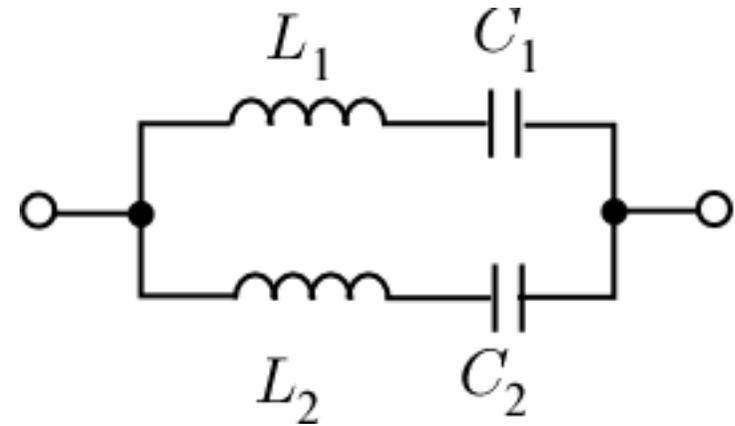


【問題1】どのタイプか答えよ



$$\begin{aligned}
 Z(s) &= \frac{\left(sL_1 + \frac{1}{sC_1}\right) \left(sL_2 + \frac{1}{sC_2}\right)}{\left(sL_1 + \frac{1}{sC_1}\right) + \left(sL_2 + \frac{1}{sC_2}\right)} \\
 &= \frac{(s^2L_1C_1 + 1)(s^2L_2C_2 + 1)}{sC_2(s^2L_1C_1 + 1) + sC_1(s^2L_2C_2 + 1)} \\
 &= \frac{(s^2L_1C_1 + 1)(s^2L_2C_2 + 1)}{s(s^2L_1C_1C_2 + C_2 + s^2L_2C_2C_1 + C_1)} \\
 &= \frac{(s^2L_1C_1 + 1)(s^2L_2C_2 + 1)}{s(C_1C_2(L_1 + L_2)s^2 + (C_1 + C_2))} \\
 &= \frac{\cancel{L_1}\cancel{C_1}\cancel{L_2}\cancel{C_2}}{\cancel{C_1}\cancel{C_2}(L_1 + L_2)} \frac{\left(s^2 + \frac{1}{L_1C_1}\right) \left(s^2 + \frac{1}{L_2C_2}\right)}{s \left(s^2 + \frac{C_1 + C_2}{C_1C_2(L_1 + L_2)}\right)}
 \end{aligned}$$

$$F(s) = K \frac{(s^2 + \omega_1^2)(s^2 + \omega_3^2) \cdots (s^2 + \omega_{2n-1}^2)}{s(s^2 + \omega_2^2)(s^2 + \omega_4^2) \cdots (s^2 + \omega_{2n-2}^2)}$$

$$Z(s) = \frac{L_1 L_2}{L_1 + L_2} \frac{\left(s^2 + \frac{1}{L_1 C_1}\right) \left(s^2 + \frac{1}{L_2 C_2}\right)}{s \left(s^2 + \frac{C_1 + C_2}{C_1 C_2 (L_1 + L_2)}\right)}$$

