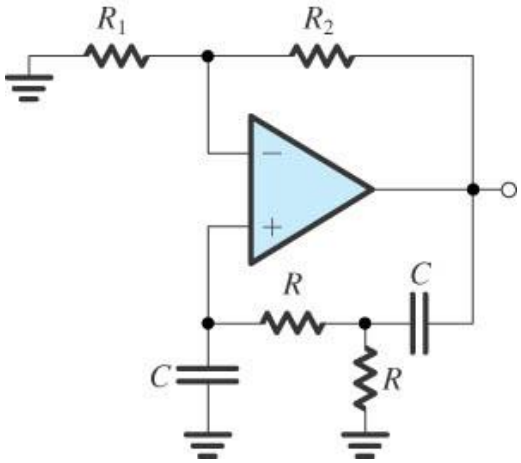
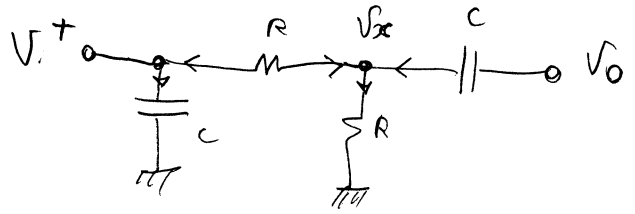
Problema

Osciladores 1 – Oscilador RC sinusoidal com amplificador operacional

Considere o circuito da figura. Determine Aβ(s), Aβ(jω), a frequência de oscilação e qual o valor mínimo do ganho para que o circuito oscile.



Oscilatores 1



$$\beta(s) = \frac{V^+(s)}{V_o(s)}$$

$$\begin{cases} \dfrac{V^+}{\frac{1}{sC}} = \dfrac{V_x - V^+}{R} \\ \dfrac{V^+ - V_x}{R} + \dfrac{V_o - V_x}{\frac{1}{sC}} = \dfrac{V_x}{R} \end{cases} \qquad \begin{cases} V_x = V^+(1+sRC) \\ V^+ - V_x + sRCV_o - sRCV_x = V_x \end{cases}$$

$$\beta = \frac{V^+}{V_o} = \frac{\frac{s}{RC}}{s^2 + \frac{3}{RC}s + \frac{1}{R^2C^2}} \qquad A = \frac{V_o}{V^+} = 1 + \frac{R_2}{R_1}$$

$$A\beta(s) = \frac{\left(1+\frac{R_2}{R_1}\right)\frac{s}{RC}}{s^2 + \frac{3}{RC}s + \frac{1}{R^2C^2}} \qquad A\beta(j\omega) = \frac{\left(1+\frac{R_2}{R_1}\right)\frac{j\omega_o}{RC}}{-\omega_o^2 + 3j\frac{\omega_o}{RC} + \frac{1}{R^2C^2}}$$

$$A\beta = 1 \Rightarrow \begin{cases} Im\{A\beta\} = 0 \Rightarrow \omega_o^2 = \frac{1}{R^2C^2} & \boxed{\omega_o = \frac{1}{RC}} \\ Re\{A\beta\} = 1 \Rightarrow 1 + \frac{R_2}{R_1} = 3 & \boxed{A_{min} = 3} \end{cases} \qquad \left(\frac{R_2}{R_1}\right)_{min} = 2$$