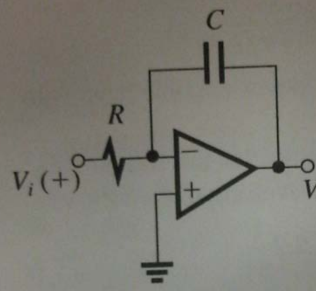
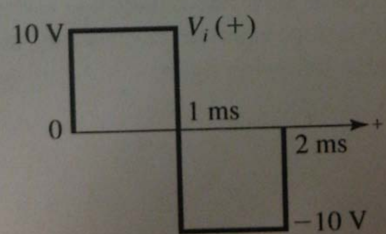
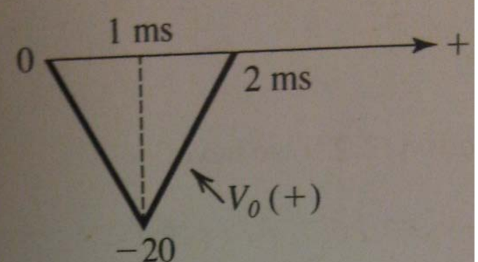
Ex: 2.27



$$V_o(+) = \frac{-1}{CR}\int_0^{+} V_i(+)dt$$

The waveforms for one period of the input and the output signals are shown below:





We have

$$-20 = \frac{-1}{CR}\int_0^{1\text{ ms}} 10\ dt$$

$$\Rightarrow -20 = \frac{-1}{CR} \times 10 \times 1\text{ ms}$$

$$CR = \frac{10}{20} \times 1\text{ ms} = 0.5\text{ ms}$$

2.2

Refer to fig P 2.2

$$v_+ = v_i \times \frac{1\ \text{K}}{1\ \text{K} + 1\ \text{M}} = v_i \frac{1}{1001}$$

$$v_o = Av_+ = Av_i \frac{1}{1001}$$

$$A = 1001 \frac{v_o}{v_i}$$

$$= 1001 \times \frac{4}{2}$$

$$A = 2002\ \text{V/V}$$

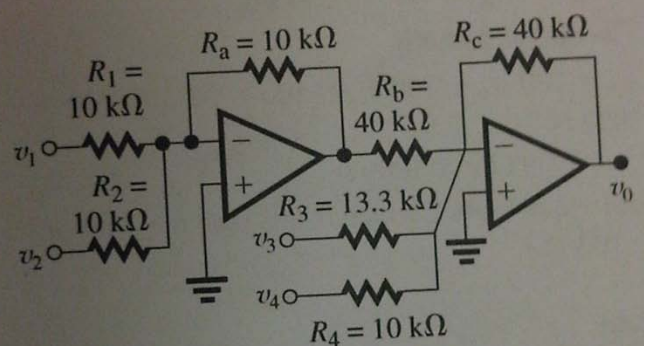
2.41

$v_o = v_1 + 2v_2 - 3v_3 - 4v_4$: Consider Fig. 2.11.
According to eq. 2.8 For a weighted summer circuit:

$$v_o = v_1 \frac{R_a R_c}{R_1 R_b} + v_2 \frac{R_a R_c}{R_2 R_3} - v_3 \frac{R_c}{R_3} - v_4 \frac{R_c}{R_4}$$

$$\frac{R_a}{R_1}\frac{R_c}{R_b} = 1,\ \frac{R_a}{R_2}\frac{R_c}{R_b} = 1,\ \frac{R_c}{R_3} = 3,\ \frac{R_c}{R_4} = 4$$

assume:



$$R_4 = 10\ \text{k}\Omega \Rightarrow R_c = 40\ \text{k}\Omega \Rightarrow R_3 = \frac{40}{3}$$

$$= 13.3\ \text{k}\Omega$$

$$\frac{R_a}{R_1} \times \frac{40}{R_b} = 1 \quad \frac{R_a}{R_2} \times \frac{40}{R_b} = 1$$

$$R_b = 40\ \text{k}\Omega, \qquad R_1 = R_2 = R_a = 10\ \text{k}\Omega$$

2.49

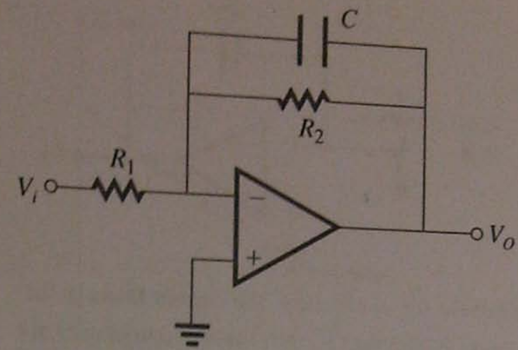
$$v_+ = v_I \frac{R_4}{R_3 + R_4} = v$$

$$\frac{v}{R_1} = \frac{v_o - v_-}{R_2} \Rightarrow v_o = v_-\left(1 + \frac{R_2}{R_1}\right)$$

From the two above equations:

$$\frac{v_o}{v_I} = \left(1 + \frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3 + R_4}\right) = \frac{1 + R_2/R_1}{1 + R_3/R_4}$$

2.86



Let $Z_2 = R_2 \parallel \frac{1}{SC}$ and $Z_1 = R_1$

$$\frac{v_o}{v_i} = -\frac{Z_2}{Z_1} = -\frac{Y_1}{Y_2} = -\frac{1/R_1}{\frac{1}{R_2} + SC}$$

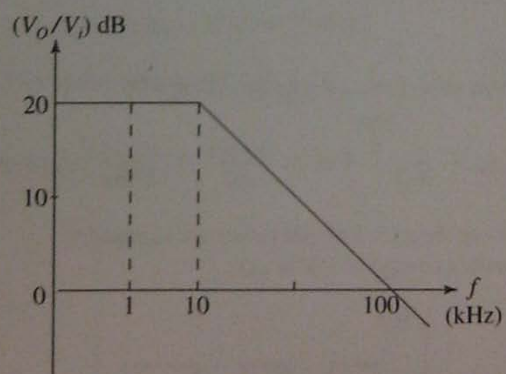
$$= -\frac{(R_2/R_1)}{1 + sCR_2}$$

This function is of a STC, low pass circuit having a dc gain of $-\frac{R_2}{R_1}$ and 3-dB frequency

$$\omega_o = \frac{1}{CR_2}$$

$R_{in} = R_1 = 10\ \text{k}\Omega$
dc gain = 20 dB = 10

$$\therefore 10 = \frac{R_2}{R_1} \Rightarrow R_2 = 10\ R_1 = 100\ \text{k}\Omega$$



3dB frequency at 10 kHz

$$\therefore \omega_o = 2\pi \times 10 \times 10^3 = \frac{1}{CR_2}$$

$$C = \frac{1}{2\pi \times 10 \times 10^3 \times 100\ \text{K}} = 0.5\ \text{nF}$$

Unity gain frequency at 100 kHz