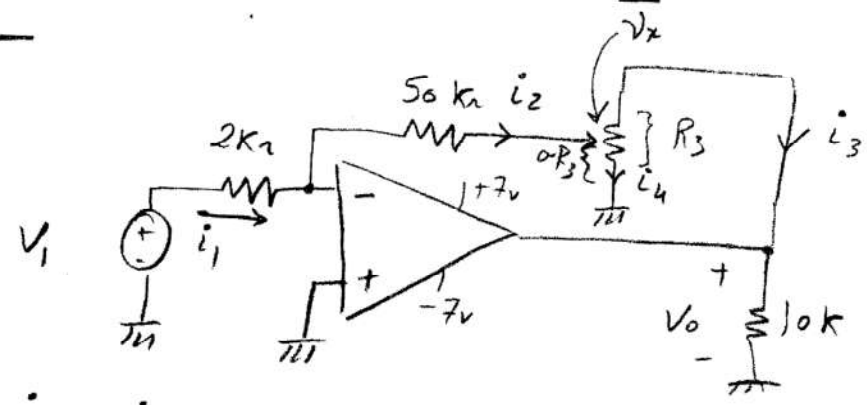
1)



$R_3 = 100\,k\Omega$

$i_1 = i_2$

$$\frac{v_i - 0}{2\,k\Omega} = \frac{0 - v_x}{50\,k\Omega}$$

$$\frac{v_x}{v_i} = -25$$

$i_2 = i_3 + i_4$

$$\frac{-v_x}{50\,k\Omega} = \frac{v_x}{\alpha\,100k\Omega} + \frac{v_x - v_o}{(1-\alpha)100\,k\Omega} \quad (3)$$

$$v_o\left(\frac{1}{(1-\alpha)100k\Omega}\right) = v_x\left(\frac{1}{50\,k\Omega} + \frac{1}{\alpha 100k\Omega} + \frac{1}{(1-\alpha)100k\Omega}\right)$$

$$v_o\left(\frac{1}{(1-\alpha)100k\Omega}\right) = v_x\left(\frac{2\alpha(1-\alpha) + (1-\alpha) + \alpha}{\alpha(1-\alpha)100\,k\Omega}\right)$$

$$\frac{v_o}{v_x} = \frac{1 + 2\alpha - 2\alpha^2}{\alpha}$$

$$\frac{v_o}{v_i} = \frac{v_o}{v_x} \times \frac{v_x}{v_i} = \frac{-25(1 + 2\alpha - 2\alpha^2)}{\alpha}$$

a) $v_i = 40\,mV$ $\alpha = 0.2$ $v_o = -6.6\,V$

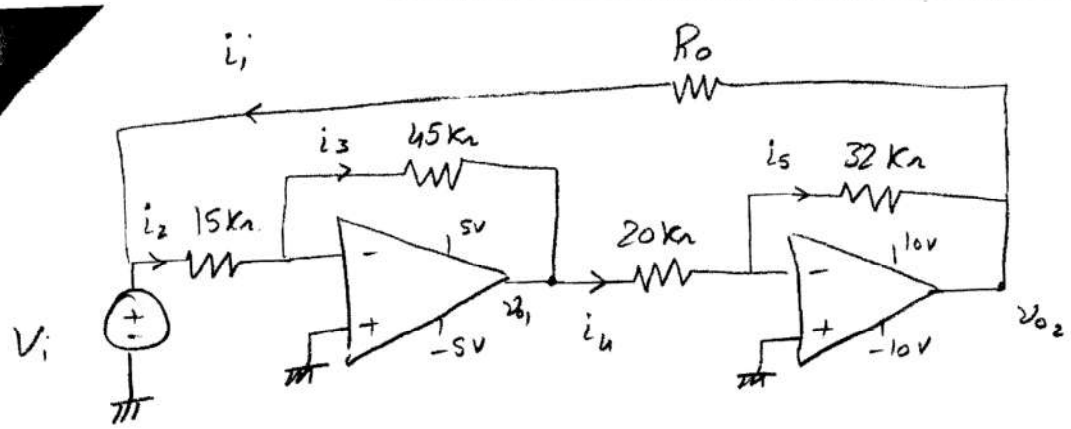
$\alpha = 1.0$ $v_o = -1\,V$ (3)

