$$R = \frac{1}{wc} \rightarrow R = 20K\Omega,$$

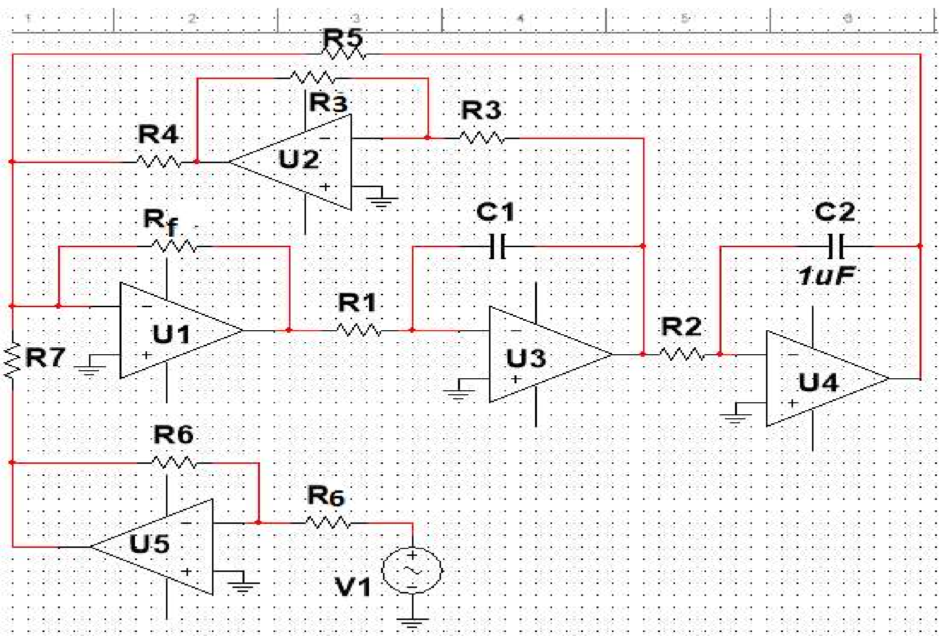
$$5 = \frac{Rf}{R1} let\ Rf = 20K\Omega \rightarrow R1 = 4K\Omega$$

Q5/: Design electronic circuit to solve the following Differential equation

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dx} + 5y = 2sinwt \ \ where\ , y(0) = 1volt\ and\ \frac{dy}{dx}(0) = 0.5volt$$

مبدأ الحل: أخلي المعادلة بدلاله اعلى مشتقه

$$\frac{d^2y}{dt^2} = -4\frac{dy}{dx} - 5y + 2sinwt$$



$$\frac{1}{R1C1} = 1 \rightarrow let\ C1 = 10\mu F \rightarrow R1 = 100K\Omega$$

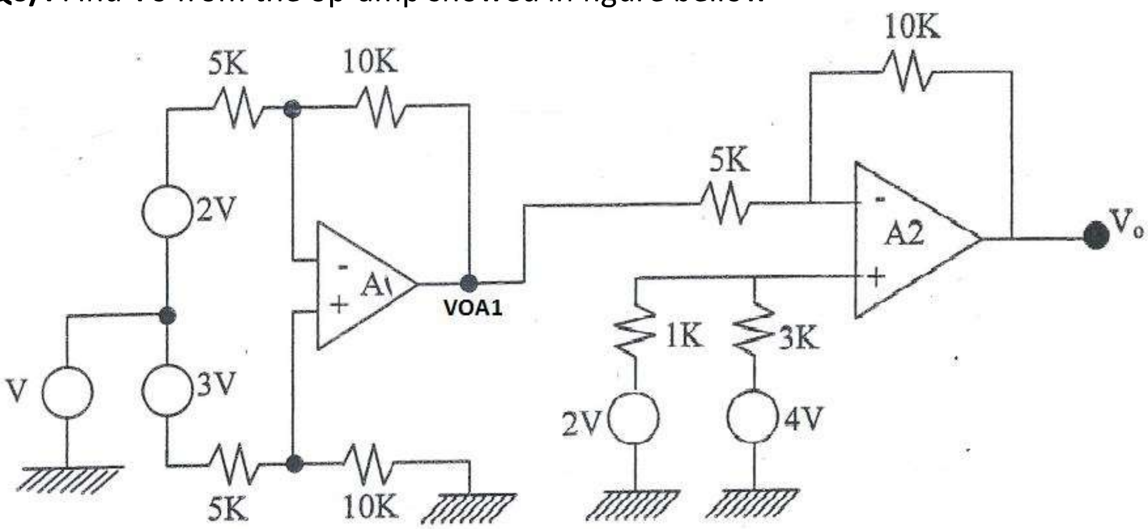
$$\frac{1}{R2C2} = 1 \rightarrow let\ C2 = 10\mu F \rightarrow R2 = 100K\Omega$$

