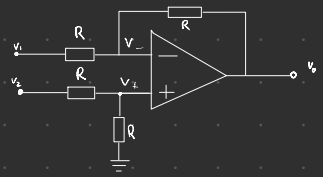
① 

$I_{R_1} = \frac{V_1 - V_-}{R}$ $\quad I_{R_2} = \frac{V_- - V_0}{R}$ $\quad I_{R_1} = I_{R_2}$

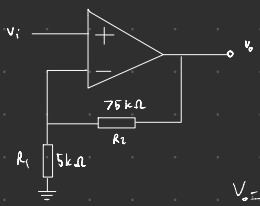
$\frac{V_1 - V_-}{R} = \frac{V_- - V_0}{R}$

$V_- = V_+ = \frac{V_2}{R+R} \cdot R = \frac{V_2}{2}$

$V_1 - V_- = V_- - V_0$

$V_1 - \frac{V_2}{2} = \frac{V_2}{2} - V_0$

$V_0 = V_2 - V_1$

②a) 

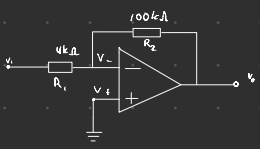
$I = \frac{V_0}{R_1+R_2}$

$V_- = \frac{V_0}{R_1+R_2} R_1$

$V_- = V_i$

$V_i = \frac{V_0}{R_1+R_2} R_1$

$V_0 = V_i \left(\frac{R_1+R_2}{R_1}\right) = V_i \left(1 + \frac{R_2}{R_1}\right) = V_i \left(1 + \frac{75k\Omega}{5k\Omega}\right) = \underline{16 V_i}$

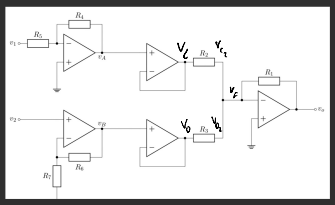
b) 

$\frac{V_1 - V_-}{R_1} = \frac{V_- - V_0}{R_2}$

$V_0 = -\frac{R_2}{R_1} V_i = -\frac{100k\Omega}{4k\Omega} = \underline{-25 V_i}$

c) $V_{i\,max} = \frac{15}{16} = \underline{\pm 0{,}94V}$

$V_{i\,max} = \frac{12}{25} = \underline{\pm 0{,}6V}$

③a 

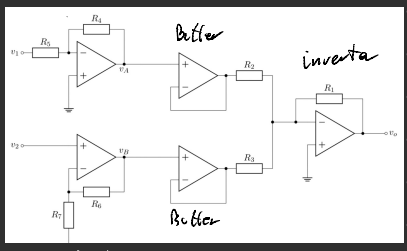
$V_A = -V_G = -5V$

$V_B = \frac{5 \cdot 2000}{1000} = 10V$

$\frac{V_A}{R_2} + \frac{V_B}{R_3} = -\frac{V_0}{R_1}$

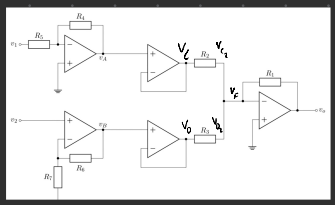
$V_0 = R_1 \cdot \left(-\frac{V_A}{R_2} - \frac{V_B}{R_3}\right) = 1000\,\Omega \cdot \left(+\frac{5V}{1000} - \frac{10V}{1000}\right) = \underline{-5V}$

b) inverter



verstärker

③ c)



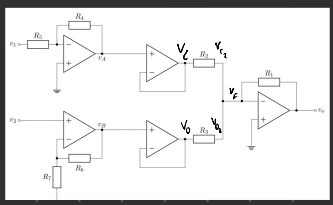
$V_A = -V_0 = -5V$

$V_B = \frac{5 \cdot 1500}{500} = 15\ V$

$\frac{V_A}{R_2} + \frac{V_B}{R_3} = \frac{-V_0}{R_1}$

$V_0 = R_1 \cdot \left(-\frac{V_A}{R_2} - \frac{V_B}{R_3}\right) = 1000\,\Omega \cdot \left(+\frac{5V}{1000} - \frac{15\ V}{1000}\right) = \underline{\underline{-10\ V}}$