$$-6.6 \le v_o \le -1$$

b) $v_o = -7\,V$ $v_i = 40mV$ (4)

$$\frac{v_o}{v_i} = -175 = \frac{-25(1 + 2\alpha - 2\alpha^2)}{\alpha},$$

$$\alpha = 0.186$$



$$i_2 = i_3$$

$$\frac{v_{o1}}{v_i} = \frac{-45}{15} = -3 \quad (4)$$

$$i_4 = i_5$$

$$\frac{v_{o2}}{v_{o1}} = -\frac{32}{20} = -1.6$$

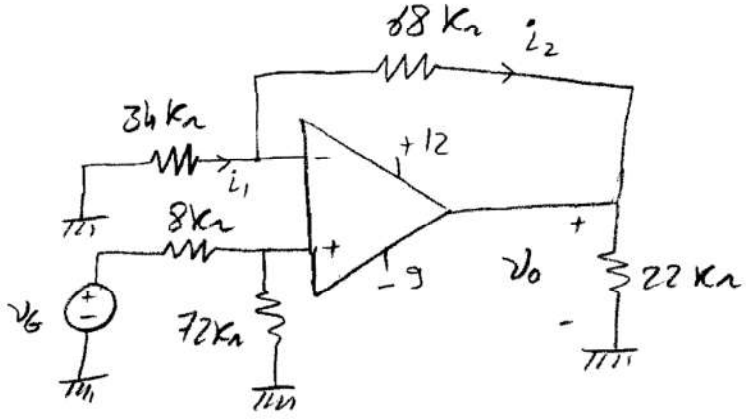
$$\frac{v_{o2}}{v_i} = \frac{v_{o1}}{v_i} \times \frac{v_{o2}}{v_{o1}} = 4.8$$

$$i_G = 0, \quad i_1 = i_2$$

$$\frac{v_{o2} - v_i}{R_o} = \frac{v_i}{15\,k\Omega} \qquad v_{o2} = 4.8\, v_i \quad (4)$$

$$\frac{v_i (4.8 - 1)}{R_o} = \frac{v_i}{15\,k\Omega}$$

$$\boxed{R_o = 57\,k\Omega} \quad (2)$$



$$v^+ = \frac{v_G \times 72k\Omega}{72k\Omega + 8k\Omega} = 0.9\,v_G$$

$$i_1 = i_2$$

$$\frac{0 - 0.9\,v_G}{34\,k\Omega} = \frac{0.9\,v_G - v_o}{68\,k\Omega}$$

$$0.9\,v_G\left(\frac{1}{68\,k\Omega} + \frac{1}{34k\Omega}\right) = \frac{v_o}{68\,k\Omega}$$

$$\boxed{\frac{v_o}{v_G} = 2.7}$$

$v_G = 3V$ $\quad \boxed{v_o = 8.1\,V}$ (4)

$-9V \le v_o \le +12\,V$

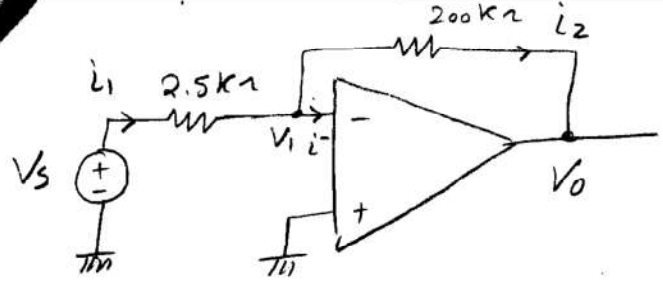
$-9\,V \le 2.7\,v_G \le +12V$

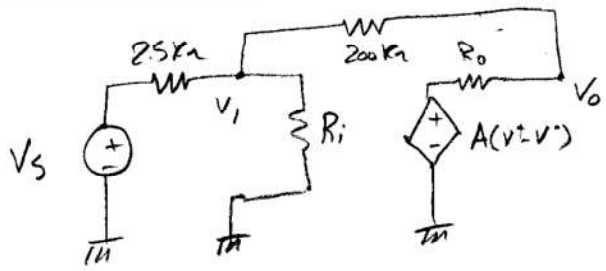
$$\boxed{\frac{-10}{3}V \le v_G \le +\frac{40}{9}V} \quad (3)$$

