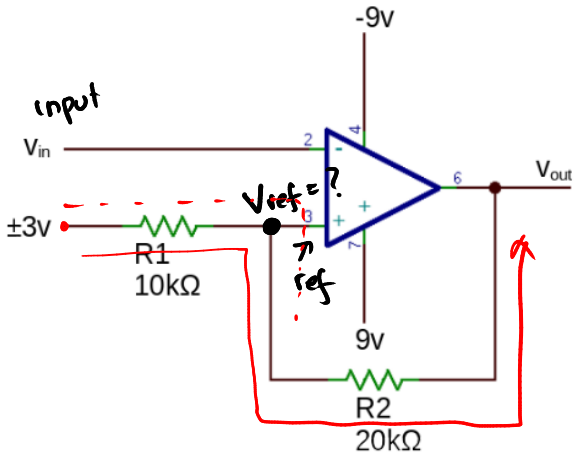
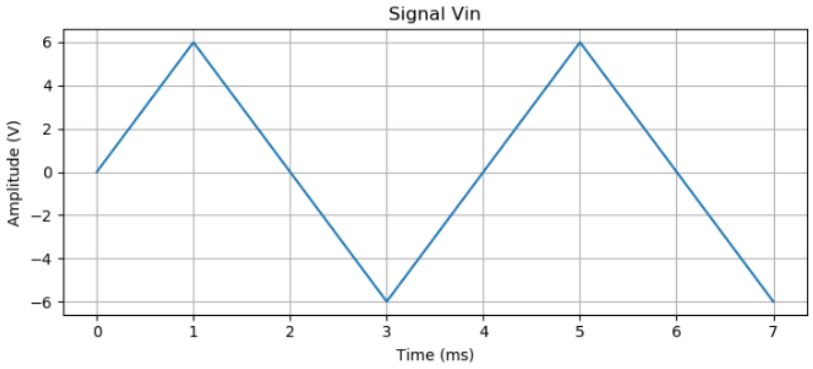
PEMBAHASAN SOAL UTS

**(Sub-CPMK 1: 20 Poin)**

1. Diberikan rangkaian op-amp sebagai komparator, tentukan! (NIM genap gunakan +3V, NIM ganjil gunakan -3V




a. Upper threshold!
b. Lower threshold!
c. Sketsa $\mathbf{V_{out}}$ ketika diberikan $\mathbf{V_{in}}$




(a) ±3V — Vref — Vout = ± Vsat

$R_1$ — $R_2$

$I_{R_1} = I_{R_2}$

$$\frac{(+3 - V_{ref})}{R_1} = \frac{V_{ref} - V_{out}}{R_2}$$

$$3 - V_{ref} = (V_{ref} - V_{out}) \cdot \frac{R_1}{R_2}$$

$$3 - V_{ref} = V_{ref} \cdot \frac{R_1}{R_2} - V_{out} \cdot \frac{R_1}{R_2}$$

$$3 + V_{out} \cdot \frac{R_1}{R_2} = V_{ref} + V_{ref} \cdot \frac{R_1}{R_2}$$

$$3 + V_{out} \frac{R_1}{R_2} = V_{ref} \left(1 + \frac{R_1}{R_2}\right)$$

$$V_{ref} = \frac{3 + V_{out} \frac{R_1}{R_2}}{1 + \frac{R_1}{R_2}}$$

NIM Genap

(+3V)

utk $V_{out} = +V_{sat} = +9$ V → Upper threshold $= \frac{3 + 9 \cdot \frac{10k}{20k}}{1 + \frac{10k}{20k}} = \frac{3 + 4.5}{1 + 0.5} = \frac{7.5}{1.5}$

