

GATE 2022 -AE 63

EE23BTECH11057 - Shakunaveti Sai Sri Ram Varun

Question: For the circuit shown, the locus of the impedance $Z(j\omega)$ is plotted as ω increases from zero to infinity. The values of R_1 and R_2 are:

- (A) $R_1 = 2 \text{ k}\Omega, R_2 = 3 \text{ k}\Omega$
 (B) $R_1 = 5 \text{ k}\Omega, R_2 = 2 \text{ k}\Omega$
 (C) $R_1 = 5 \text{ k}\Omega, R_2 = 2.5 \text{ k}\Omega$
 (D) $R_1 = 2 \text{ k}\Omega, R_2 = 5 \text{ k}\Omega$

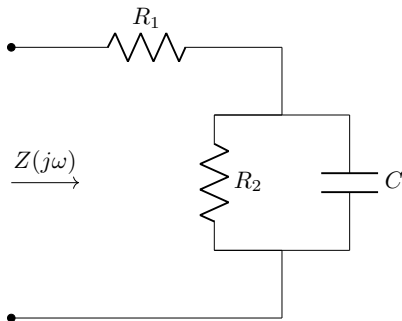


Fig. 1. Figure of circuit

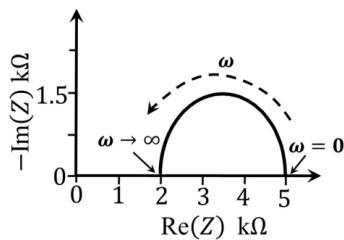


Fig. 2.

(GATE ECE 2022 QUESTION 38)

Solution:

In ω domain (i.e. after Laplace transform) Fig. 1

Parameter	Description	Value
$Z(j\omega)$	Impedance of circuit	?
R_1	Resistor 1	?
R_1	Resistor 2	?
C	Capacitor	?
ω	angular frequency of input voltage	ω

TABLE I
INPUT VALUES

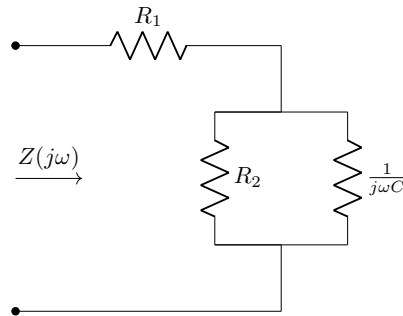


Fig. 3.

the circuit in ω domain is:

$$Z(j\omega) = R_1 + \frac{1}{\frac{1}{R_2} + j\omega C} \quad (1)$$

From Fig. 2, $Z(j\omega) = 2$ as $\omega \rightarrow \infty$ and $Z(j\omega) = 5$ as $\omega \rightarrow 0$

$$2 = R_1 + \frac{1}{\frac{1}{R_2} + j\infty} \quad (2)$$

$$\Rightarrow 2\Omega = R_1 \quad (3)$$

$$5 = R_1 + \frac{1}{\frac{1}{R_2} + 0} \quad (4)$$

$$\Rightarrow 3\Omega = R_2 \quad (5)$$

Hence, option (A) is correct.

can be represented as Fig. 3 So, the impedance for