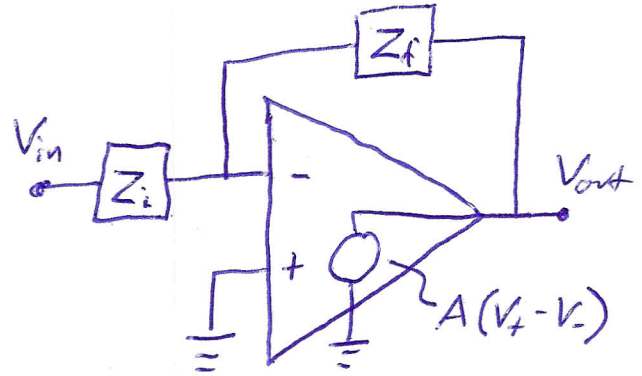


Question #1

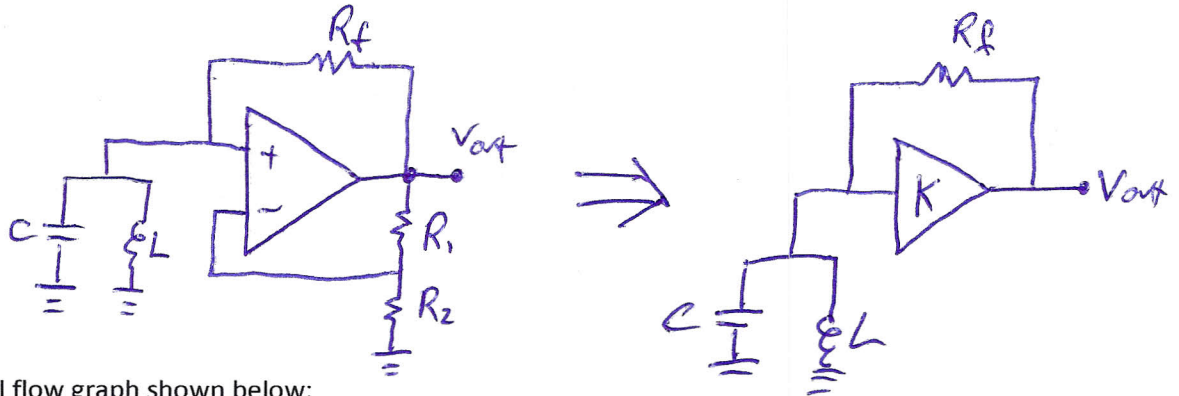
For the circuit shown at right, the feedback term is $B = Z_i / (Z_f + Z_i)$

- Derive the transfer function of this circuit for the op-amp model given, and show that it is proportional to $1/(1+AB)$.
- Assuming $Z_i = 1/sC$, $Z_f = R$, and $A = G/s$, show that this transfer function has a second order response.
- Sketch two possible modifications that could increase the phase margin of this circuit. Why would they work?

Question #2

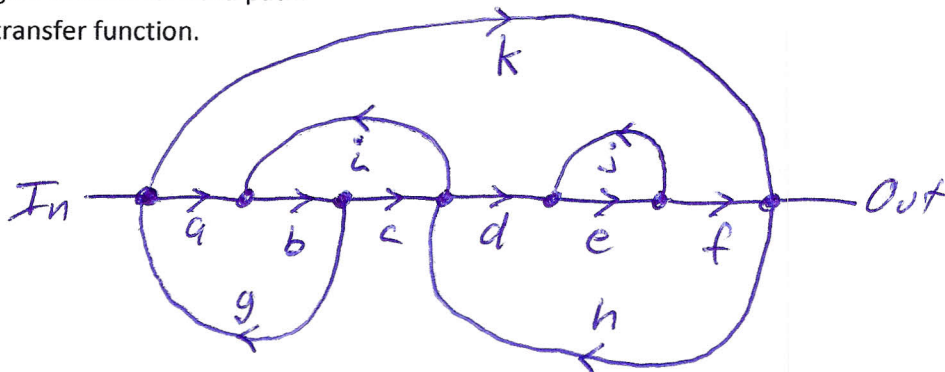
For the circuit shown below, we can model the voltage follower portion as an amplifier with gain K.

- Assuming an ideal op-amp model, what is K as a function of R_1 and R_2 ?
- Find the loop gain AB in terms of K and the other circuit parameters.
- What is the ideal relationship between R_1 and R_2 for this circuit to work as an oscillator?

Question #3

For the signal flow graph shown below:

- Find the determinant.
- Find the gain of each forward path.
- Find the transfer function.

Question #4

- Draw a signal flow graph for a band-pass filter using two integrators.
- Verify that your graph produces a band-pass filter by finding its transfer function.
- Draw a circuit that implements this function with three op-amps.