$V_G = 2V$, $\quad v_o = 12V$ $\quad \frac{v_o}{v_G} = 6$

$$6 = 0.9 + \frac{(0.9)(68\,k\Omega)}{R}$$

$\boxed{R = 12\,k\Omega}$ (3)





$$i_1 = i^- + i_2$$

$$\frac{V_S - V_1}{2.5k\Omega} = \frac{V_1}{400k\Omega} + \frac{V_1 - V_O}{200k\Omega}$$

$$\frac{V_S}{2.5k\Omega} = V_1\left(\frac{1}{2.5k\Omega} + \frac{1}{400k\Omega} + \frac{1}{200k\Omega}\right) - \frac{V_O}{200k\Omega}$$

$$V_S = V_1\left(\frac{163}{160}\right) - \frac{V_O}{80}$$

$$V_O = -AV_1 + i_2(4k\Omega)$$

$$V_O = -2\times10^5 V_1 + \frac{V_1 - V_O}{50}$$

$$V_1\left(-2\times10^5 + \frac{1}{50}\right) = V_O\left(1 + \frac{1}{50}\right)$$

$$V_1 = \frac{V_O\left(1 + 1/50\right)}{\left(1/50 - 2\times10^5\right)} \simeq -5.1\times10^{-6}\, V_O$$

$$V_S = -5.1\times10^{-6}\left(\frac{163}{160}\right)V_O - \frac{V_O}{80}$$

a) $\boxed{\frac{V_O}{V_S} = -79.9667 \simeq -80}$ (2.5)

b) $$V_O = \frac{\left(1/50 - 2\times10^5\right)}{\left(1 + 1/50\right)} V_1 = -196078.4\, V_1$$

$$V_S = V_1\left(\frac{163}{160} + \frac{196078.4}{80}\right), \quad V_S = 1V$$

$\boxed{V_1 = 407.8\ \mu V}$ (2.5) (2.5)

c) $R_{in} = \frac{V_S}{i_1}$, $i_1 = \frac{V_S - V_1}{2.5k\Omega} = 3.998\times10^{-4} A$, $\boxed{R_{in} = 2501\ \Omega}$

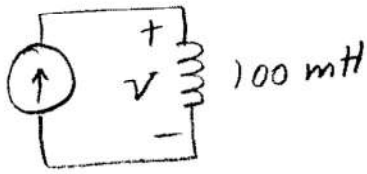
$\frac{V_o}{V_s} = -\frac{200}{2.5} = -80$

$V^- = V^+ \;,\quad V_1 = 0$

$i_1 = \frac{V_s - 0}{2.5\,k\Omega}$

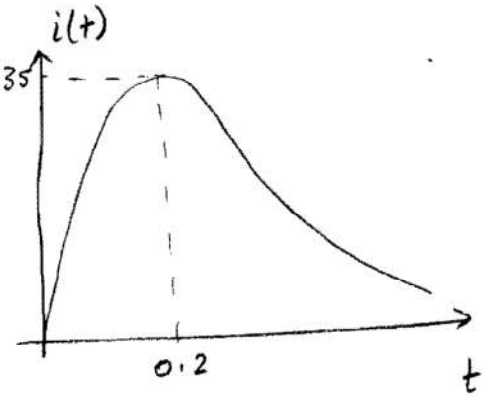
$R_{in} = \frac{V_s}{i_1} = 2.5\ k\Omega$ (2.5)

5)



$i(t) = \begin{cases} 10\,te^{-5t} & , t \geq 0 \\ 0 & , t < 0 \end{cases}$

a)



