

Instructions: The points allocated to each problem on this exam are as indicated. All work should be included on the exam itself. Attach additional sheets only if you run out of space on a problem. Students may bring 1 page of notes to the exam. Calculators are permitted but can not be shared. Partial credit may be given in situations where sufficient progress towards a solution is demonstrated but if mistakes are made when using calculators, partial credit is often difficult to justify.

Questions:

1. (2pts) What are the two key properties of a Null Port ?
2. (2pts) Who first introduced the concept of Feedback?
3. (2pts) Almost all amplifiers are built from one of three basic electronic components. Give two of them.
4. (2 pts) What is the ideal output impedance of a transconductance amplifier?
5. (2 pts) Why is the half-power frequency of an amplifier often termed the -3dB frequency?
6. (5 pts) An amplifier has a voltage gain given by the transfer function listed below. If the input to the amplifier is given by $V_{in} = 0.2\sin(3t+45^\circ)$, determine the sinusoidal steady state response.

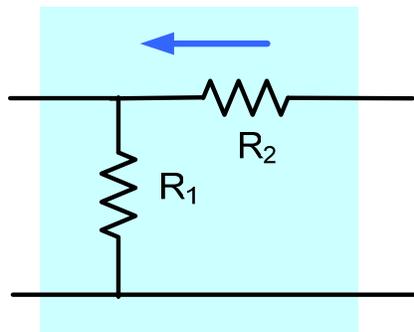
$$T(s) = \frac{s+1}{s^2+2s+16}$$

7. (3 pts) Give typical values for the voltage gain, the output impedance, and the input impedance of an operational amplifier built with FET input devices.
8. (2 pts) Thermocouples were used in the laboratory. What is the approximate voltage that the thermocouple will provide if the temperature differential across the thermocouple is 50°C ?

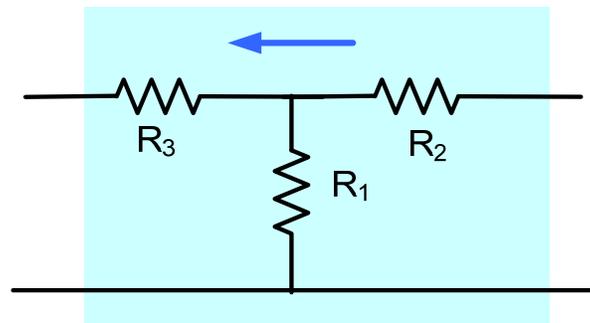
Problem 1 (10 pts)

Determine the β of the following “ β ” structures if they are used in a standard feedback amplifier configuration where the “A” amplifier has ideal input and output impedances and it is of the type specified. The direction of propagation of the signal through the β network is indicated by the arrow.

