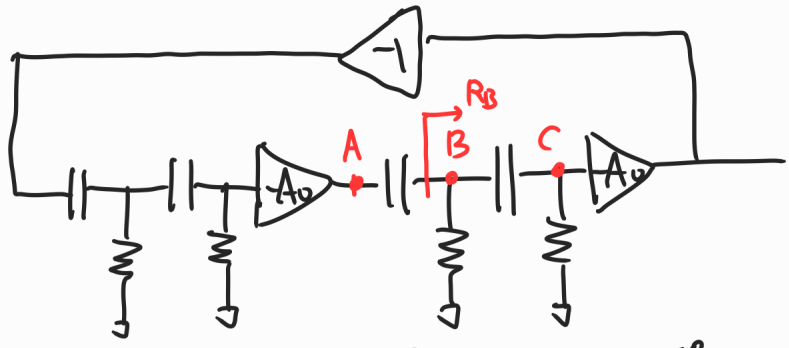
Quiz 5.



- $\frac{C}{A} = \frac{B}{A} \cdot \frac{C}{B} = \frac{R_B}{\frac{1}{sC} + R_B} \cdot \frac{sCR}{sCR+1} = \frac{sCR_B}{sCR_B+1} \cdot \frac{sCR}{sCR+1} \Rightarrow$

- $\frac{C}{B} = \frac{R}{\frac{1}{sC} + R} = \frac{sCR}{sCR+1}$ (eq)

- $R_B = R \parallel \left(R + \frac{1}{sC}\right) = \frac{R\left(R+\frac{1}{sC}\right)}{R+R+\frac{1}{sC}} = \frac{R(sCR+1)}{2sCR+1}$ (eq.)

$$\Rightarrow \frac{C}{A} = \frac{sC\left(\frac{R(sCR+1)}{2sCR+1}\right)}{sC\cdot\left(\frac{R(sCR+1)}{2sCR+1}\right)+1} \cdot \frac{sCR}{sCR+1} = \frac{(sCR)^2}{sCR(sCR+1)+2sCR+1}$$

$$= \frac{(sCR)^2}{(sCR)^2 + 3(sCR)+1}$$

$$\Rightarrow \boxed{T(s) = \frac{-A_0^2 (sCR)^4}{\{(sCR)^2 + 3(sCR)+1\}^2}} \quad (a)$$

$\Rightarrow$ To oscillate, $\angle T(j\omega_0) = 0^\circ$ or 360° & $|T(j\omega_0)| \geq 1$

$$\Rightarrow T(j\omega_0) = \frac{-A_0^2 (\omega_0 CR)^4}{\left(j\cdot(3\omega_0 CR) + (1-(\omega_0 CR)^2)\right)^2} \Rightarrow \angle T(j\omega_0) = -180 - 2\cdot \underbrace{\tan^{-1}\left(\frac{3\omega_0 RC}{1-(\omega_0 RC)^2}\right)}_{90^\circ}$$

$$\Rightarrow (\omega_0 RC)^2 = 1 \Rightarrow \boxed{\omega_0 = \frac{1}{RC}} \quad (b)$$

$\Rightarrow$ A_0 for starting oscillation, $|T(j\omega_0)| = 1 = \left|\frac{-A_0^2}{(j\cdot 3+1-1)^2}\right|$

$$\Rightarrow A_0^2 = 9 \rightarrow \boxed{A_0 = 3} \quad (c) \quad (A_0 \text{ is positive})$$