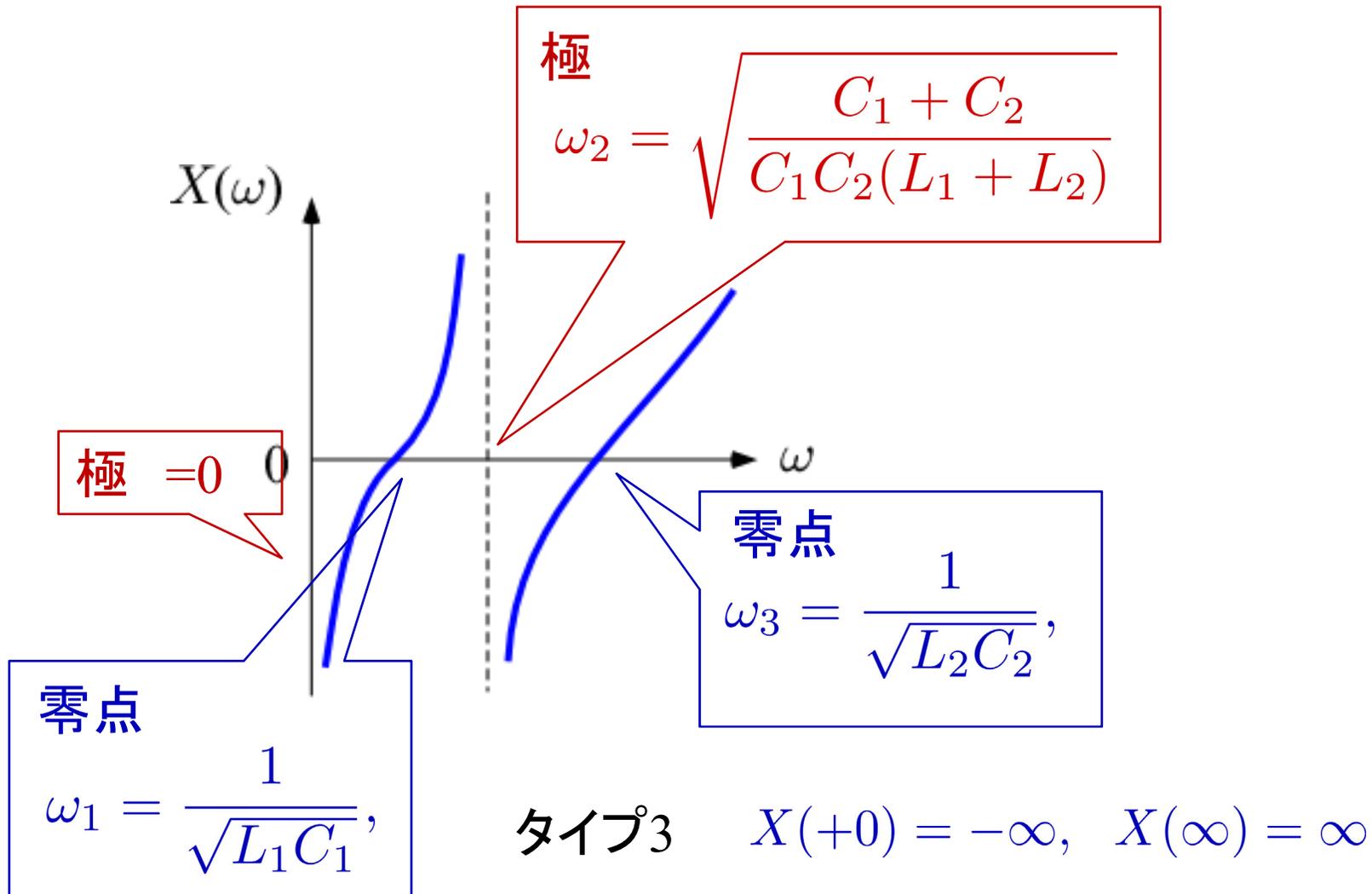
$$K = \frac{L_1 L_2}{L_1 + L_2}, \quad \omega_1 = \frac{1}{\sqrt{L_1 C_1}}, \quad \omega_3 = \frac{1}{\sqrt{L_2 C_2}},$$

$$\omega_2 = \sqrt{\frac{C_1 + C_2}{C_1 C_2 (L_1 + L_2)}}$$

$$Z(j\omega) = \frac{L_1 L_2}{L_1 + L_2} \frac{\left(-\omega^2 + \frac{1}{L_1 C_1}\right) \left(-\omega^2 + \frac{1}{L_2 C_2}\right)}{j\omega \left(-\omega^2 + \frac{C_1 + C_2}{C_1 C_2 (L_1 + L_2)}\right)}$$

$$X(\omega) = -\frac{L_1 L_2}{L_1 + L_2} \frac{\left(-\omega^2 + \frac{1}{L_1 C_1}\right) \left(-\omega^2 + \frac{1}{L_2 C_2}\right)}{\omega \left(-\omega^2 + \frac{C_1 + C_2}{C_1 C_2 (L_1 + L_2)}\right)}$$

$$X(\omega) = -\frac{L_1 L_2}{L_1 + L_2} \frac{\left(-\omega^2 + \frac{1}{L_1 C_1}\right) \left(-\omega^2 + \frac{1}{L_2 C_2}\right)}{\omega \left(-\omega^2 + \frac{C_1 + C_2}{C_1 C_2 (L_1 + L_2)}\right)}$$



