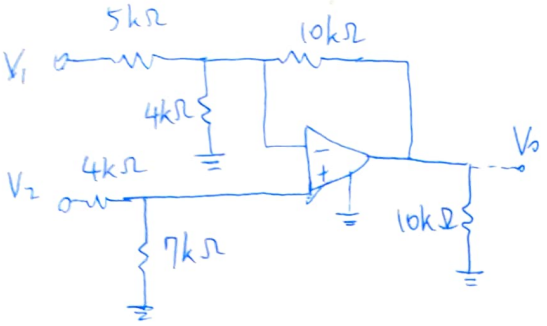
1.




(a) $V_o = V_{o1} + V_{o2}$

$V_{o1} = V_1 \times \left(-\frac{10}{5}\right) + 0 \times \left(\frac{-10}{4}\right) = -2V_1$

$V_{o2} = V_2 \times \frac{7}{4+7} \times \left(1 + \frac{10}{5//4}\right) = \frac{7}{2} V_2$

$V_o = -2V_1 + 3.5V_2$ #

(b) $V_1 = V_2 = 4\ V$

$V_o = -2 \times 4 + 3.5 \times 4 = 6\ V$ #

(c) $V_2 = 2V$

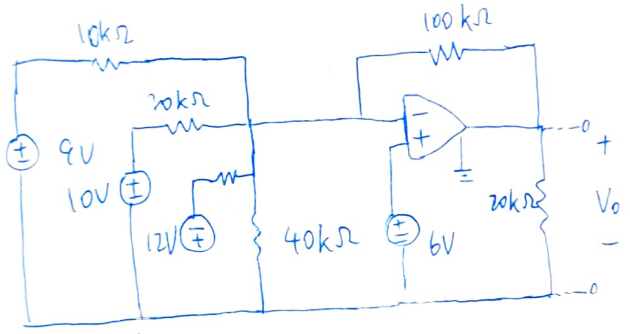
$\Rightarrow V_2 = -2V_1 + 7$

$15 \le V_o \le 15$

$-15 \le -2V_1 + 7 \le 15$

$-4 \le V_1 \le 11\ (V)$ #

2.




$V^+ = V^- = 6\ V$

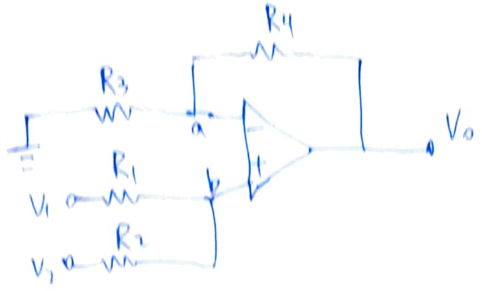
$\Rightarrow \frac{6-9}{10k} + \frac{6-10}{20k} + \frac{6+12}{30k} + \frac{6}{40k} + \frac{6-V_o}{100k} = 0$

$\times 1k$

$\Rightarrow -0.3 - 0.2 + 0.6 + 0.15 + 0.06 = 0.01\ V_o$

$V_o = 31\ V$ #

3.

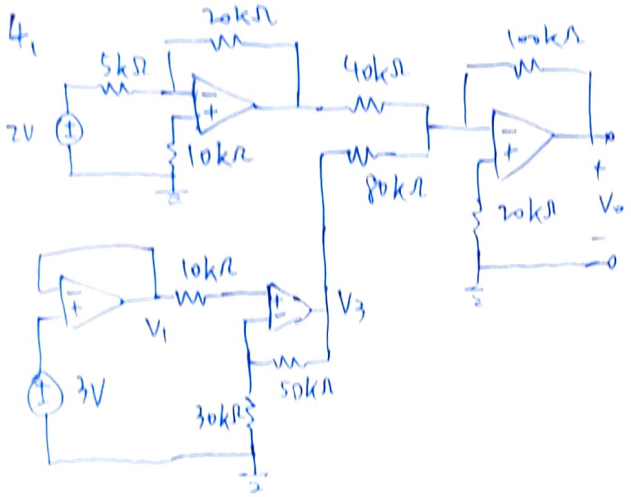



$$V_a = V^+ = V^- = V_b = \frac{1}{(R_1+R_2)}(V_1 \times R_2 + V_2 \times R_1)$$

$$V_o = \left(1 + \frac{R_4}{R_3}\right) \times V_b = \left(1 + \frac{R_4}{R_3}\right) \times \left(\frac{V_1 R_2 + V_2 R_1}{R_1 + R_2}\right)$$

$$= \frac{R_3 + R_4}{R_3 (R_1 + R_2)} (R_2 V_1 + R_1 V_2)$$

4.




$$V_1 = 3V$$

$$V_2 = 2 \times \left(-\frac{20k}{5k}\right) = -8V$$

$$V_3 = V_1 \times \left(1 + \frac{50k}{30k}\right) = 3 \times \frac{8}{3} = 8V$$

$$V_o = \left(-\frac{100}{40}\right) V_2 + \left(-\frac{100}{80}\right) V_3 = 20 - 10 = 10\ V$$

5.

