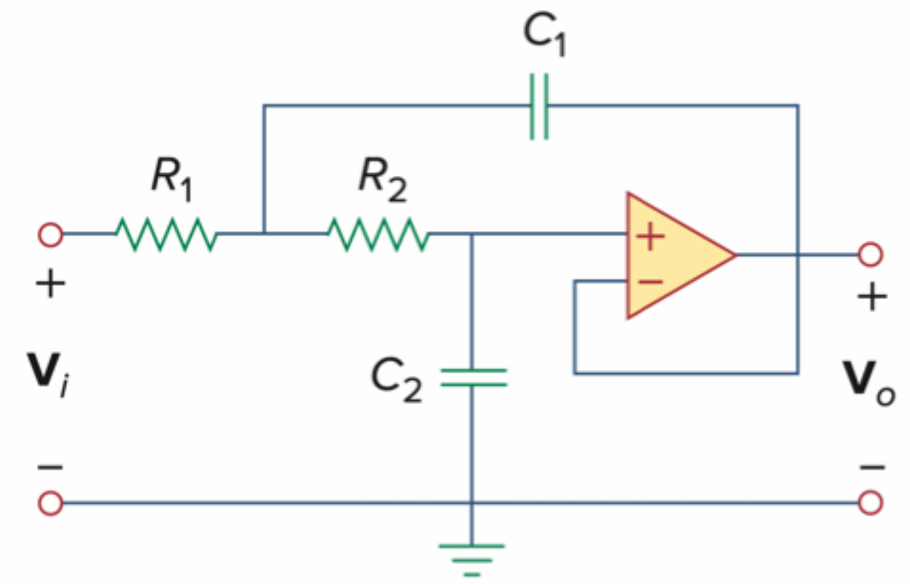
Q. What type of filter is shown below?




A. Solving the KCL/KVL equations,

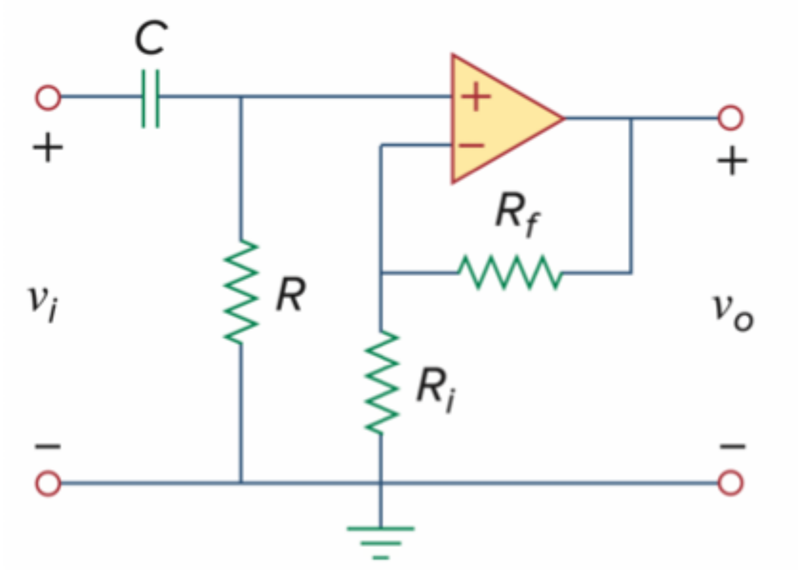
$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{\frac{1}{R_1}\cdot\frac{1}{R_2}}{\frac{1}{R_1}\cdot\frac{1}{R_2} + sC_2\left(\frac{1}{R_1}+\frac{1}{R_2}+sC_1\right)}$$

$$\Rightarrow \quad H(s) = \frac{1}{1 + sC_2\left(R_1 + R_2 + sR_1R_2C_1\right)}$$

$H(0) = 1$ and $H(\infty) = 0$

Hence, this is a low-pass filter.