【問題2】どのタイプか答えよ

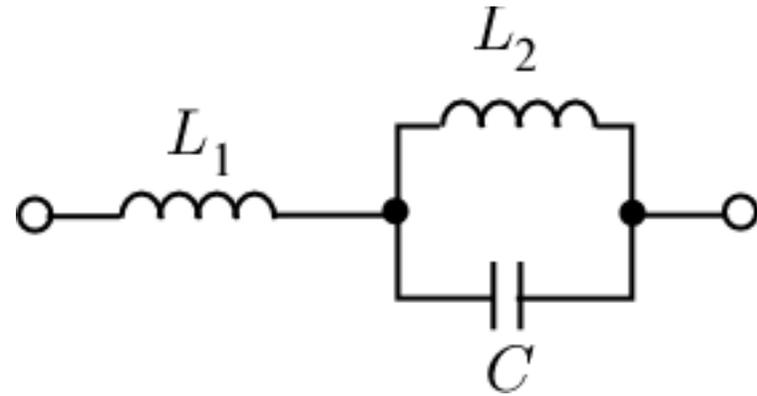
$$Z(s) = L_1 s + \frac{sL_2 \frac{1}{sC}}{sL_2 + \frac{1}{sC}}$$

$$= L_1 s + \frac{sL_2}{1 + s^2 L_2 C}$$

$$= \frac{L_1 s(1 + s^2 L_2 C) + sL_2}{1 + s^2 L_2 C} = \frac{s((L_1 + L_2) + L_1 L_2 C s^2)}{L_2 C s^2 + 1}$$

$$= \frac{L_1 L_2 C s \left(s^2 + \frac{L_1 + L_2}{L_1 L_2 C} \right)}{L_2 C \left(s^2 + \frac{1}{L_2 C} \right)}$$

$$= \boxed{L_1} \frac{s \left(s^2 + \frac{L_1 + L_2}{L_1 L_2 C} \right)}{s^2 + \frac{1}{L_2 C}}$$



$$K = L_1, \quad \omega_3 = \sqrt{\frac{L_1 + L_2}{L_1 L_2 C}}$$

$$\omega_2 = \sqrt{\frac{1}{L_2 C}}$$

$$F(s) = K \frac{(s^2 + \omega_1^2)(s^2 + \omega_3^2) \cdots (s^2 + \omega_{2n-1}^2)}{s(s^2 + \omega_2^2)(s^2 + \omega_4^2) \cdots (s^2 + \omega_{2n-2}^2)}$$

$$Z(s) = L_1 \frac{s \left(s^2 + \frac{L_1+L_2}{L_1 L_2 C} \right)}{s^2 + \frac{1}{L_2 C}}$$

