The circuit of Figure 1 is a Wein Bridge Oscillator. Choose $R_o$, $R_1$ and $R_2$ so that the amplifier biasing is designed for optimal sinusoidal operation, the parallel combination of $R_1$ and $R_2$ equals $R_o$, and the oscillator oscillates at 400Hz.

$$R_o C = 1/(2\pi 400) = 1/(2513)$$
$$R_o = 10^6/2513 = 39.8K$$
$$V_E = (12/2)(1/3) = 2V$$
$$R_1/(R_1+R_2) = (2+0.6)/12 = 0.217$$
$$R_1 R_2/(R_1+R_2) = 39.8K$$
$$R_2 = 39.8K/0.217 = 183K$$
$$R_1 = 39.8K/(1-0.217) = 50.8K$$

Use PSPICE to simulate the circuit of the figure using
Q1 as a 2N2222 transistor
Q2 as a 2N2907 transistor

Choose $R_E$ in the simulation so that the circuit oscillates.
Set $v_{C1}(0) = 5V$ to initiate the oscillations. Calculate the frequency of oscillations and compare your result with the simulation value.

For $V_{C1}(0) = 2.6V$ $V_{C2}(0) = 4.9V$ $R_E = 1.765K$ $f_o = 400Hz$. 
In theory the frequency of oscillation should be \( f = \frac{(1/2\pi)}{0.39E^{-3}} = 408\text{Hz} \)

By measurement \( P = 2.4\text{ms} \) and \( f = 417\text{Hz} \).

An alternative RC oscillator is that of Fig. 2.
The resistors are equal and the capacitances are equal.
Determine the gain required for oscillation and the frequency of operation.
(Hint: Use the flow graph below.)

\[
\Delta = 1 + \frac{5}{sCR} + \frac{6}{(sCR)^2} + \frac{1}{(sCR)^3} + \frac{3A}{(sCR)^3}
\]

\[
P(j\omega) = -j(\omega CR)^3 - 5(\omega CR)^2 + j6(\omega CR) + 3A
\]

For oscillations \( (\omega CR)^3 = 6(\omega CR) \quad 3A = 5(\omega CR)^2 \)
\[
\omega CR = 6^{1/2} \quad A = 10
\]
\[
\omega = 6^{1/2}/RC
\]