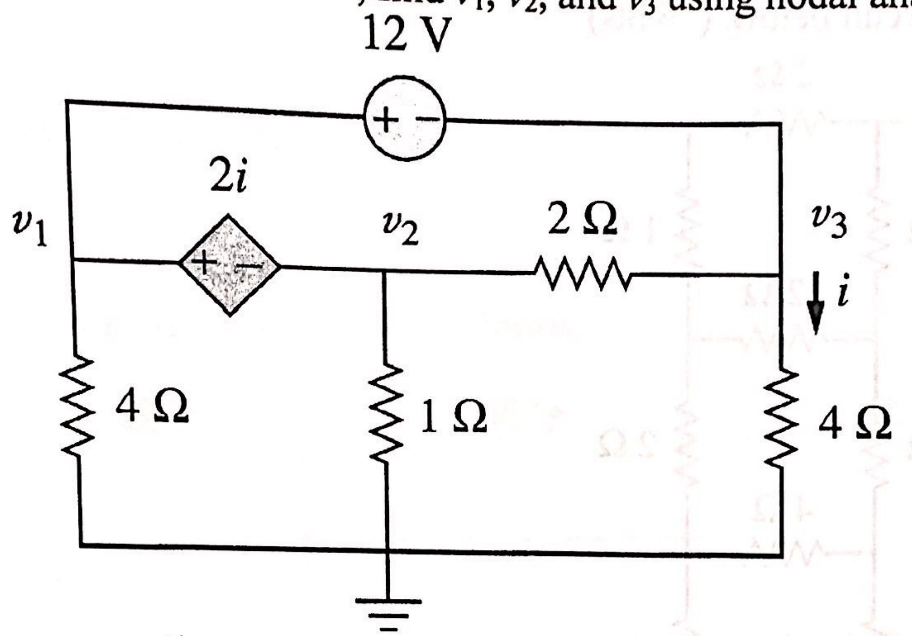
$$\frac{6\times12}{3+12+6} = \frac{24}{7}\Omega$$

$$\frac{4\times10}{4+8+10} = \frac{20}{11}\Omega$$

$$\frac{4\times8}{4+8+10} = \frac{16}{11}\Omega$$

$$\frac{8\times10}{\ldots} = \frac{40}{11}\Omega$$

2. For the circuit below, find v_1, v_2, and v_3 using nodal analysis. (16 pts)



$$\begin{cases} i = \frac{V_3}{4} & 1'' \\ \frac{V_1}{4} + \frac{V_2}{1} + \left(\frac{V_2 - V_3}{2} + \frac{V_3 - V_2}{2} + \right) \frac{V_3}{4} = 0 & 5'' \\ V_1 - V_3 = 12 & 1'' \\ V_1 - V_2 = 2i & 1'' \end{cases}$$

~~use several equations but not combine −2 points~~

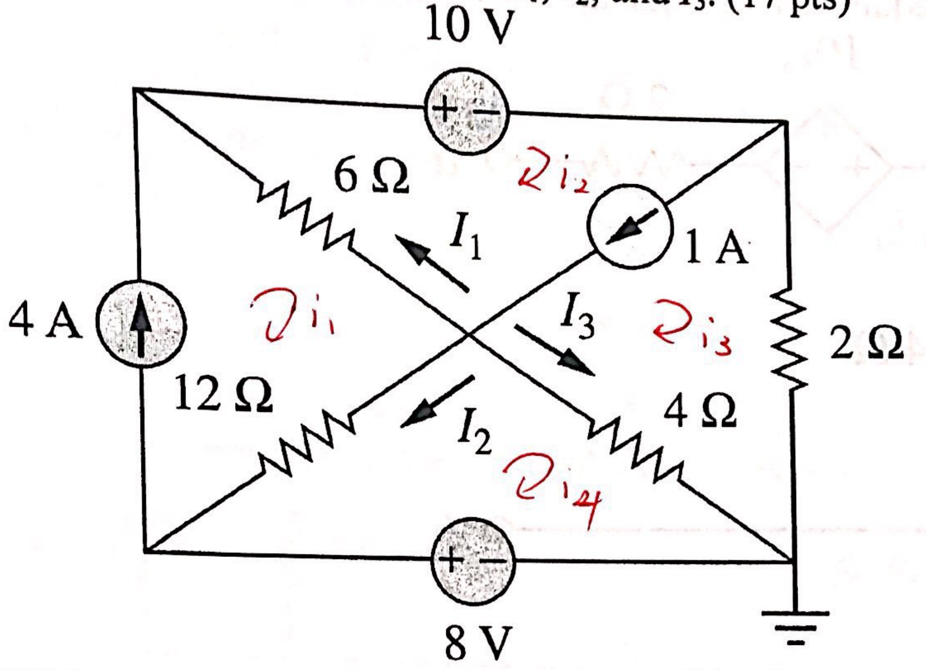
$V_1 = -3V$ $V_2 = 4.5V$ $V_3 = -15V$ 8"

one correct 3"
two correct 6"
three correct 8"

lose unit, each one −2 points
no decimal each one −2 points

no use nodal analysis −10 points

…, solve for I_1, I_2, and I_3. (17 pts)