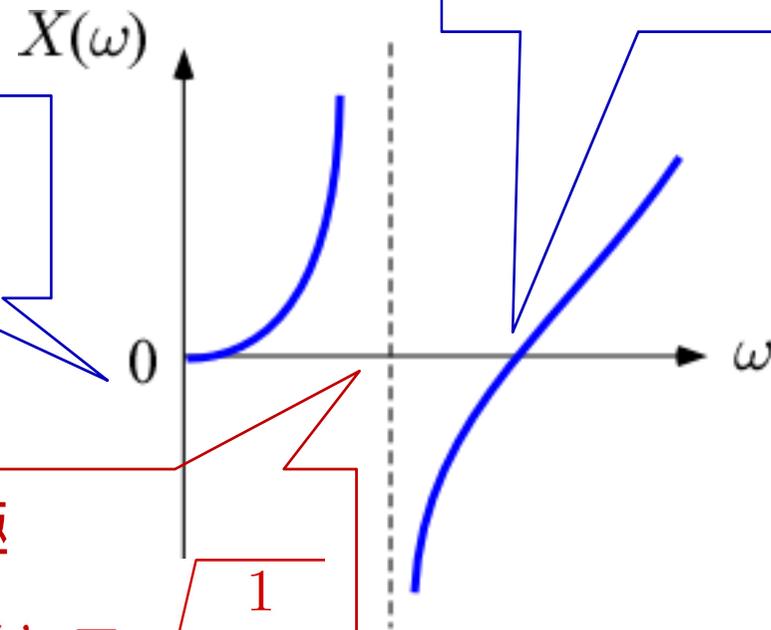
$$Z(j\omega) = L_1 \frac{j\omega \left(-\omega^2 + \frac{L_1+L_2}{L_1 L_2 C} \right)}{-\omega^2 + \frac{1}{L_2 C}}$$

$$X(\omega) = L_1 \frac{\omega \left(-\omega^2 + \frac{L_1+L_2}{L_1 L_2 C} \right)}{-\omega^2 + \frac{1}{L_2 C}}$$

零点
 $\omega_1 = 0$

極
 $\omega_2 = \sqrt{\frac{1}{L_2 C}}$

零点
 $\omega_3 = \sqrt{\frac{L_1 + L_2}{L_1 L_2 C}}$

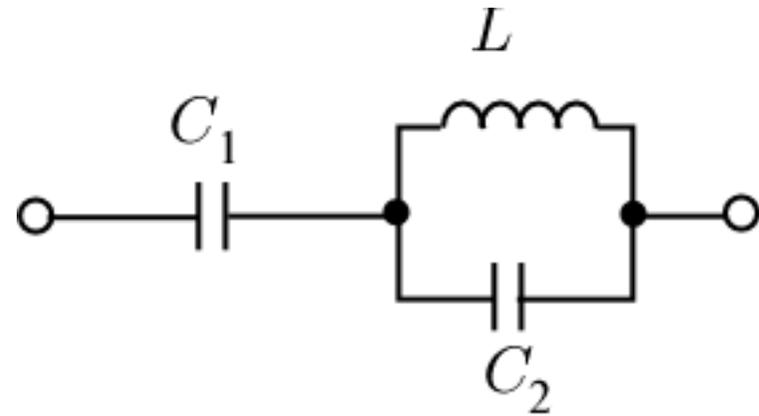


タイプ1

$$X(0) = 0, \quad X(\infty) = \infty$$

【問題3】どのタイプか答えよ

$$\begin{aligned}
 Z(s) &= \frac{1}{sC_1} + \frac{sL \frac{1}{sC_2}}{sL + \frac{1}{sC_2}} \\
 &= \frac{1}{sC_1} + \frac{sL}{s^2LC_2 + 1} \\
 &= \frac{(s^2LC_2 + 1) + s^2LC_1}{sC_1(s^2LC_2 + 1)} \\
 &= \frac{L(C_1 + C_2)s^2 + 1}{sC_1(s^2LC_2 + 1)} \\
 &= \frac{L(C_1 + C_2)}{LC_1C_2} \frac{s^2 + \frac{1}{L(C_1+C_2)}}{s(s^2 + \frac{1}{LC_2})} \\
 &= \boxed{\frac{C_1 + C_2}{C_1C_2}} \frac{s^2 + \boxed{\frac{1}{L(C_1+C_2)}}}{s(s^2 + \boxed{\frac{1}{LC_2}})}
 \end{aligned}$$



$$F(s) = K \frac{(s^2 + \omega_1^2)(s^2 + \omega_3^2) \cdots (s^2 + \omega_{2n-1}^2)}{s(s^2 + \omega_2^2)(s^2 + \omega_4^2) \cdots (s^2 + \omega_{2n-2}^2)}$$

$$K = \frac{C_1 + C_2}{C_1C_2}$$

$$\omega_1 = \frac{1}{\sqrt{L(C_1 + C_2)}}$$

$$\omega_2 = \frac{1}{\sqrt{LC_2}}$$

$$Z(s) = \frac{C_1 + C_2}{C_1 C_2} \frac{s^2 + \frac{1}{L(C_1 + C_2)}}{s(s^2 + \frac{1}{LC_2})}$$