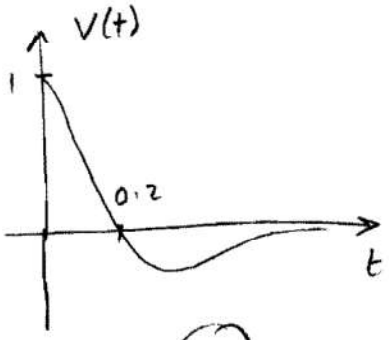
(2)

b) $\frac{di(t)}{dt} = -50\,te^{-5t} + 10\,e^{-5t} = 0$

$50t = 10 \;,\quad \boxed{t = 0.2\ \text{Sec}}$ (2)

c) $\boxed{V(t) = L\frac{di(t)}{dt} = e^{-5t} - 5te^{-5t}}$ (1)

d)



(2)

e) No (1)

f) $t = 0.2$ Sec (1)

g) Yes at $t = 0$ (1)

$$V(t) = \begin{cases} 0 & t \le 0 \\ 4t & 0 \le t \le 1 \\ 4e^{-(t-1)} & 1 \le t \le \infty \end{cases}$$

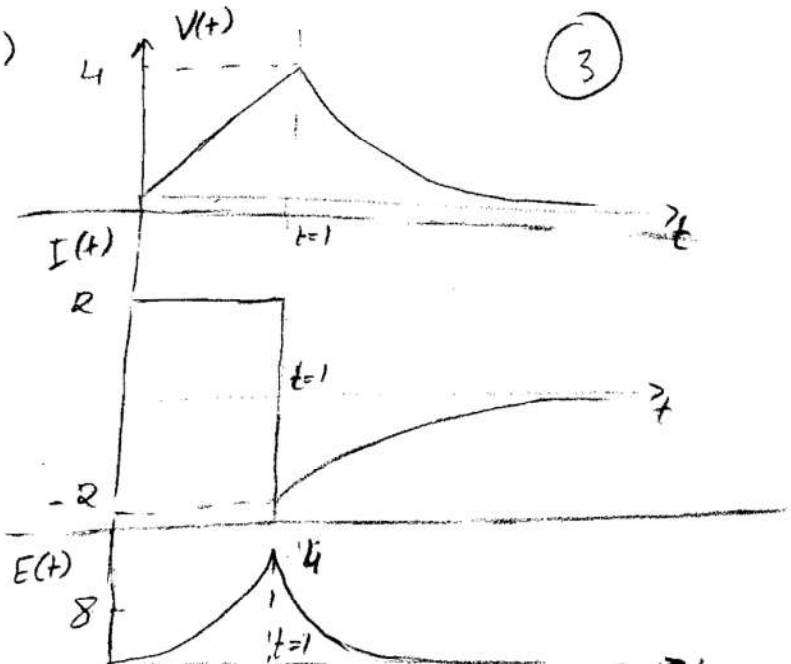
a) $I(t) = C \dfrac{dV(t)}{dt}$

$$I(t) = \begin{cases} 0 & t \le 0 \\ 2 & 0 \le t \le 1 \\ -2e^{-(t-1)} & \end{cases} \quad \mu A \qquad (3)$$

$$p(t) = I(t)\,V(t) = \begin{cases} 0 & t \le 0 \\ 8t & 0 \le t \le 1 \\ -8e^{-2(t-1)} & 1 \le t \le \infty \end{cases} \quad \mu W \qquad (3)$$

$$E(t) = \tfrac{1}{2} C V^2(t) = \begin{cases} 0 & t \le 0 \\ 4t^2 & 0 \le t \le 1 \\ 4e^{-2(t-1)} & 1 \le t \le \infty \end{cases} \quad \mu J \qquad (3)$$

b) (3)



c) $0 \le t \le 1$ (1)

d) $\int_0^1 8t\,dt = 4\ \mu J$ (2)

$\int_1^\infty -8e^{-2(t-1)}\,dt = -4\ \mu J$

Energy Stored = Energy delivered