③ d)



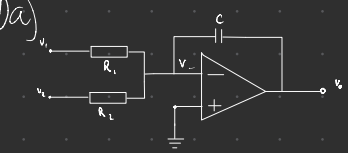
$V_A = -V_0 = -5V$

$V_B = \lim_{R\to\infty} \frac{5 \cdot (1000+R)}{R} = \lim_{R\to\infty} \frac{5000+5R}{R} = 5\ V$

$\frac{V_A}{R_2} + \frac{V_B}{R_3} = \frac{-V_0}{R_1}$

$V_0 = R_1 \cdot \left(-\frac{V_A}{R_2} - \frac{V_B}{R_3}\right) = 1000\,\Omega \cdot \left(+\frac{5V}{1000} - \frac{5\ V}{1000}\right) = \underline{\underline{0\ V}}$

④ a)

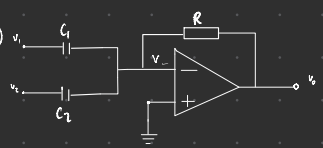


$-i_C = \frac{V_2}{R_2} + \frac{V_1}{R_1}$

$\frac{V_2}{R_2} + \frac{V_1}{R_1} = -C\,\dot{V}_0$

$\underline{\underline{V = -\frac{1}{C}\int \left(\frac{V_2}{R_2} + \frac{V_1}{R_1}\right) dt}}$

b)



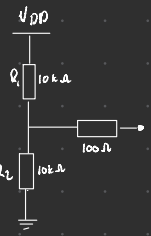
$\dot{v}_1 C_1 + \dot{v}_2 C_2 = -\frac{V_0}{R}$

$\underline{\underline{V_0 = -R\left(\dot{v}_1 C_1 + \dot{v}_2 C_2\right)}}$

c) $\underline{\underline{\text{a) er en integrator og b) er en derivator}}}$

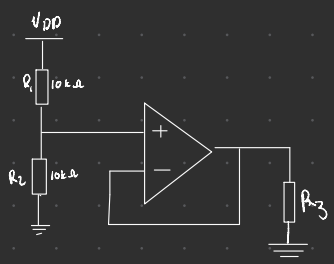
5) a) $V_{ut} = \frac{V_{p2} \cdot R_1}{R_1 + R_2} = \frac{5V \cdot 10k\Omega}{20k\Omega} = 2{,}5\ V$

$I = \frac{V_{DD}}{R_1 + R_2} = 0{,}0025 = 2{,}5mA$ er det han har tenkt men ikke tatt $R_{negativ}$ i systemet. Systemet ser slik ut.



$V_{out} = 5 \cdot \frac{\frac{10k \cdot 100}{10k + 100}}{\frac{10k \cdot 100}{10k + 100} + 10k} = 49mV$

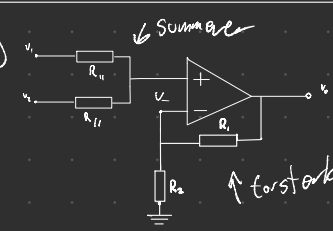
b)



6) a) B siden ±5V er max

b) Siden Operasjonsforsterkeren ødelegger den sinussignalet

7) a)



b) $V_- = \frac{V_0 \cdot R_1}{R_1 + R_2}$

$V_0 = \left(1 + \frac{R_2}{R_1}\right) \cdot V_-$

$V_0 = \left(1 + \frac{R_2}{R_1}\right) \cdot \frac{V_1 + V_2}{2}$

$V_- = V_+$

$i_1 + i_2 = 0$

$\frac{V_1 - V_+}{R_{11}} + \frac{V_2 - V_+}{R_{11}} = 0$

$2V_+ = V_1 + V_2$

$V_+ = \frac{V_1 + V_2}{2}$

c) $V_0 = (1 + 1) \cdot \frac{V_1 + V_2}{2} = V_1 + V_2$