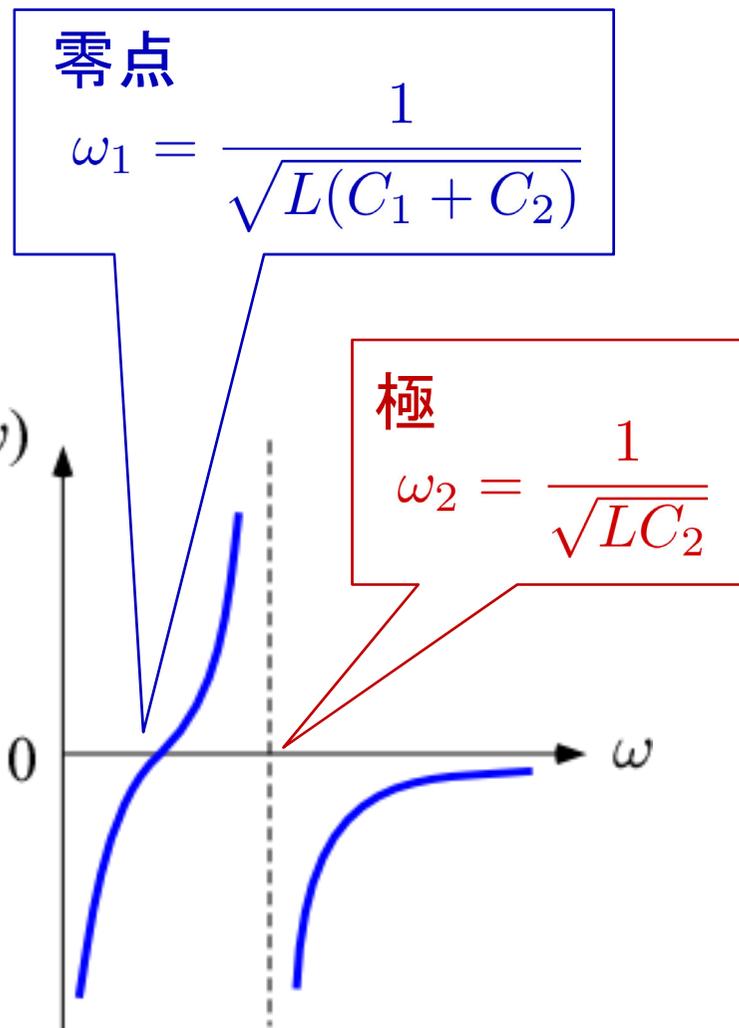
$$Z(j\omega) = \frac{C_1 + C_2}{C_1 C_2} \frac{-\omega^2 + \frac{1}{C_1 + C_2}}{j\omega(-\omega^2 + \frac{1}{LC_2})}$$

$$X(j\omega) = -\frac{C_1 + C_2}{C_1 C_2} \frac{-\omega^2 + \frac{1}{C_1 + C_2}}{\omega(-\omega^2 + \frac{1}{LC_2})}$$

タイプ4

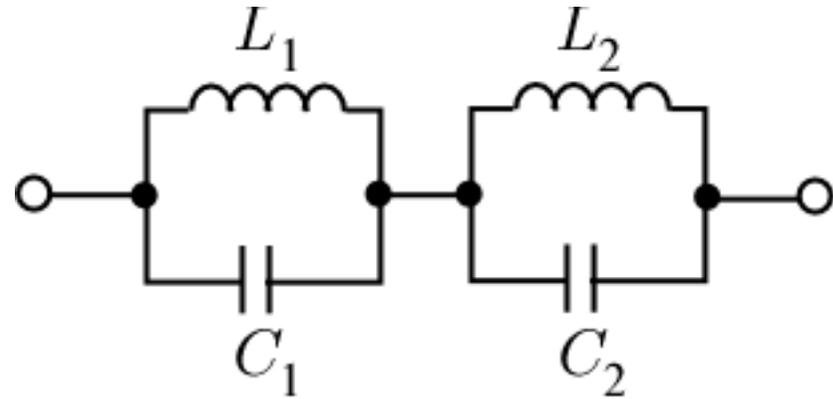
$$X(+0) = -\infty, \quad X(\infty) = 0$$