Let R3= 100KΩ, Let R6= 100KΩ

$$\frac{Rf}{R4} = 4 \rightarrow let\ R5 = 20K\Omega$$

$$\frac{Rf}{R7} = 2 \rightarrow let\ R7 = 50K\Omega$$

Q6/: Find Vo from the op-amp showed in figure bellow



1- Differential op-amp

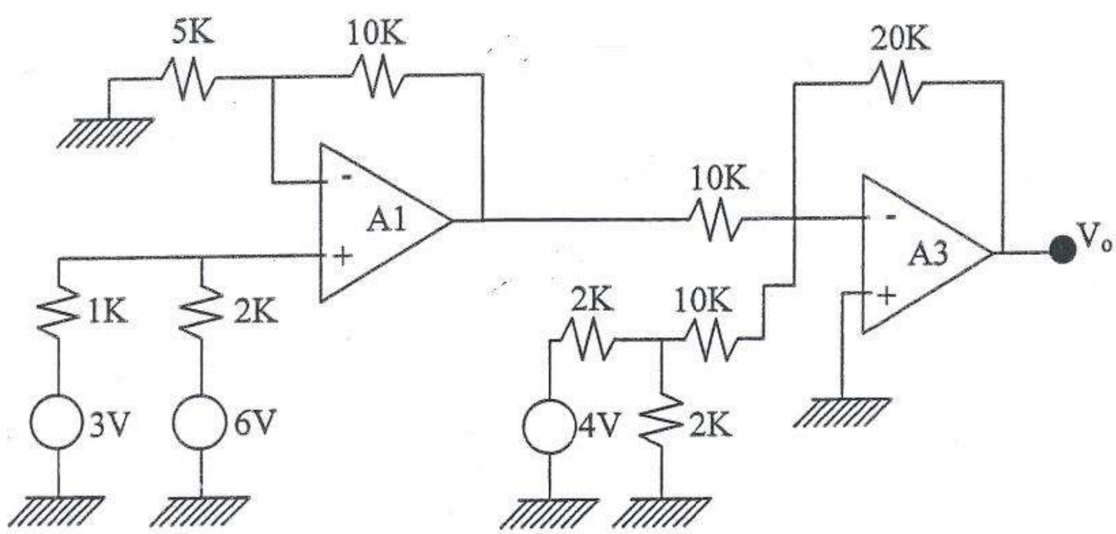
$$v_o = (v_2 - v_1) \times \frac{Rf}{R1} \rightarrow \; = (3-2) \times \frac{10}{5} = 2volt$$

$v_2 = \left(2 \times \frac{3}{4} + 4 \times \frac{1}{4}\right) = \frac{5}{2} volt$ $\qquad (super\ position)$

2- Subtractor

$$v_o = \left(1 + \frac{Rf}{R1}\right) v_2 - \frac{Rf}{R1} v_1 \; \rightarrow \; = \left(1 + \frac{10}{5}\right) v_2 - \frac{10}{5} \times 2 = 3.5volt$$

Q6/: Find Vo from the op-amp showed in figure bellow



1- Adder

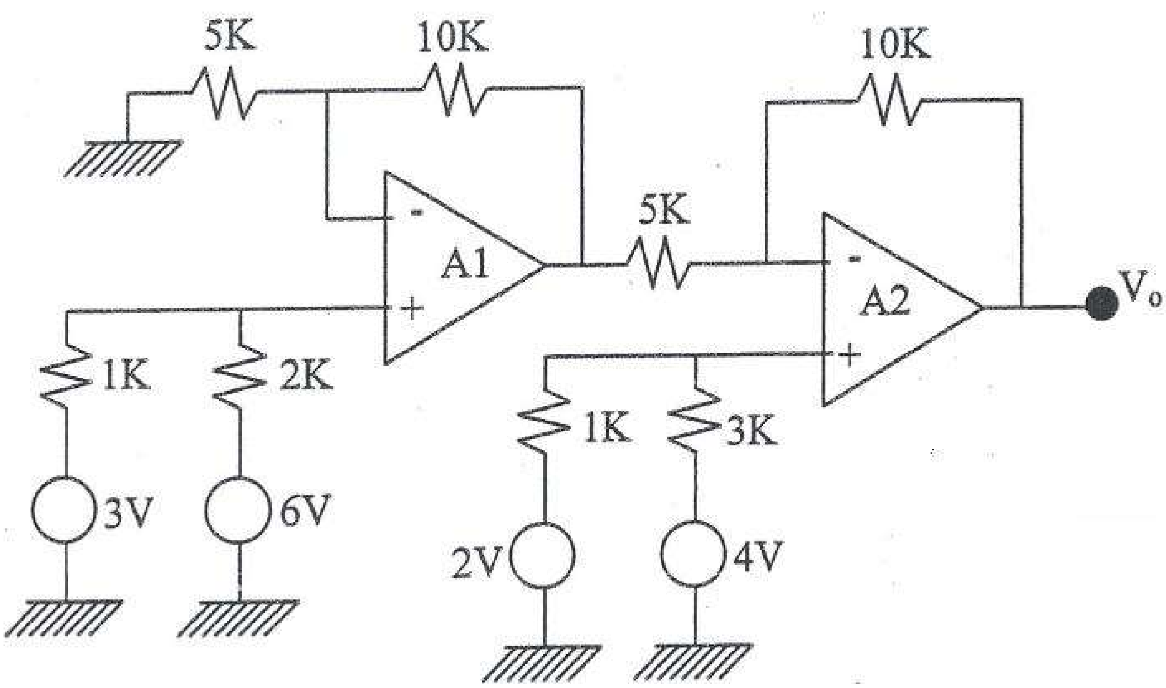
$$v_{oA1} = \frac{RA \times VB + RB \times VA}{RA + RB}\left(1 + \frac{Rf}{R1}\right) \rightarrow \ = \frac{3 \times 2 + 6 \times 1}{1 + 2}\left(1 + \frac{10}{5}\right) = 12volt$$