KVL:

$$\begin{cases} i_1 = 4 & 1'' \\ i_2 - i_3 = 1 & 2'' \\ 6(i_2 - i_1) + 10 + 2i_3 + 4(i_3 - i_4) = 0 & 3'' \\ 12(i_4 - i_1) + 4(i_4 - i_3) - 8 = 0 & 2'' \end{cases}$$

$$\begin{cases} i_1 = 4\ A & 1.5'' \\ i_2 = 3\ A & 1.5'' \\ i_3 = 2\ A & 1.5'' \\ i_4 = 4\ A & 1.5'' \end{cases}$$

if no these part points will give to the final results

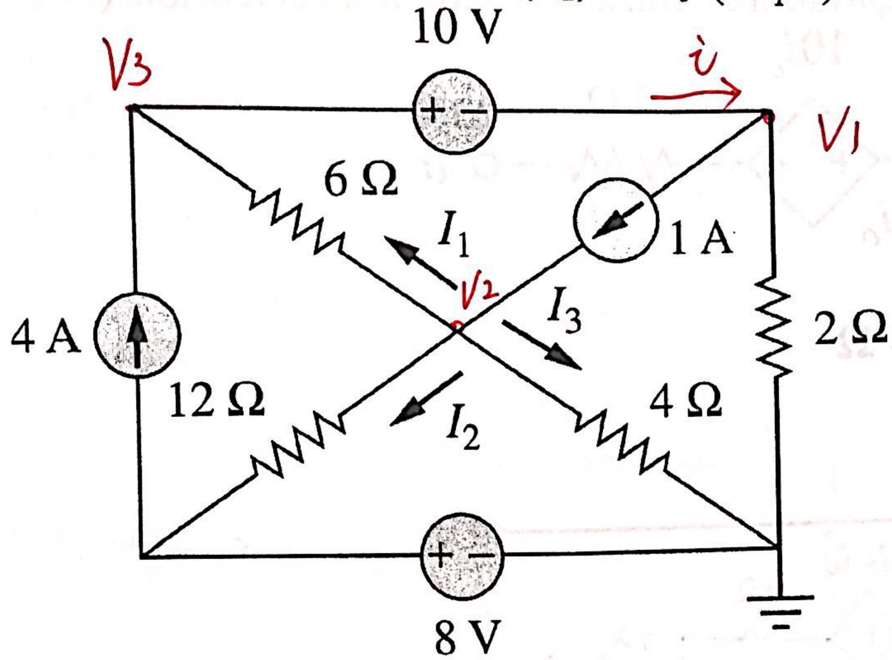
$I_1 = -1\ A$ 1'' 3''

$I_2 = 0\ A$ 1'' 3''

$I_3 = 2\ A$ 1'' 3''

no unit each one −2 points

3. In the circuit below, solve for I_1, I_2, and I_3. (17 pts)



KCl

① $$\begin{cases} \frac{V_2-V_3}{6}+\frac{V_2}{4}+\frac{V_2-8}{12}=1\,A & (2'') \\ V_3=V_1+10 & (2'') \\ i=1+\frac{V_1}{2} & (2'') \\ i=\frac{V_2-V_3}{6}+4 & (2'') \end{cases}$$

$$\Rightarrow \begin{cases} V_1=4V & (1.5'') \\ V_2=8V & (1.5'') \\ V_3=14V & (1.5'') \\ i=5A & (1.5'') \end{cases}$$

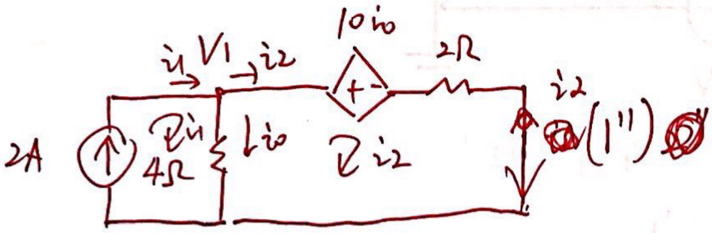
(if no this partial result) we add the points to the final result

$$\Rightarrow \begin{cases} I_1=\frac{8V-14V}{6\Omega}=-1A & (1'') & 3'' \\ I_2=\frac{8V-8V}{12\Omega}=0A & (1'') & 3'' \\ I_3=\frac{8V}{4\Omega}=2A & (1'') & 3'' \end{cases}$$

one ~~correct~~ ~~2''~~

~~two~~ correct

I_N :



$$\begin{cases} \frac{V_1}{4} + \frac{V_1 - 10 i_0}{2} = 2 & (2'') \\ V_1 = 4 i_0 & (2'') \end{cases}$$

$$\Rightarrow \begin{cases} i_0 = 1A & (1'') \\ V_1 = 4V & (1'') \end{cases} \quad \frac{-4+10}{2} = 3A.$$