極 = 0



【問題4】どのタイプか答えよ

$$\begin{aligned}
 Z(s) &= \frac{sL_1 \frac{1}{sC_1}}{sL_1 + \frac{1}{sC_1}} + \frac{sL_2 \frac{1}{sC_2}}{sL_2 + \frac{1}{sC_2}} \\
 &= \frac{sL_1}{1 + s^2L_1C_1} + \frac{sL_2}{1 + s^2L_2C_2} \\
 &= \frac{sL_1(1 + s^2L_2C_2) + sL_2(1 + s^2L_1C_1)}{(1 + s^2L_1C_1)(1 + s^2L_2C_2)} \\
 &= \frac{1}{L_1C_1L_2C_2} \frac{s((L_1 + L_2) + s^2L_1L_2(C_1 + C_2))}{\left(\frac{1}{L_1C_1} + s^2\right)\left(\frac{1}{L_2C_2} + s^2\right)} \\
 &= \frac{\cancel{L_1}\cancel{L_2}(C_1 + C_2)}{\cancel{L_1}C_1\cancel{L_2}C_2} \frac{s\left(s^2 + \frac{L_1+L_2}{L_1L_2(C_1+C_2)}\right)}{\left(s^2 + \frac{1}{L_1C_1}\right)\left(s^2 + \frac{1}{L_2C_2}\right)} \\
 &= \frac{C_1 + C_2}{C_1C_2} \frac{s\left(s^2 + \frac{L_1+L_2}{L_1L_2(C_1+C_2)}\right)}{\left(s^2 + \frac{1}{L_1C_1}\right)\left(s^2 + \frac{1}{L_2C_2}\right)}
 \end{aligned}$$



$$F(s) = K \frac{(s^2 + \omega_1^2)(s^2 + \omega_3^2) \cdots (s^2 + \omega_{2n-1}^2)}{s(s^2 + \omega_2^2)(s^2 + \omega_4^2) \cdots (s^2 + \omega_{2n-2}^2)}$$