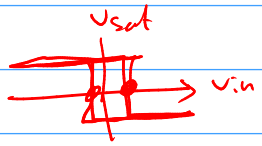
(a) Upper threshold = 5 Volt

ute $V_{out} = -V_{sat} = -9$ volt → lower threshold

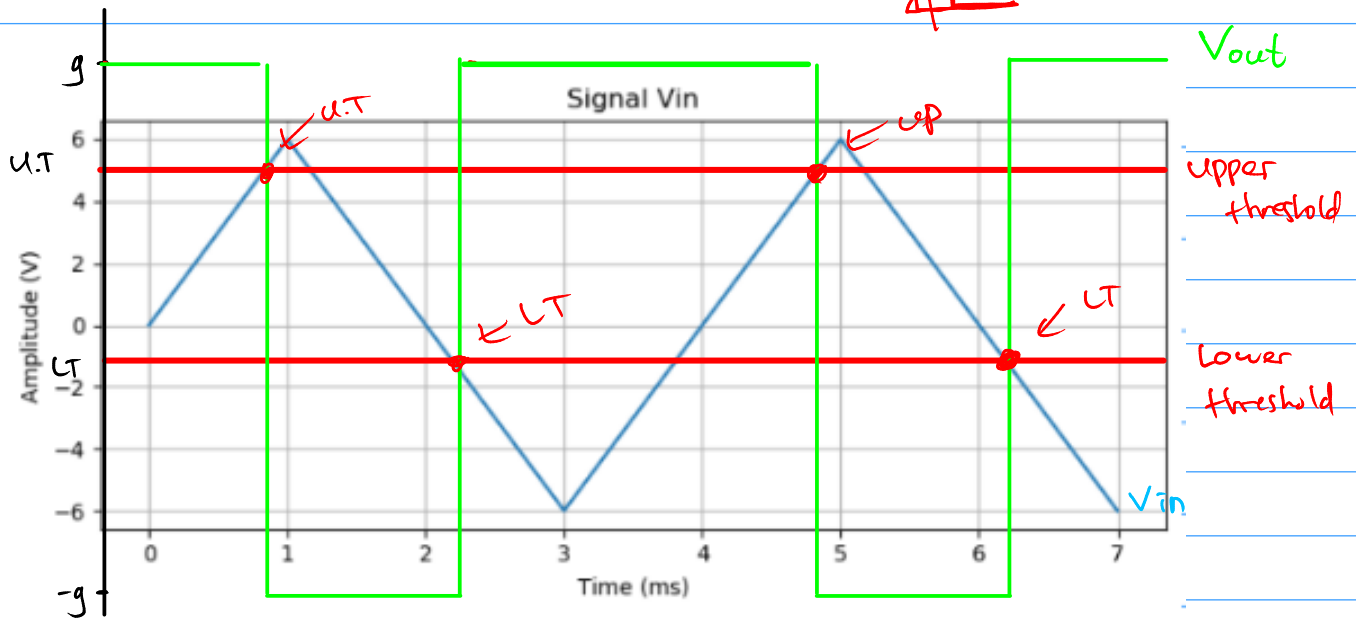
$$\text{lower threshold} = \frac{3 + V_{out} \cdot \frac{R_1}{R_2}}{1 + \frac{R_1}{R_2}}$$

$$= \frac{3 - 9 \cdot \frac{10k}{20k}}{1 + \frac{10k}{20k}} \quad \left(\tfrac{1}{2}\right) \quad = \frac{3 - 4.5}{1.5} = -\frac{1.5}{1.5}$$

