

# NCERT Analog- 12.7.7

EE23BTECH11045 - Palavelli Srija\*

**Question 12.7.7:** A charged  $30\mu F$  capacitor is connected to a  $27mH$  inductor. What is the angular frequency of free oscillations of the circuit?

**Solution:**

Symbol	Description	Value
$C$	Capacitance	$30\mu F$
$L$	Inductance	$27mH$
$\omega_0$	Angular Frequency	??

TABLE 0  
INPUT PARAMETERS

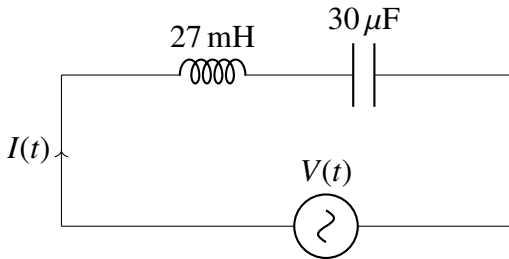


Fig. 0. LC Circuit Diagram

From Kirchhoff's Voltage Law (KVL):

$$V(t) = V_L + V_C \quad (1)$$

Using reactances from Fig. 0,

$$V(s) = sLI(s) + \frac{1}{sC}I(s) \quad (2)$$

$$= I(s) \left( Ls + \frac{1}{sC} \right) \quad (3)$$

$$\Rightarrow I(s) = \frac{V(s)}{\left( Ls + \frac{1}{sC} \right)} \quad (4)$$

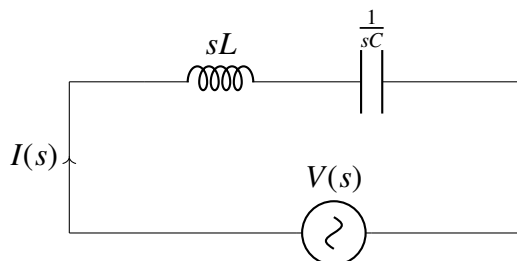


Fig. 0. LC Circuit Diagram

At resonance, the reactances of capacitor and inductor cancel out as follows:

$$Ls + \frac{1}{sC} = 0 \quad (5)$$

$$\Rightarrow s = j \frac{1}{\sqrt{LC}} \quad (6)$$

$s$  can be expressed in terms of angular resonance frequency as

$$s = j\omega_0 \quad (7)$$

on comparing (6) and (7)

$$\omega_0 = \frac{1}{\sqrt{LC}} \quad (8)$$

$$\omega_0 = \frac{1}{\sqrt{(30 \times 10^{-6}) \times (27 \times 10^{-3})}} \quad (9)$$

$$= \frac{1}{\sqrt{8.1 \times 10^{-7}}} \quad (10)$$

$$\approx 1.11 \times 10^3 \text{ rad/s} \quad (11)$$