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1) $R = 100K\Omega$
$L = 20mH$
$C = 5nF$

$$\omega_1 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(20\times10^{-3})(5\times10^{-9})}} = \frac{1}{\sqrt{1\times10^{-10}}} = 100000 \text{ rad/s}$$

$\omega_1 = 100 \text{ krad/s}$

$$Q = \frac{R}{\omega_0 L}$$

$$= \frac{100\times10^3}{(100\times10^3)(20\times10^{-3})}$$

$$= \frac{1}{20\times10^{-3}}$$

$$= 50_n$$

$$B = \frac{\omega_0}{Q}$$

$$= \frac{100\times10^3}{50}$$

$= 2000 = 2 \text{krad/s}$.

Since $Q > 1.0$, $\omega_1 = \omega_0 - \frac{B}{2} = 100\times10^3 - \frac{2000}{2}$

$= 100\times10^{-3} - 1000 = 99000$

$\omega_1 = 99 \text{krad/s}$

$$\omega_2 = \omega_r + \frac{B_0}{2}$$

$$= 100\times10^3 + \frac{2000}{2}$$

$$= 100\times10^3 + 1000$$

$\omega_2 = 101000 = 101 \text{krad/s}$.

b) $Y = \frac{1}{w} + jw0.1 + \frac{1}{2+jw2} = 0.1 + jw0.1 + \frac{1}{2+jw2}$

$\frac{1}{2+jw2} = \frac{1}{2+jw2} \times \frac{2-jw2}{2-jw2} = \frac{2-jw2}{4-4jw+4jw+4w^2}$

$= \frac{2-jw2}{4+4w^2}$

$Y = 0.1 + jw0.1 + \frac{2-jw2}{4+4w^2} = 0.1 + jw0.1 + \frac{2}{4+4w} - \frac{jw^2}{4+4w^2}$

$Y = 0.1 + \frac{2}{4+4w^2} + jw0.1 - \frac{jw2}{4+4w^2}$

$= 0.1 + \frac{2}{4+4w^2} + j\left(w0.1 - \frac{w2}{4+4w^2}\right)$

$\therefore w_0 0.1 - \frac{w_0 2}{4+4w_0^2} = 0$

$0.1 - \frac{2}{4-4w_0^2} = 0$

$0.1 = \frac{2}{4+4w_0^2}$

$0.4 + 0.4w_0^2 = 2$

$0.4w_0^2 = 1.6$

$w_0^2 = 4$

$w_0 = 2 \text{ rad/s}$

c) $Z = jw(100 \times 10^{-3}) + \left(\frac{20}{jw(0.5 \times 10^{-3})} \div \left(\frac{20}{1} + \frac{1}{0.5 \times 10^{-3} jw}\right)\right)$

$= jw(100 \times 10^{-3}) + \left(\frac{20}{jw(1.5 \times 10^{-3})} \div \left(\frac{0.01jw+1}{0.5 \times 10^{-3} jw}\right)\right)$

$= jw(100 \times 10^{-3}) + \left(\frac{20}{jw(0.5 \times 10^{-3})} \times \frac{jw(0.5 \times 10^{-3})}{0.01jw+1}\right)$

$= jw(100 \times 10^{-3}) + \left(\frac{20}{0.01jw+1}\right)$

$\frac{20}{0.01jw+1} = \frac{20}{0.01jw+1} \times \frac{0.01jw-1}{0.01jw-1}$

$$= \frac{jw0.2 - 20}{-1\times10^{-4}w^2 - jw0.01 + jw0.1 - 1}$$

$$= \frac{jw0.2 - 20}{-1\times10^{-4}w^2 - 1}$$

$$= \frac{-20 + jw0.2}{-1\times10^{-4}w^2 - 1}$$

$$= \frac{-(20 - 0.2jw)}{(1\times10^{-4}w^2 + 1)}$$

$$= \frac{20 - 0.2jw}{1 + 1\times10^{-4}w^2}$$

$$= \frac{20}{1 + 1\times10^{-4}w^2} + \frac{0.2jw}{1 + 1\times10^{-4}w^2}$$

$$Z = jw(100\times10^{-3}) + \frac{20}{1 + 1\times10^{-4}w^2} - \frac{0.2jw}{1 + 1\times10^{-4}w^2}$$

$$= \frac{20}{1 + 1\times10^{-4}w^2} + jw(100\times10^{-3}) - \frac{0.2jw}{1 + 1\times10^{-4}w^2}$$

$$= \frac{20}{1 + 1\times10^{-4}w^2} + j\left(w(100\times10^{-3}) - \frac{0.2w}{1 + 1\times10^{-4}w^2}\right)$$

At resonance the Imaginary part of Z, $Z_{(w)} = 0$

$$w_0(100\times10^{-3}) - \frac{0.2w_0}{1 + 1\times10^{-4}w_0^2} = 0$$

$$w_0(100\times10^{-3}) = \frac{0.2w_0}{1 + 1\times10^{-4}w_0^2}$$

$$w_0(100\times10^{-3})(1 + 1\times10^{-4}w_0) = 0.2w_0$$

$$0.1 + 1\times10^{-5}w_0^2 = 0.2$$

$$1\times10^{-5}w_0^2 = 0.2 - 0.1$$

$$w_0^2 = \frac{0.1}{1\times0.5}$$

$$w_0^2 = 10000$$

$$w_0 = \sqrt{10000}$$

w_0 = bandwidth.