(b) lower threshold = −1 volt

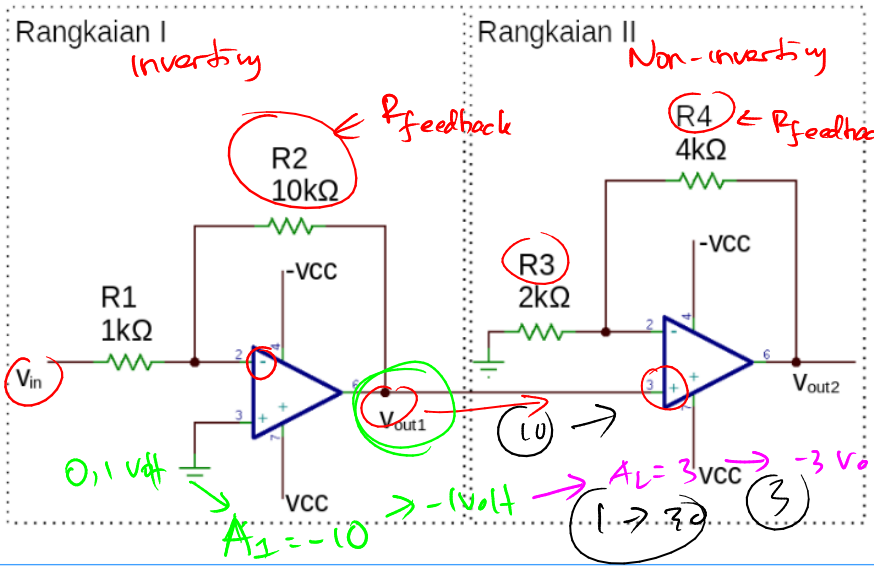



(c)

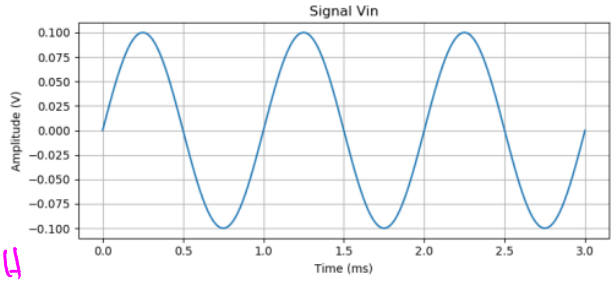


**(Sub-CPMK 2: 20 Poin)**

2. Diberikan rangkaian op-amp sebagai penguat, tentukan!




a. penguatan rangkaian I!
b. penguatan rangkaian II!
c. penguatan total!
d. Sketsa $\mathbf{V_{out1}}$ dan $\mathbf{V_{out2}}$ ketika diberikan $\mathbf{V_{in}}$




(a) Penguatan Rangkaian I → Op Amp Inverting

$$A_1 = -\frac{R_f}{R_1} = -\frac{R_2}{R_1} = -\frac{10k}{1k} = -10$$

perubahan fasa -180°

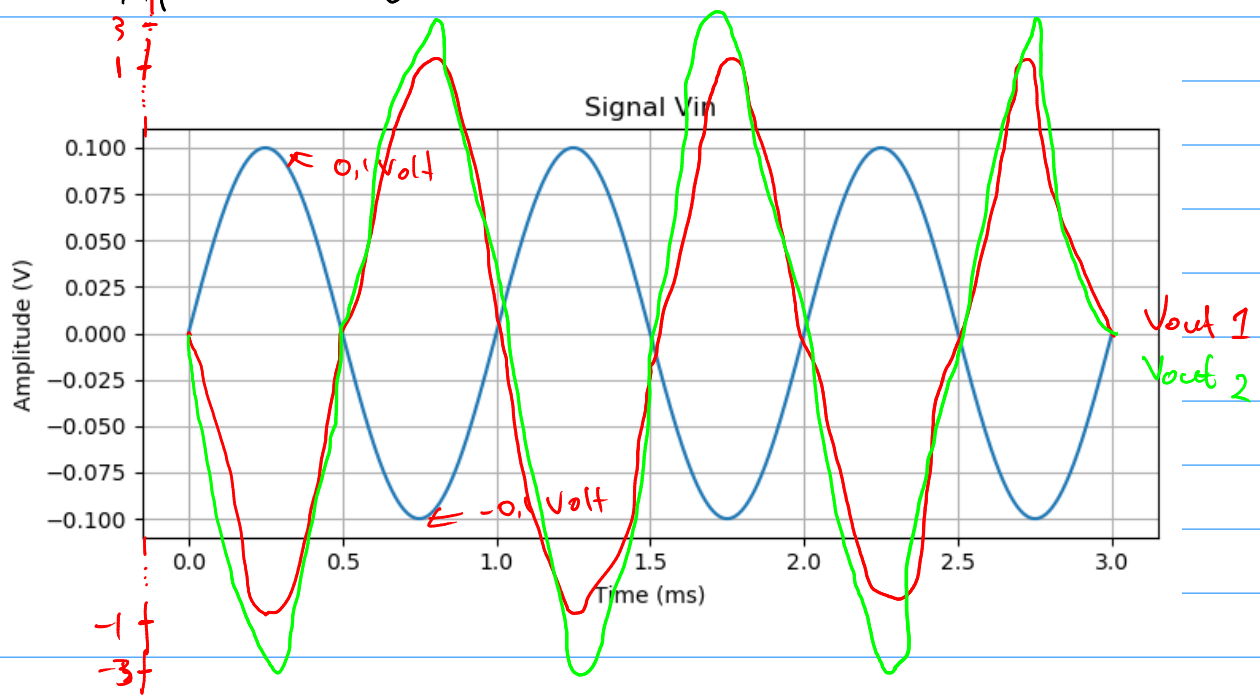
(b) Penguatan Rangkaian II → Op amp non-inverting