$$v_2 = \left(4 \times \frac{2}{4}\right) = 2\ volt \qquad (voltage\ divider)$$

2- Summing

$$v_o = -\left(\frac{Rf}{R1}v_1 + \frac{Rf}{R2}v_2\right) \rightarrow = -\left(\frac{20}{10} \times 12 + \frac{20}{10} \times 2\right) = \ -28\ volt$$

Q7/: Find Vo from the op-amp showed in figure bellow



1- Adder

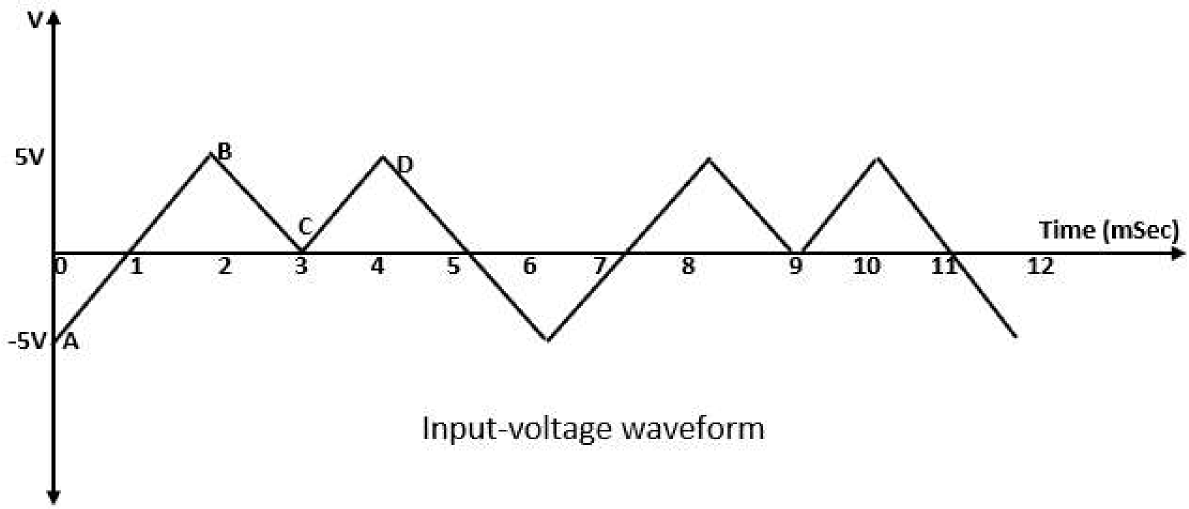
$$v_{oA1} = \frac{RA \times VB + RB \times VA}{RA + RB}\left(1 + \frac{Rf}{R1}\right) \rightarrow \ = \frac{3 \times 2 + 6 \times 1}{1 + 2}\left(1 + \frac{10}{5}\right) = 12volt$$

$$v_2 = \left(2 \times \frac{3}{4} + 4 \times \frac{1}{4}\right) = \frac{5}{2}volt \qquad (super\ position)$$

2- Subtractor

$$v_o = \left(1 + \frac{Rf}{R1}\right)v_2 - \frac{Rf}{R1}v_1 \ \rightarrow \ \ = \left(1 + \frac{10}{5}\right)2.5 - \frac{10}{5} \times 12 = -16.5volt$$

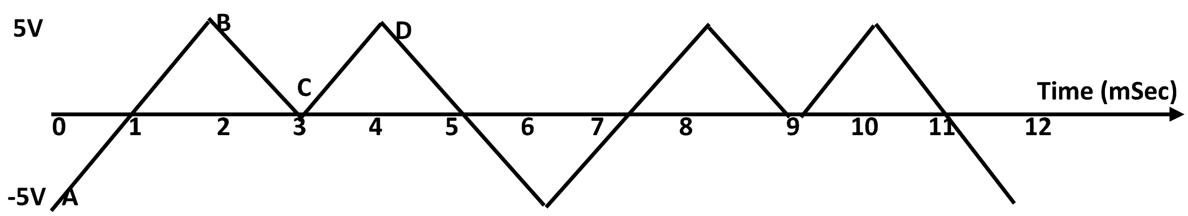
Q8/: For the differentiator; if $R_f = 10K\Omega$ and the value of the capacitor is 0.001µF, the input signal is given bellow. Find the output voltage waveform



Input-voltage waveform

$$(A) \qquad \frac{dv_1}{dt} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-(-5)}{2\times10^{-3}-0} = 5\times10^3 vse$$

$$c$$



Input-voltage waveform