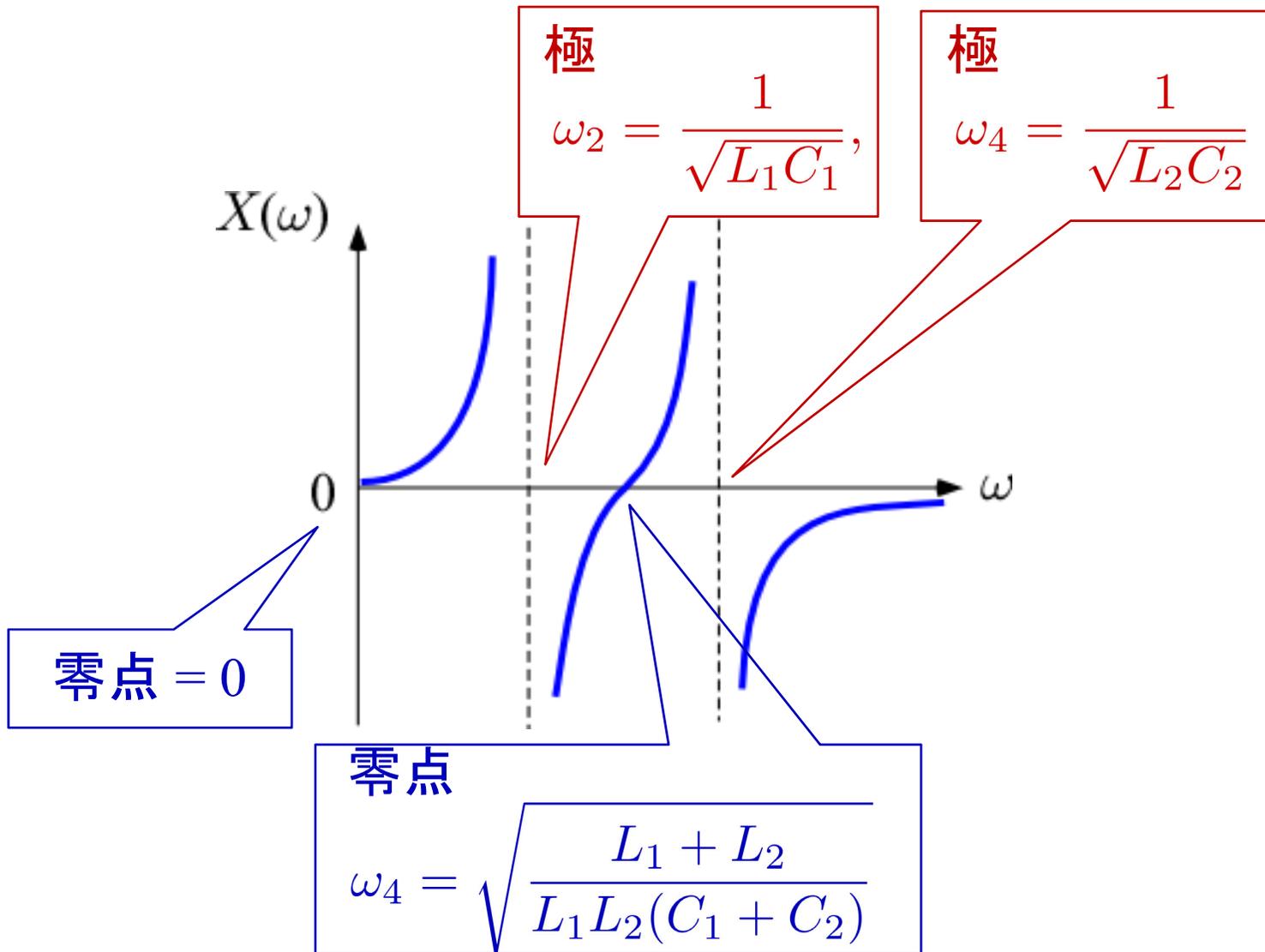
$$Z(s) = \frac{C_1 + C_2}{C_1 C_2} \frac{s \left(s^2 + \frac{L_1 + L_2}{L_1 L_2 (C_1 + C_2)} \right)}{\left(s^2 + \frac{1}{L_1 C_1} \right) \left(s^2 + \frac{1}{L_2 C_2} \right)}$$

$$K = \frac{C_1 + C_2}{C_1 C_2}, \quad \omega_2 = \frac{1}{\sqrt{L_1 C_1}}, \quad \omega_4 = \frac{1}{\sqrt{L_2 C_2}}$$

$$\omega_4 = \sqrt{\frac{L_1 + L_2}{L_1 L_2 (C_1 + C_2)}}$$

$$Z(j\omega) = \frac{C_1 + C_2}{C_1 C_2} \frac{j\omega \left(-\omega^2 + \frac{L_1 + L_2}{L_1 L_2 (C_1 + C_2)} \right)}{\left(-\omega^2 + \frac{1}{L_1 C_1} \right) \left(-\omega^2 + \frac{1}{L_2 C_2} \right)}$$

$$X(j\omega) = \frac{C_1 + C_2}{C_1 C_2} \frac{\omega \left(-\omega^2 + \frac{L_1 + L_2}{L_1 L_2 (C_1 + C_2)} \right)}{\left(-\omega^2 + \frac{1}{L_1 C_1} \right) \left(-\omega^2 + \frac{1}{L_2 C_2} \right)}$$



タイプ2 $X(0) = 0, X(\infty) = 0$