$$A_2 = \left(1 + \frac{R_f}{R}\right) = \left(1 + \frac{R_4}{R_3}\right) = \left(1 + \frac{4k}{2k}\right) = (1+2) = 3$$

(c) Penguatan total = ?

$$A_T = A_1 \cdot A_2 = (-10) \cdot 3 = -30$$

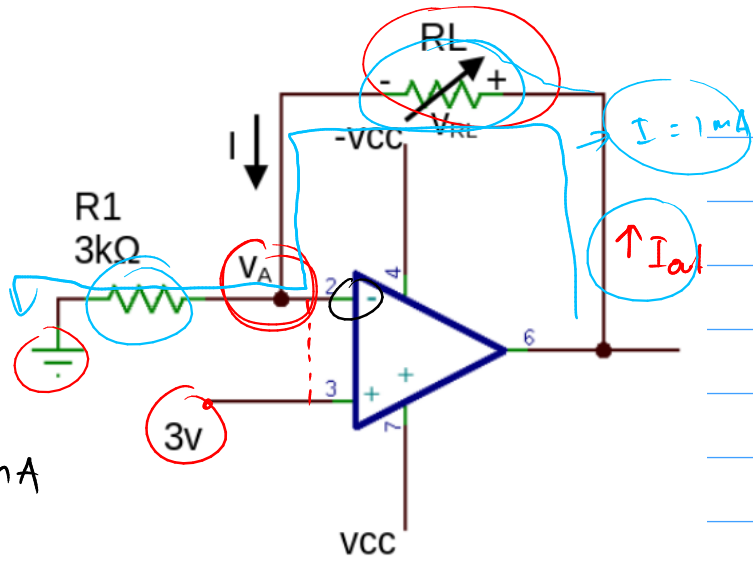
(d)



**(Sub-CPMK 2: 20 Poin)**

= Voltage Controled Current Source

3. Diberikan rangkaian VCIS sebagai berikut, tentukan!
   a. $\mathbf{V_A}$!
   b. $\mathbf{I_{out}}$!
   c. $\mathbf{V_{RL}}$!