(a) $t = 1.7\,ms$

$$W = \frac{1}{2} \cdot L \cdot I^2$$

$$= \frac{1}{2} \cdot 0.5 \cdot (6.5\,m)^2$$

$$= 10.5625\,mJ$$

(b) $t = 4.2\,ms$

$$W = \frac{1}{2} \cdot 0.5 \cdot (-9\,m)^2$$

$$= 20.25\,mJ$$

(c) $t = 1.2\,ms$

$$P = VI$$

$$= 0.5 \cdot \left(\frac{5-10}{1\,m}\right) \cdot 1\,m \cdot 9\,m$$

$$= -22.5\,mW$$

(c) $t = 2.8$ ms

$$P = 0.5 \cdot \left(\frac{5-5}{1m}\right) \cdot 1m \cdot 5m$$

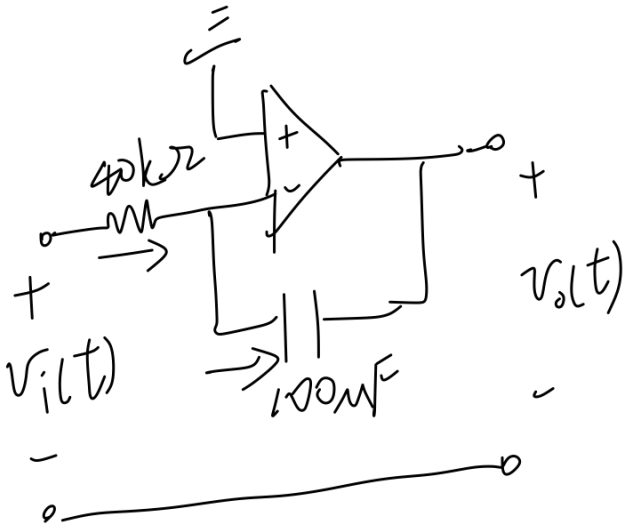
$$= 0 \text{ W}$$

$t = 5.3$ ms

$$P = 0.5 \cdot \left(\frac{0-(-10)}{2m}\right) \cdot 1m \cdot (-3.5m)$$

$$= -8.75 \text{ mW}$$

6.




$$I_{40k\Omega} = I_{100\mu F}$$

$$\frac{v_i(t)}{R} = C\frac{dv}{dt} \Rightarrow \frac{v_i(t)}{40k} = 100\mu \frac{d(-v_o(t))}{dt}$$

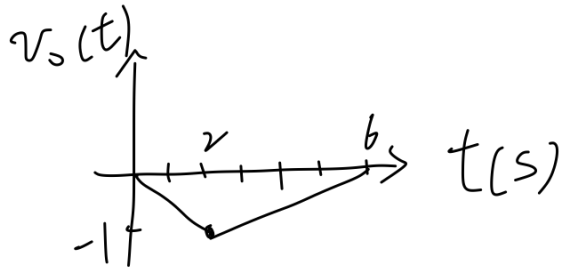
$$\Rightarrow d\,v_o(t) = -\frac{1}{4}\,v_i(t)\,dt$$

$$\Rightarrow v_o(t) = -\frac{1}{4}\int v_i(t)\,dt$$

$$v_o(2) = \frac{1}{4}\int_0^2 v_i(2)\,dt = -\frac{1}{4}\times 2\times(2-0) + v_o(0)$$

$$= -1 \quad (V)$$

$$v_o(6) = -\frac{1}{4}\int_2^6 -1\,dt = -\frac{1}{4}\times -1\times(6-2) + v_o(2) = 0\ (V)$$



7. $\frac{v_{s1}(t)}{20k} + \frac{v_{s2}(t)}{10k} = 1\mu \frac{d(-v_o(t))}{dt}$

$\Rightarrow dv_o(t) = -\left[\frac{v_{s1}(t)}{20m} + \frac{v_{s2}(t)}{10m}\right] dt$

$\Rightarrow v_o(t) = -\left(\int \frac{v_{s1}(t)}{20m}\, dt + \int \frac{v_{s2}(t)}{10m}\, dt\right)$

$= -\frac{8000}{324} \sin 324t$

$= -24.69 \sin 324t \ V$