1. The circuit shows a Wein bridge oscillator. If \( R_1 = R_2, \ C_1 = 0.1 \mu F, \ C_2 = 0.22 \mu F, \) and \( R_4 = 10 \text{k}\Omega, \) specify \( R_1, \ R_2, \) and \( R_3 \) for the circuit to have stable oscillations at \( f = 1000 \text{Hz}. \) Answers: \( R_1 = R_2 = 1073 \Omega \) and \( R_3 = 6875 \Omega. \)

2. The figure shows a phase-shift oscillator with the feedback loop broken.

By writing node equations, it can be shown that the loop-gain transfer function is given by

\[
\frac{V'_o}{V_o} = -\frac{R_F}{R} \frac{(RCs)^3}{(RCs)^3 + 6(RCs)^2 + 5(RCs) + 1}
\]

(a) To solve for the frequency of oscillation, what do you set \( V'_o/V_o \) equal to? Answer: \( 120^\circ. \) (b) Use the transfer function to solve for the frequency of oscillation. Answer: \( f_0 = 1/(2\pi \sqrt{5}RC). \) (c) Use the transfer function to solve for value of \( R_F/R \) in order for \( |V'_o/V_o| = 120^\circ \) at \( f = f_0. \) Answer: \( R_F/R_1 = 29. \)

3. The figure shows a phase shift oscillator. If \( C = 0.1 \mu F, \) specify \( R \) and \( R_F \) for the circuit to have stable oscillations at \( f = 200 \text{Hz}. \) Answers: \( R = 3249 \Omega \) and \( R_F = 94.21 \text{k}\Omega. \)
4. The loop-gain transfer function of a particular oscillator circuit is given by

\[ \frac{V_o}{V'_o} = K \frac{s}{(s/100)^2 + 0.5(s/100) + 1} \]

At what frequency does the circuit oscillate and what must be the value of \( K \) for stable oscillations? Answers: \( f = 15.9 \) Hz and \( K = 0.005 \).