(a) $V_A = 3$ Volt

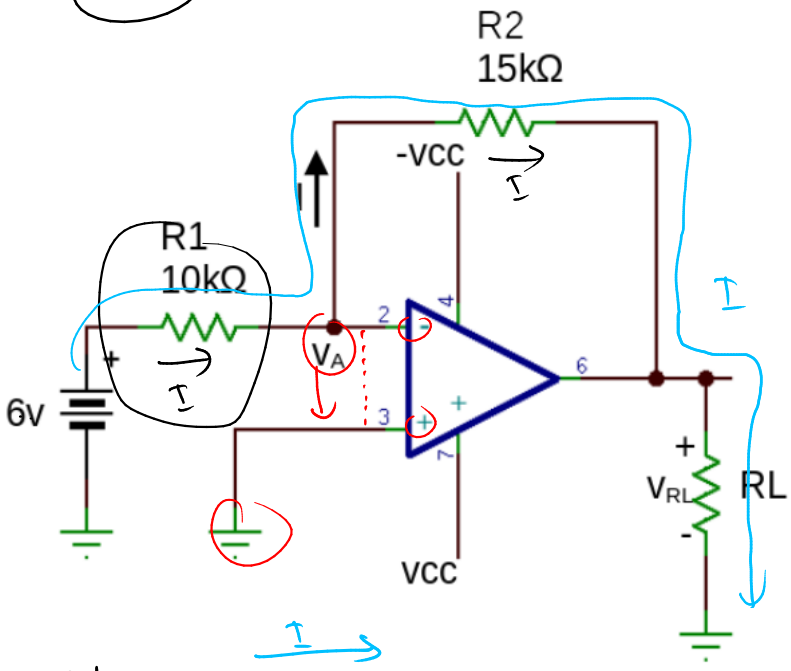
(b) $I_{out} = \frac{V_A}{3\,k\Omega} = \frac{3\,V}{3\,k\Omega} = 1\,mA$

(c) $V_{RL} = I_{RL} \cdot RL = 1mA \cdot RL = RL\ mVolt = RL \cdot 10^{-3} \cdot Volt$

**(Sub-CPMK 2: 20 Poin)**

= Current Controlled Voltage Source (CCVS)

