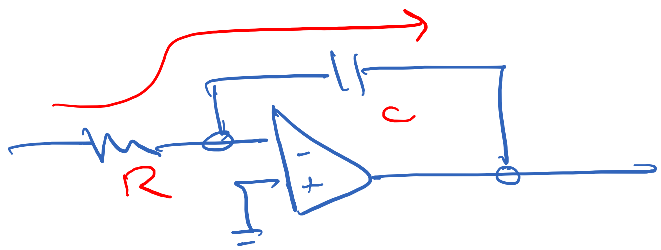
PS 3 Solutions

1

A.



$$I = \frac{V_{in}}{R}$$

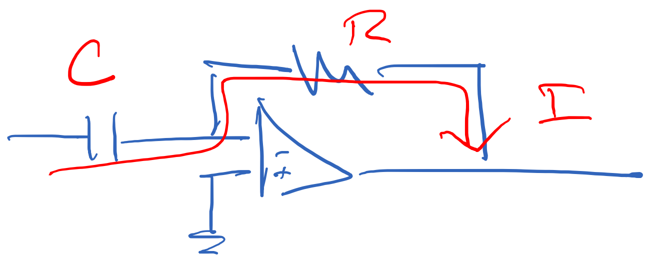
$$V_{out} = -\frac{1}{C}\int I\,dt$$

$$V_{out} = -\frac{1}{RC}\int V_{in}\,dt$$

B. $V_{in} = V_0 e^{j\omega t}$

$$\frac{V_{out}}{V_{in}} = -\frac{\frac{1}{j\omega C}}{R} \quad ; \quad V_{out} = \frac{j}{\omega RC} V_0 e^{j\omega t}$$

②



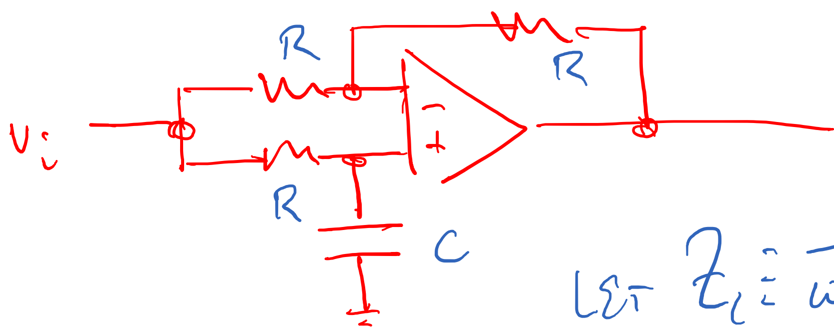
A. $I = C\frac{dV_{in}}{dt}$; $V_{out} = -RC\frac{dV_{in}}{dt}$

B. $V_{in} = V_0 e^{j\omega t}$

$$\frac{V_{out}}{V_{in}} = \frac{-R}{\frac{1}{j\omega C}} = -j\omega RC$$

$$V_{out}(\omega) = -j\omega RC\, V_0 e^{j\omega t}$$

③



Let $Z_c = \frac{1}{\omega C}$

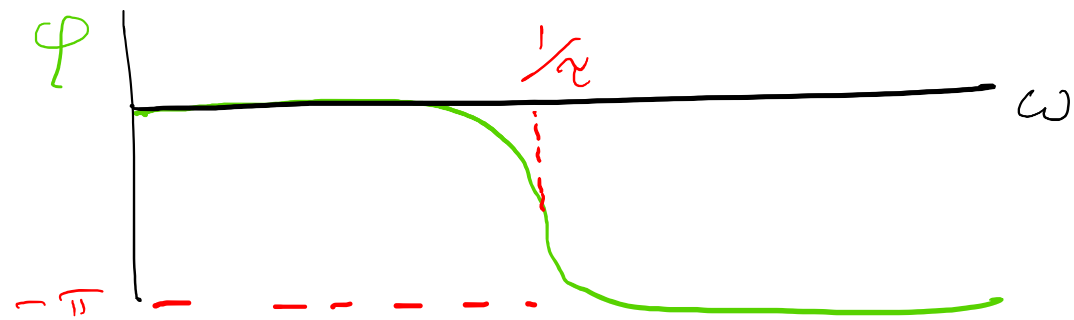
$$v_+ = \frac{-jZ_c}{R - jZ_c} v_i = v_-$$

$$I_{in} = \frac{v_{in}}{R}\left[1 + \frac{jZ_c}{R - jZ_c}\right] = \frac{v_{in}}{R - jZ_c}$$

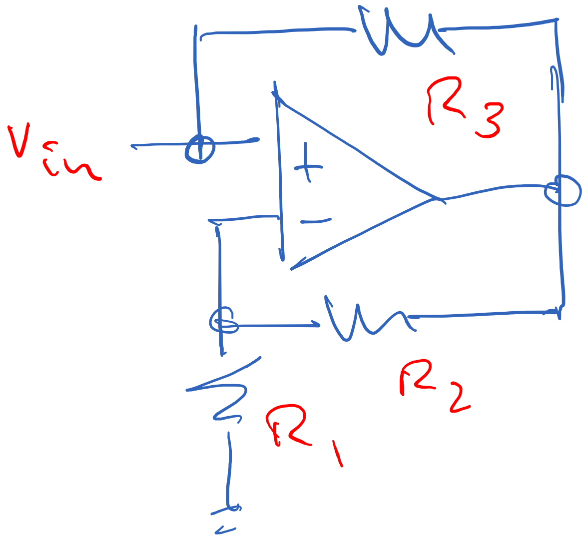
$$v_{out} = v_- - I_{in}R = -\frac{R + jZ_c}{R - jZ_c} v_{in}$$

$$V_o = \frac{1 - j\omega\tau}{1 + j\omega\tau} v_i$$

$\tau = RC$



(4)



$$V_- = V_{in}$$

$$V_{out} = V_{in}\left[1 + \frac{R_2}{R_1}\right]$$

$$I_{in} = (V_{in} - V_{out})/R_3 = -\frac{R_2}{R_1 R_3} V_{in}$$

$$R_{in} = \frac{V_{in}}{I_{in}} = -\frac{R_1 R_3}{R_2}$$

NEGATIVE IMPEDANCE CONVERTER.