Q. What type of filter is shown below?




A. Solving the KCL/KVL equations,

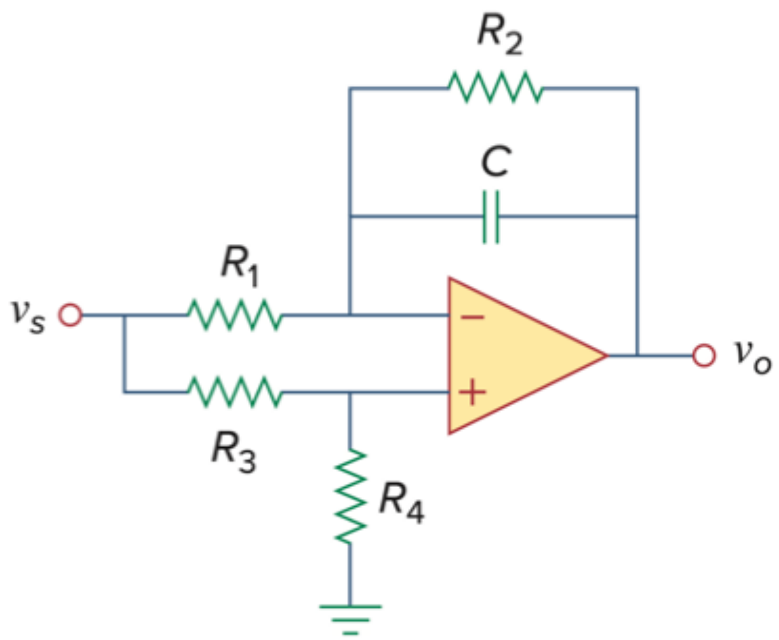
$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{\dfrac{sRC}{1+sRC}}{\dfrac{R_i}{R_i+R_f}}$$

$$\Rightarrow \quad H(s) = \left(1 + \frac{R_f}{R_i}\right) \cdot \left(\frac{sRC}{1+sRC}\right)$$

$$H(0) = 0 \quad \text{and} \quad H(\infty) = 1 + \frac{R_f}{R_i}$$

Hence, this is a high-pass filter.

Q. What type of filter is shown below?




A. Solving the KCL/KVL equations,

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{R_4}{R_3+R_4}\left(\frac{s + \dfrac{R_1R_4 - R_2R_3}{R_1R_2R_4C}}{s + \dfrac{1}{R_2C}}\right)$$

$$\Rightarrow \quad H(s) = \frac{R_4}{R_3+R_4} \cdot \frac{s + \dfrac{1}{R_1C}\left(\dfrac{R_1}{R_2} - \dfrac{R_3}{R_4}\right)}{s + \dfrac{1}{R_2C}}$$

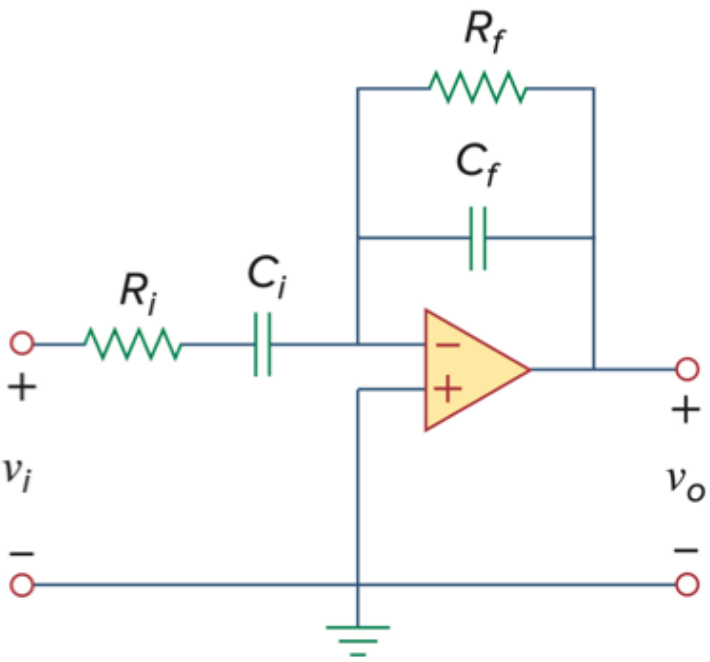
This circuit can be used as both LPF & HPF.

For LPF : Choose $R_3 \to \infty \Rightarrow H(s) = \dfrac{-\dfrac{1}{R_1C}}{s + \dfrac{1}{R_2C}}$

For HPF :

Choose $R_1R_4 = R_2R_3 \Rightarrow H(s) = \dfrac{R_4}{R_3+R_4} \cdot \dfrac{s}{s + \dfrac{1}{R_2C}}$

Q. What type of filter is shown below?




A. Solving the KCL/KVL equations,

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{\dfrac{-R_f}{1 + sR_fC_f}}{\dfrac{1 + sR_iC_i}{sC_i}}$$

$$\Rightarrow \quad H(s) = \frac{-R_fC_is}{(1 + sR_fC_f)(1 + sR_iC_i)}$$

$$H(0) = H(\infty) = 0$$

Hence, this is a band-pass filter.