4. Diberikan rangkaian ICVS sebagai berikut, tentukan!
   a. $\mathbf{V_A}$!
   b. **I**!
   c. $\mathbf{V_{RL}}$!

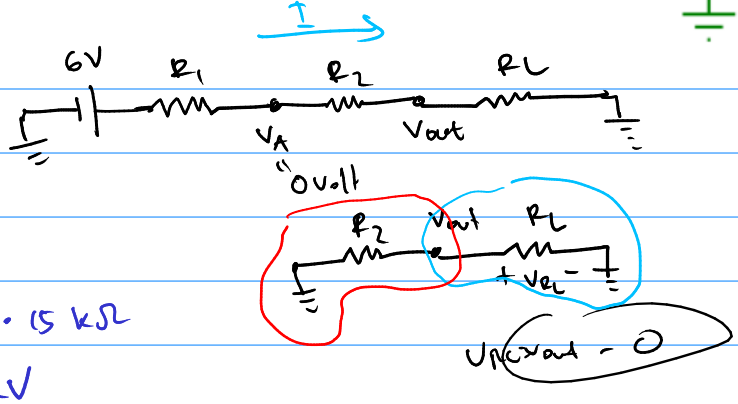



(a) $V_A = 0$ Volt

(b) $I = \frac{V}{R} = \frac{6}{10k} = 0.6\,mA$

(c) $V_{RL} = I \cdot RL$

$= 0.6\,RL\ mV$



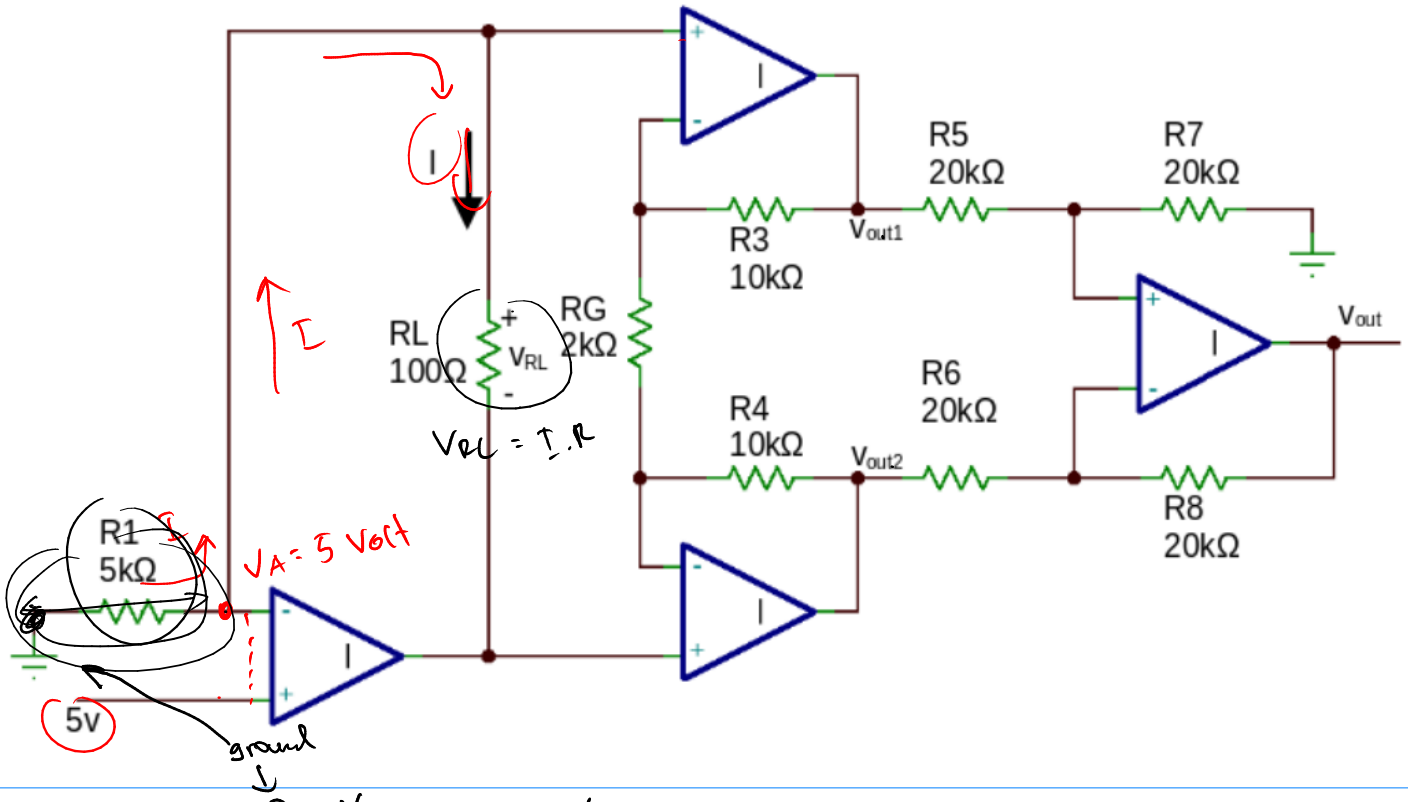

$V_{RL} = V_{out} = V_{R2} = I \cdot R_2 = 0.6 \cdot 15\,k\Omega$

$V_{RL} = 9\,kV$

VRL = Vout = 0

**(Sub-CPMK 2: 20 Poin)**

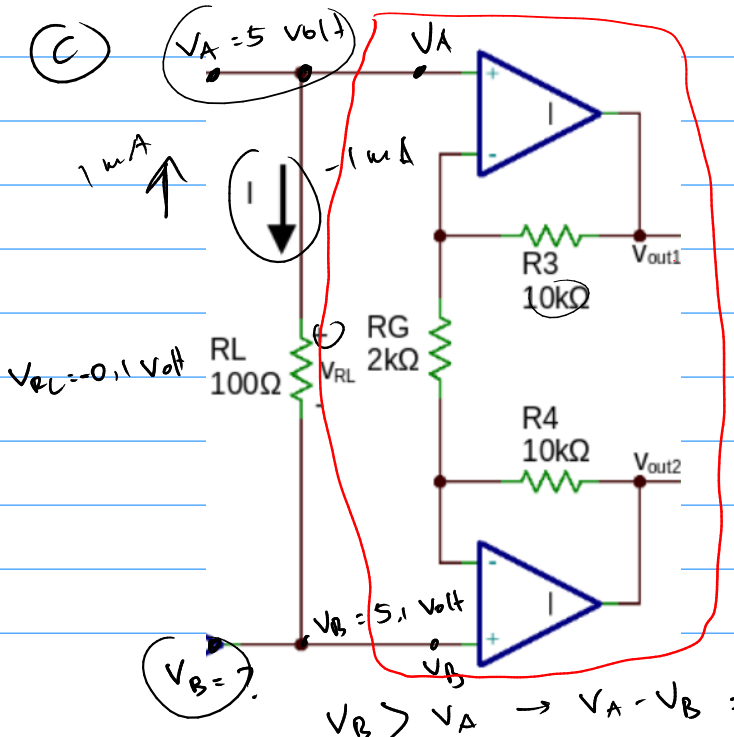
5. Diberikan rangkaian antarmuka sensor menggunakan op-amp (skematik rangkaian di halaman berikutnya), tentukan!
   a. **I**!
   b. $\mathbf{V_{RL}}$!
   c. $\mathbf{V_{out1}}$ dan $\mathbf{V_{out2}}$!
   d. $\mathbf{V_{out}}$!