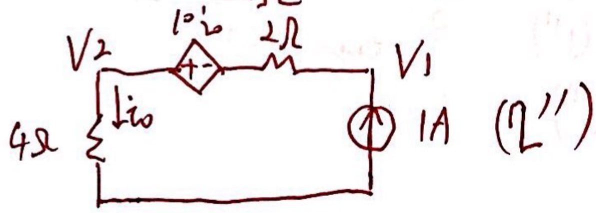
$I_N = \cancel{\frac{[0-(4-10)]V}{2\Omega} = 3A}$ (1'')

$$\begin{cases} i_1 = 2A & 1' \\ (i_2 - i_1)\cdot 4 + 10 i_0 + 2 i_2 = 0 & 1' \\ i_0 = i_1 - i_2 & 1' \end{cases}$$

$$\Rightarrow \cancel{\begin{cases} i_1 = 2A \\ i_2 = 3A \end{cases}} \begin{cases} i_2 = 3A & 1' \\ i_1 = 2A & 2'' \\ i_0 = -1A & 1' \end{cases}$$

$i_N = 3A$

R_N :



$$\begin{cases} i_0 = 1A & (1'') \\ V_2 = 4\Omega \cdot 1A = 4V & (1'') \\ \frac{V_1 - (V_2 - 10 i_0)}{2} = 1A & (2'') \end{cases} \Rightarrow \begin{cases} i_0 = 1A \\ V_1 = -4V \\ V_2 = 4V & (2'') \end{cases}$$

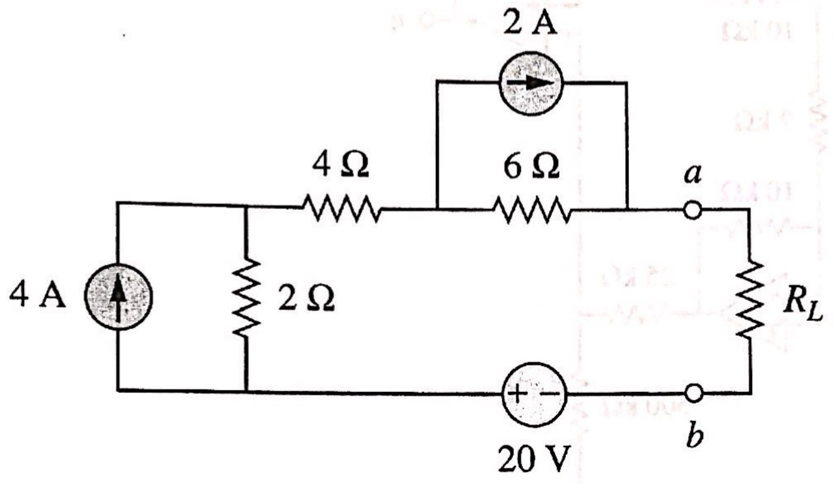
$\Rightarrow R_N = \frac{-4V}{1A} = -4\Omega$ (1'')

or

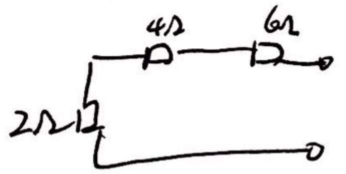
$$\begin{cases} -1 + 6i - 10 i_0 = 0 & (2'') \\ i = i_0 & (2'') \end{cases} \Rightarrow i = -0.25A \quad (2'')$$

$\Rightarrow R_N = \cancel{\frac{-4V}{1A} = -4\Omega}\ \frac{1V}{-0.25A} = -4\Omega$ (1'')

5. (a) For the circuit below, obtain the Thevenin equivalent at terminals *a*-*b*. 4
(b) Calculate the current in $R_L = 8\Omega$. 5
(c) Find R_L for maximum power deliverable to R_L. 4
(d) Determine that maximum power. 4
(17 pts)

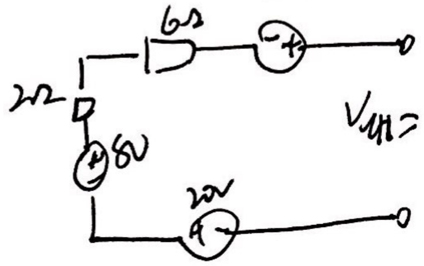


(a) R_{Th}:



$R_{th} = 12\Omega$ 2'

V_{th}



$V_{th} = 40V$ 2'

(b). $I = \frac{V_{th}}{R_L + R_{th}} = \frac{40V}{20\Omega} = 2A$ 5'

(c). when $R_L = R_{th} = 12\Omega$ 4'

P maximum

(d). $P_{max} = \left(\frac{40V}{24\Omega}\right)^2 \cdot 12\Omega$

$= 33\frac{1}{3}W$ 4'

上海交通大学试卷草稿纸 Draft Paper

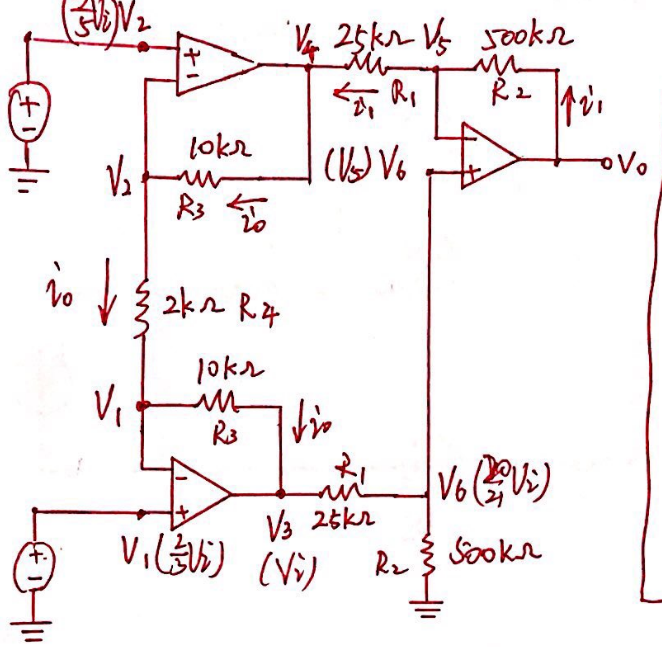
（2019-2020-1-Fall)

Course Code ________ Name ____________ Student ID ______________

6.

Examier:

Shi Jian.



Or:

$V_1 = \frac{2}{3}V_i\,(V)$ ..... 1'

$V_2 = \frac{3}{5}V_i\,(V)$ ..... 1'

By using the equation on slides,

$V_0 = \frac{R_2}{R_1}\cdot(1+\frac{2R_3}{R_4})\cdot(V_2-V_1)$ --- 4'

$V_0 = \frac{500}{25}\cdot(1+\frac{2\times10}{2})\times(V_2-V_1)$ -- 4'

$= \frac{44}{3}V_i\,(V)$ ---- 1'

$\Rightarrow A = \frac{V_0}{V_i} = \frac{44}{3} \approx 14.67$ --- 6'

$V_1 = \frac{80k}{80k+40k}\cdot V_i = \frac{2}{3}V_i\,(V)$ ...... 1'

$V_2 = \frac{30k}{30k+20k}V_i = \frac{3}{5}V_i\,(V)$ .... 1'

$i_0 = \frac{V_2-V_1}{2k} = \frac{(\frac{3}{5}-\frac{2}{3})V_i}{2k} = \frac{-\frac{1}{15}V_i}{2k} = -\frac{1}{30k}V_i\,(A)$ .... 2'

$V_3 = V_1 - 10k\cdot(i_0) = \frac{2}{3}V_i - (-\frac{1}{30k})V_i\cdot 10k = V_i\,(V)$ ..... 2'

$V_4 = V_2 + 10k(i_0) = \frac{3}{5}V_i + 10k(-\frac{1}{30k})V_i = \frac{4}{15}V_i\,(V)$ ..... 2'

$V_6 = \frac{500k}{500k+25k}\cdot V_3 = \frac{20}{21}V_3 = \frac{20}{21}V_i\,(V)$ .... 2'

Since $V_5 = V_6$, ... 1'

$i_1 = \frac{V_5-V_4}{25k} = \frac{\frac{20}{21}V_i - \frac{4}{15}V_i}{25k} = \frac{24}{875k}V_i\,(V)$ .... 2'

$V_0 = V_5 + (500k)i_1 = \frac{20}{21}V_i + (500k)\cdot\frac{24}{875k}V_i = \frac{44}{3}V_i\,(V)$ .... 2'

$\Rightarrow A = \frac{V_0}{V_i} = \frac{44}{3} \approx \boxed{14.67}$ 1'

--- 2' if not decimal