EE2210 Electric circuits Quiz 2 Ans.

1.

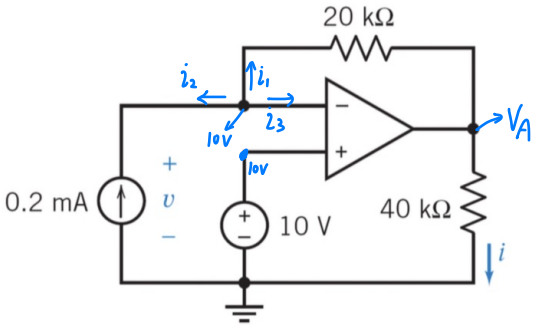


Figure 1.

The voltages at the input nodes of an ideal OP amplifier are equal!

$\therefore V = 10\ (V)$ ※

Apply KCL at inverting input node of OP

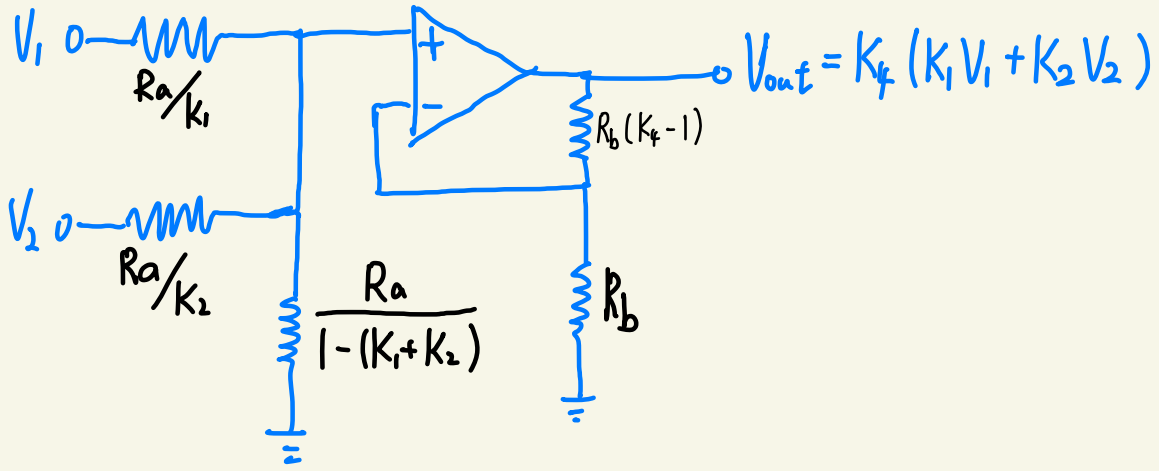
$$i_1 + i_2 + i_3 = 0$$

$$\frac{10 - V_A}{20 \times 10^3} + (-0.2 \times 10^{-3}) + 0 = 0 \qquad \therefore V_A = 6\ (V)$$

$$i = \frac{V_A}{40k} = \frac{6}{40000} = 0.15\ (mA)$$ ※

2. $V_0 = V_1 + 2V_2$

By noninverting summing amplifier



Design : $K_1 = 0.1$, $K_2 = 0.2$, $K_f = 10$,

R_a, R_b : arbitrary (Ex : $R_a = 1k\Omega$, $R_b = 1k\Omega$)

3. if V_i is step function, $V_i = 1$ when $t > 0$, $V_i = 0$ when $t < 0$

$t \ll 0$, $i = 0$

$t \gg 0$, $i = 1$

$\tau = \frac{L}{R} = \frac{0.4}{10} = \frac{1}{25}$

$i(t) = 1 - e^{-25t}$

consider V_i is ramp function

$$i(t) = \int_{-\infty}^{t} (1 - e^{-25t'})\, dt'$$

$$= t' + \frac{1}{25} e^{-25t'} \Big|_0^t$$

$$= t + \frac{1}{25}(e^{-25t} - 1) \quad (A) \quad \text{for } t \geq 0$$

4. if V_i is step function, $V_i = u(t)$

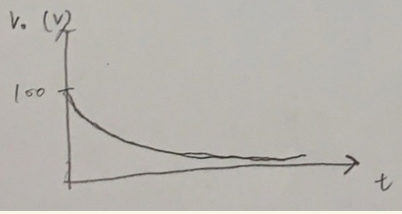
$t \ll 0$, $V_o = 0$

$t \gg 0$, $V_o = 1$

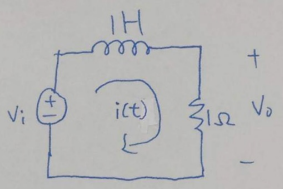
$\tau = RC = 10k \cdot 1\mu = 10^{-2}$, $V_o(t) = 1 - e^{-100t}$

consider V_i is impulse function

$$V_o(t) = \frac{d}{dt}(1 - e^{-100t}) = 100\, e^{-100t} \quad (V) \quad \text{for } t \geq 0$$



5.



$$V_i(t) = L\frac{di(t)}{dt} + R\,i(t)$$

$$\Rightarrow V_i(t) = \frac{di(t)}{dt} + i(t)$$

$$\Rightarrow \frac{di(t)}{dt} + i(t) = 20, \text{ for } t \geq 5$$

$$\Rightarrow i(t) = 20 + Ae^{-t}$$

$$\because i_L(0) = 0 = i(0) = 20 + A$$

$$\therefore A = -20$$

$$\Rightarrow i(t) = 20(1 - e^{-t})$$

$$V_o(t) = \begin{cases} 0\ V, & \text{for } 0 \leq t < 5 \\ 20(1 - e^{-(t-5)})\ V, & \text{for } t \geq 5 \end{cases}$$

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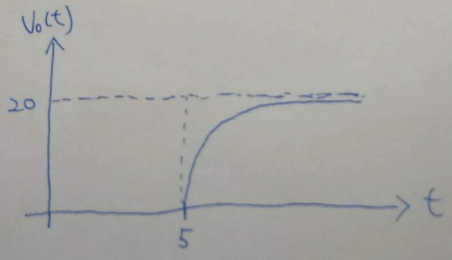

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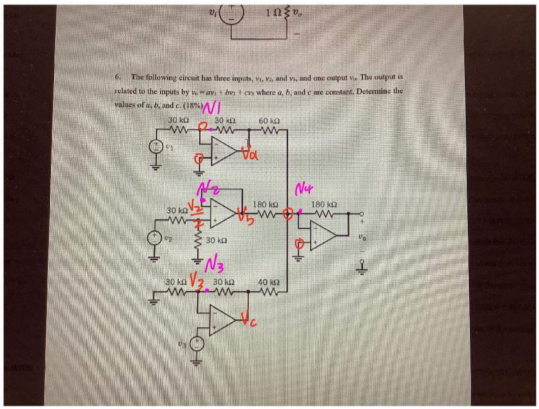
6.



N_1 $\quad \frac{0-V_1}{30K} + \frac{0-V_a}{30K} = 0 \qquad V_a = -V_1$

N_2 $\quad V_b = \frac{V_2}{2}$

N_3 $\quad \frac{V_3-0}{30K} + \frac{V_3-V_c}{30K} = 0 \qquad V_c = 2V_3$

N_4 $\quad \frac{0-V_o}{180K} = \frac{V_a}{60K} + \frac{V_b}{180K} + \frac{V_c}{40K}$

$= \frac{-V_1}{60K} + \frac{V_2/2}{180K} + \frac{2V_3}{40K}$

$V_o = \underbrace{3}_{a}V_1 - \underbrace{\frac{1}{2}}_{b}V_2 - \underbrace{9}_{c}V_3$