a) $I = \dfrac{0 - V_A}{R_1} = \dfrac{-5\ V}{5\ k\Omega} = -1\ mA$

b) $V_{RL} = I \cdot RL = -1\ mA \cdot 100\ \Omega = -100\ mV = -0{,}1\ Volt$

c)




$V_{out1} = \left(\frac{R_3}{R_5} + 1\right) V_A - \frac{R_4}{R_5} \cdot V_B$

$= \left(\frac{10k}{2k} + 1\right) 5 - \frac{10k}{2k} \cdot 5{,}1$

$= (5+1)5 - 5 \cdot 5{,}1$

$= 6 \cdot 5 - 5 \cdot 5{,}1$

$= 30 - 25{,}5$

$V_{out1} = 4{,}5$ Volt

$V_B > V_A \rightarrow V_A - V_B = -0{,}1$

$5 - V_B = -0{,}1$

$V_B = 5{,}1$ volt

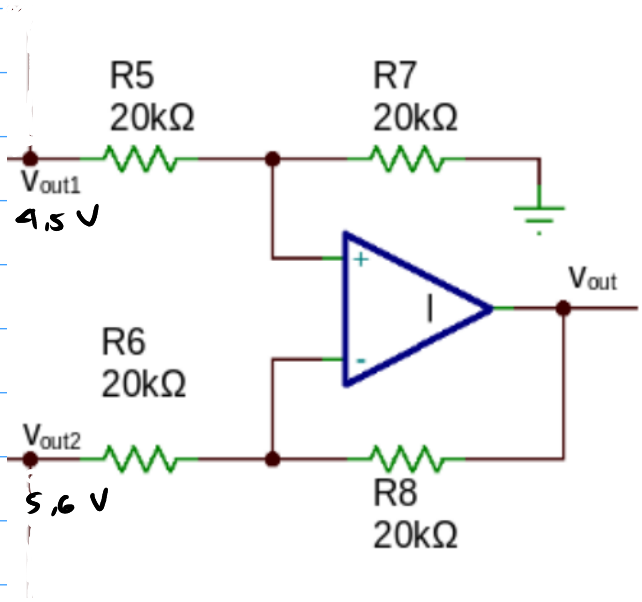
$$V_{out2} = -\frac{R_3}{R_6} \cdot V_A + \left(\frac{R_4}{R_6} + 1\right) V_B = -\frac{10k}{2k} \cdot 5 + \left(\frac{10k}{2k} + 1\right) \cdot 5{,}1$$

$$= -5 \cdot 5 + 6 \cdot 5{,}1$$

$$= -25 + 30{,}6$$

$$V_{out_2} = 5{,}6 \text{ Volt}$$

(d) $V_{out} = ?$




$$V_{out} = V_{out_2} - V_{out\,1}$$

$$= 5{,}6\,V - 4{,}5\,V$$

$$V_{out} = 1{,}1 \text{ Volt}$$