

Q1

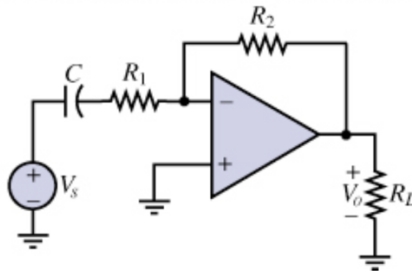


Fig P8.53

a) For the inverting amplifier,

$$\frac{V_o}{V_s} = -\frac{Z_2}{Z_1}$$

$$Z_2 = R_2$$

$$Z_1 = X_c + R_1 = R_1 + \frac{1}{j\omega C}$$

$$\frac{V_o}{V_s} = -\frac{R_2}{\frac{1+j\omega R_1 C}{j\omega C}} = -\frac{j\omega R_2 C}{1+j\omega R_1 C} = -\frac{j\omega R_2 C}{1+j\omega R_1 C} * \frac{\frac{1}{j\omega R_1 C}}{\frac{1}{j\omega R_1 C}} = \frac{-\frac{R_2}{R_1}}{1+\frac{1}{j\omega R_1 C}} = \frac{-A}{1+\frac{\omega_c}{j\omega}}$$

Therefore, we can realize that the system is a high-pass filter.

b) Consider the gain is equal to $A = \frac{R_2}{R_1} = -\frac{8.2k}{1.8k} = \frac{41}{9}$, Gain in dB = $20\log(A) = 13.17$ c) For the cutoff frequency ω_c , we know $\frac{\omega_c}{j\omega} = \frac{1}{j\omega R_1 C}$ and $\omega_c = \frac{1}{R_1 C} = \frac{1}{1.8k * 1\mu} = 555.55 \text{ rad/s}$

Q2

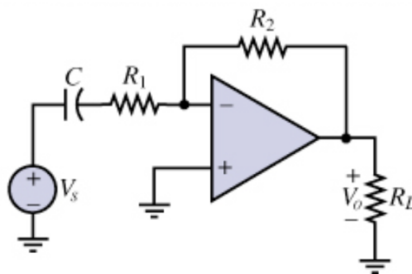


Fig P8.53

a) The circuit is the same as question 1. Hence, it is still a high-pass filter.

b) Consider the gain is equal to $A = \frac{R_2}{R_1} = \frac{220k}{10k} = 22$, Gain in dB = $20\log(A) = 26.84$ c) For the cutoff frequency ω_c , we know $\frac{\omega_c}{j\omega} = \frac{1}{j\omega R_1 C}$ and $\omega_c = \frac{1}{R_1 C} = \frac{1}{10k * 100p} = 1 \text{ M rad/s}$

Q3

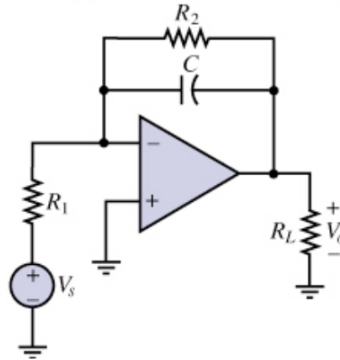


Fig P8.57

a) For the inverting amplifier,

$$\frac{V_o}{V_s} = -\frac{Z_2}{Z_1}$$

$$Z_2 = R_2 \parallel X_C = \frac{R_2 \cdot \frac{1}{j\omega C}}{R_2 + \frac{1}{j\omega C}} = \frac{\frac{R_2}{j\omega C}}{\frac{j\omega R_2 C + 1}{j\omega C}} = \frac{R_2}{1 + j\omega R_2 C}$$

$$Z_1 = R_1$$

$$\frac{V_o}{V_s} = -\frac{\frac{R_2}{1 + j\omega R_2 C}}{R_1} = \frac{-\frac{R_2}{R_1}}{1 + j\omega R_2 C} = \frac{-A}{1 + \frac{j\omega}{\omega_c}}$$

Therefore, we can realize that the system is a low-pass filter.

b) Consider the gain is equal to $A = \frac{R_2}{R_1} = \frac{22k}{9.1k}$, Gain in dB = $20\log(A) = 7.667$

c) For the cutoff frequency ω_c , we know $\frac{j\omega}{\omega_c} = j\omega R_2 C$ and $\omega_c = \frac{1}{R_2 C} = \frac{1}{22k \cdot 0.47\mu} = 96.7 \text{ rad/s}$

Q4

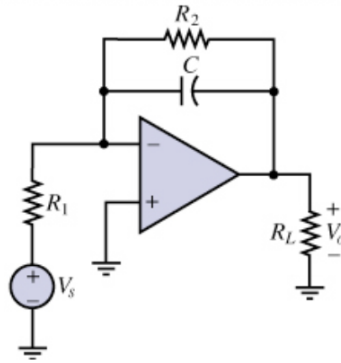


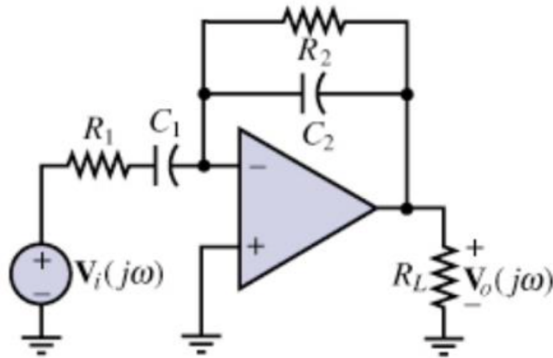
Fig P8.57

a) The circuit is same as question 1. Hence, it is still a high-pass filter.

b) Consider the gain is equal to $A = \frac{R_2}{R_1} = \frac{68k}{2.2k}$, Gain in dB = $20\log(A) = 29.8$

c) For the cutoff frequency ω_c , we know $\frac{j\omega}{\omega_c} = j\omega R_2 C$ and $\omega_c = \frac{1}{R_2 C} = \frac{1}{68k \cdot 0.47\mu} = 31.29k\text{rad/s}$

Q5



a) For the inverting amplifier,

$$\frac{V_o}{V_s} = -\frac{Z_2}{Z_1}$$

$$Z_2 = \frac{R_2}{1 + j\omega R_2 C}$$

$$Z_1 = \frac{1 + j\omega R_1 C}{j\omega C}$$

$$\frac{V_o}{V_s} = \frac{R_2}{1 + j\omega R_2 C} * \frac{j\omega C_1}{1 + j\omega R_1 C_1} = \frac{R_2}{1 + j\omega R_2 C} * \frac{j\omega C_1}{1 + j\omega R_1 C_1} * \frac{\frac{1}{1 + j\omega R_1 C_1}}{\frac{1}{1 + j\omega R_1 C_1}} = \frac{R_2}{1 + j\omega R_2 C} * \frac{\frac{1}{R_1}}{1 + \frac{1}{j\omega R_1 C_1}}$$

b) Consider the gain is equal to $A = \frac{R_2}{R_1} = \frac{10}{10}$, Gain = 1c) Resonant frequency = $\sqrt{\frac{1}{R_1 C_1 R_2 C_2}} = 1000 \text{ rad/s}$