

# NCERT Physics 12.7 Q21

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**Question:** Obtain the resonant frequency and Q-factor of a series LCR circuit with  $L = 3.0 \text{ H}$ ,  $C = 27 \mu\text{F}$ , and  $R = 7.4 \Omega$ . It is desired to improve the sharpness of the resonance of the circuit by reducing its 'full width at half maximum' by a factor of 2. Suggest a suitable way.

way of doing this is to reduce the resistance by a factor of 2.

$$R' = \frac{R}{2} \quad (7)$$

$$= \frac{7.4}{2} \Omega \quad (8)$$

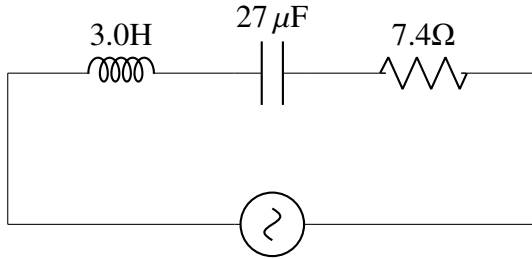
$$= 3.7 \Omega \quad (9)$$

**Solution:** Given parameters are:

$$L = 3.0 \text{ H}$$

$$C = 27 \mu\text{F}$$

$$R = 7.4 \Omega$$



Resonance Frequency ( $\omega$ ) is given by:

$$\omega = \frac{1}{\sqrt{LC}}$$

Substituting values of L and C gives:

$$\omega = \frac{1}{\sqrt{3 \cdot 27 \times 10^{-6}}} \quad (1)$$

$$= \frac{10^3}{9} \text{ s}^{-1} \quad (2)$$

$$= 111.1 \text{ s}^{-1} \quad (3)$$

Quality Factor (Q) is given by:

$$Q = \frac{1}{R} \cdot \sqrt{\frac{L}{C}}$$

Substituting values of R, L and C gives:

$$Q = \frac{1}{7.4} \cdot \sqrt{\frac{3}{27 \times 10^{-6}}} \quad (4)$$

$$= \frac{10^3}{22.2} \quad (5)$$

$$\approx 45 \quad (6)$$

To reduce the full width at half maximum by a factor of 2, the quality factor needs to be doubled. One