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(Answers).

Question 1.

Given parameters.

$R = 100\,k\Omega$, $L = 20mH$, $C = 5nF$.

Converted parameters

$R = 100 \times 10^3 = 100{,}000\,\Omega$

$L = 20 \times 10^{-3}\,H = 0.0002\,H$.

$C = 5 \times 10^{-9}\,F$.

i) $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.0002 \times 10^{-9} \times 5}} = \frac{1}{\sqrt{100 \times 10^{-2}}} = \frac{1}{10 \times 10^{-6}}$

$= 10^{-1} \times 10^6$

$= 10^5$

$= 100\,krad/s$

b) $Q = \frac{R}{\omega_0 L} = \frac{100{,}000}{100{,}000 \times 20 \times 10^{-3}}$

$= \frac{1}{20} \times 10^3$.

$= 0.05 \times 10^3$

$= 50$

c) $B = \frac{\omega_0}{Q} = \frac{100 \times 10^3}{50} = 2000\,rad/s$.

$= 2k\,rad/s$

$\omega_1 = \omega_0 - \frac{B}{2} = 100000 - \frac{2000}{2}$

$= 100{,}000 - 1000$

$= 99{,}000 = 99k\,rad/s$.

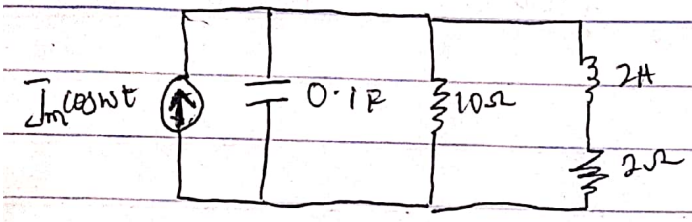
$$\omega_2 = \omega_0 + \frac{B}{2} = 100{,}000 + \frac{2000}{2}$$

$$= 100000 + 1000$$

$$= 101{,}000 \text{ rad/s.}$$

$$= 101 \text{ k rad/s.}$$

Question 2.



The input admittance is

$$Y = j\omega 0.1 + \frac{1}{10} + \frac{1}{2 + j\omega 2} = 0.1 + j\omega 0.1 + \frac{2 - j\omega 2}{4 + 4\omega^2}$$

At resonance $\mathrm{Im}(Y) = 0$.

$$\omega_0 0.1 - \frac{2\omega_0}{4 + 4\omega_0^2} = 0.$$

$$0.4\omega_0 + 0.4\omega_0^3 - 2\omega_0 = 0.$$

Divide through by ω_0.

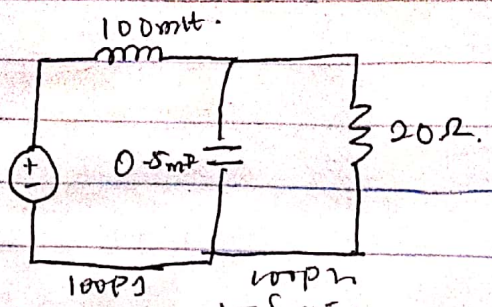
$$0.4 + 0.4\omega_0^2 - 2 = 0.$$

$$0.4\omega_0^2 = 1.6$$

$$\omega_0^2 = \frac{1.6}{0.4} \Rightarrow \omega_0 = \sqrt{4} \text{ ans}$$

$$\omega_0 = 2 \text{ rad/s.}$$

Question 3.



time domain.

$100mH = (100 \times 10^{-3})\ H \rightarrow L$

$0.5mF = (0.5 \times 10^{-3})\ F \rightarrow C$

$20\Omega \rightarrow R$

Frequency domain.

$(100 \times 10^{-3})\ j\omega\ H$

$(0.5 \times 10^{-3}) = \frac{1}{2000} = \frac{2000}{j\omega}$

20Ω.

From loop 2

$R \| C$

$$\frac{20 \times \frac{2000}{j\omega}}{20 + \frac{2000}{j\omega}}$$ i-e Product / Sum.

$$Z) \frac{40000}{20j\omega + 2000} \Rightarrow \frac{40000}{20j\omega + 2000} \times \frac{(20j\omega - 2000)}{(20j\omega + 2000)}$$ (rationalization).

$$\Rightarrow \frac{80,0000j\omega - 80,000000}{-400j\omega - 4000000}$$

Back to loop 1.

$R = L + (R \| C)$ since the inductor is in series.

$$\frac{800000j\omega - 80000000}{-400j\omega - 4000000} + (100 \times 10^{-3})j\omega$$

at resonance. $Im(R)$

$$= \frac{800000j\omega}{-400j\omega - 4000000} + j\omega(100 \times 10^{-3})$$

$800000\omega_0 + (-40\omega_0^2) - 4000000\omega_0 .$

$400000 - 40\omega^2 = 0.$

$\omega^2 = 10000$

$\omega = 100 \text{ rad/s}.$