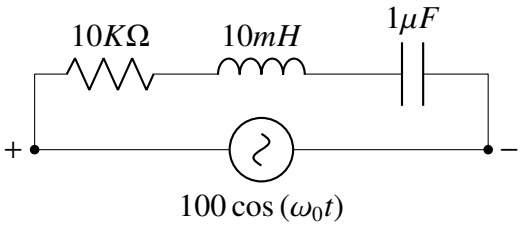
GATE-2023 BM Q-42

EE23BTECH11207 -KAILASH.C*

In the circuit shown below, it is observed that the amplitude of voltage across the resistor is the same as the amplitude of the sorce voltage. What is the angular frequency $\omega_0\,(inrad/s)$?



(A) 10^4

(B) 10^3

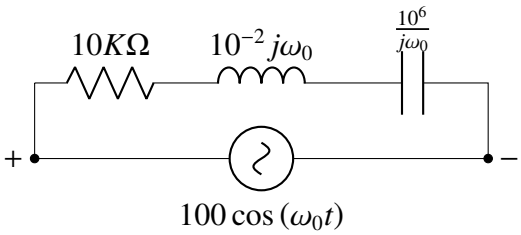
(C) $10^3\pi$

(D) $10^4\pi$

Solution:

Symbols	Parameters	Value
R	Resistance	$10K\Omega$
L	Inductance	$10mH$
C	Capacitance	$1\mu F$
ω_0	Angular Frequency	
V_s	Source Voltage	

TABLE 0
PARAMETER TABLE



We have:

$$V_R = V_s \tag{1}$$

Using KVL:

$$V_s = V_R + V_C + V_L \tag{2}$$

By using (1) in (2):

$$V_C = -V_L \tag{3}$$
$$X_C = -X_L \tag{4}$$
$$\frac{1}{j\omega_0 C} = -j\omega_0 L \tag{5}$$
$$\frac{1}{LC} = -j^2\omega_0^2 \tag{6}$$
$$\omega_0^2 = \frac{1}{LC} \tag{7}$$
$$\omega_0 = \frac{1}{\sqrt{LC}} \tag{8}$$
$$= \frac{1}{\sqrt{10^{-2}\times 10^{-6}}} \tag{9}$$
$$= \frac{1}{10^{-4}} \tag{10}$$
$$= 10^4 rad/s \tag{11}$$

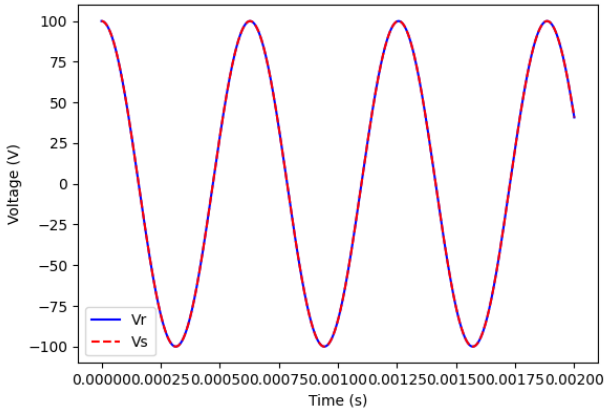


Fig. 0. Voltage across Resistor and Source voltage