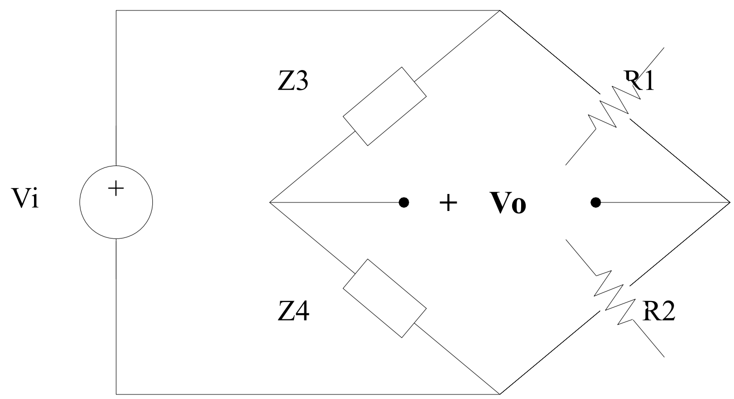
Chapter 10, Solution 90.

Let
$$Z_4 = R \| \frac{1}{j\omega C} = \frac{R}{1 + j\omega RC}$$
$$Z_3 = R + \frac{1}{j\omega C} = \frac{1 + j\omega RC}{j\omega C}$$

Consider the circuit shown below.



$$V_o = \frac{Z_4}{Z_3 + Z_4} V_i - \frac{R_2}{R_1 + R_2} V_i$$

$$\frac{V_o}{V_i} = \frac{\dfrac{R}{1 + j\omega C}}{\dfrac{R}{1 + j\omega C} + \dfrac{1 + j\omega RC}{j\omega C}} - \frac{R_2}{R_1 + R_2}$$

$$= \frac{j\omega RC}{j\omega RC + (1 + j\omega RC)^2} - \frac{R_2}{R_1 + R_2}$$

$$\frac{V_o}{V_i} = \frac{j\omega RC}{1 - \omega^2 R^2 C^2 + j3\omega RC} - \frac{R_2}{R_1 + R_2}$$

For V_o and V_i to be in phase, $\dfrac{V_o}{V_i}$ must be purely real. This happens when
$$1 - \omega^2 R^2 C^2 = 0$$
$$\omega = \frac{1}{RC} = 2\pi f$$

or
$$f = \frac{1}{2\pi RC}$$

At this frequency,

$$A_v = \frac{V_o}{V_i} = \frac{1}{3} - \frac{R_2}{R_1 + R_2}$$