- a) “A” amplifier is a voltage amplifier



- b) The “A” amplifier is a transconductance amplifier

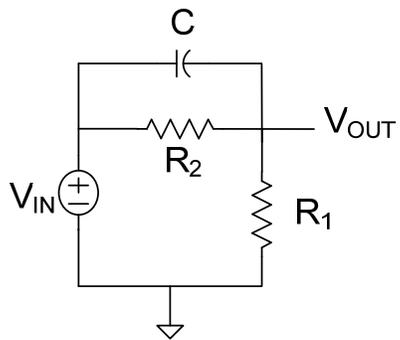


Problem 2 (10 pts) Determine the poles for the following systems

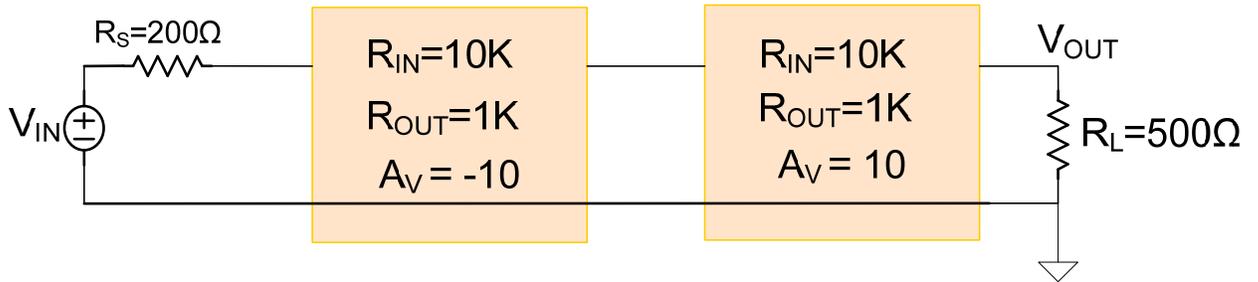
a) $T(s) = \frac{4}{s+2}$

b) $T(s) = \frac{4}{s^2 + a_3s + 6}$

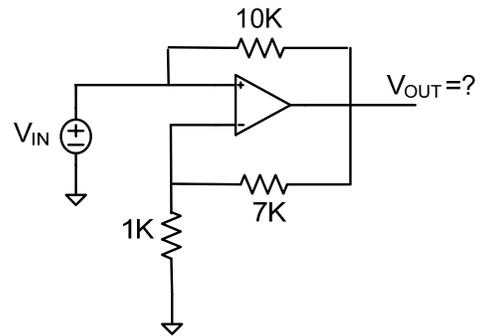
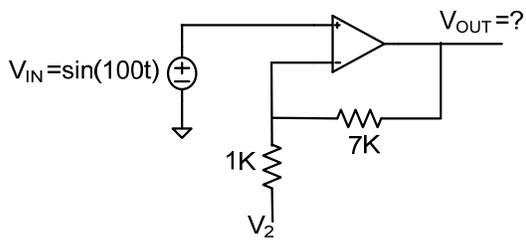
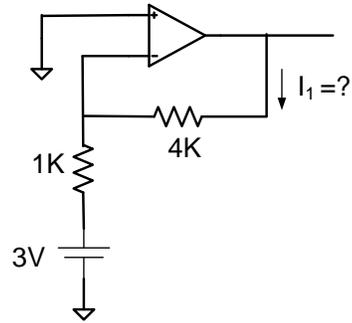
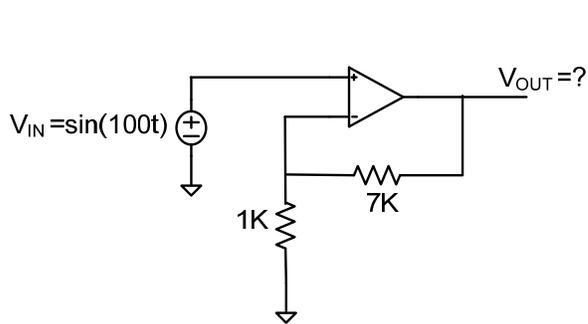
c)



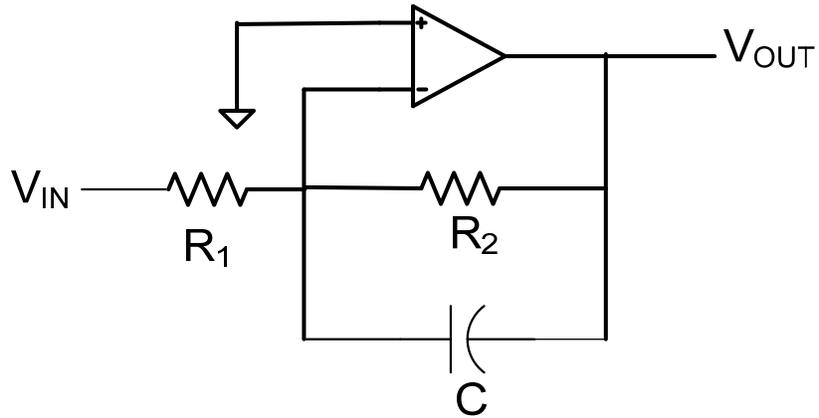
Problem 3 (10 pts) The circuit shown is the cascade of two voltage amplifiers that have a common ground. The amplifiers are unilateral and the model parameters for the amplifiers are indicated. The input is driven from a source with a source impedance of R_S . Determine the output voltage.



Problem 4 (20 pts) Determine the variables indicated with a ? on the following circuits.

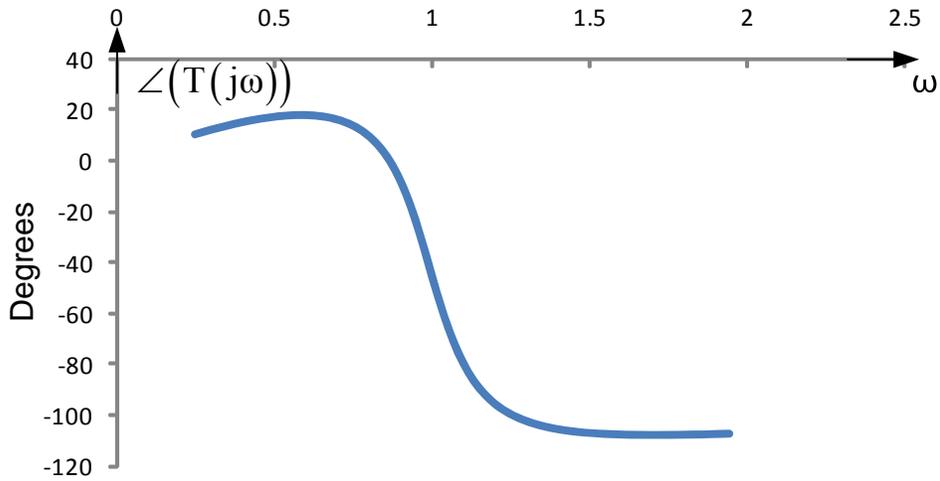
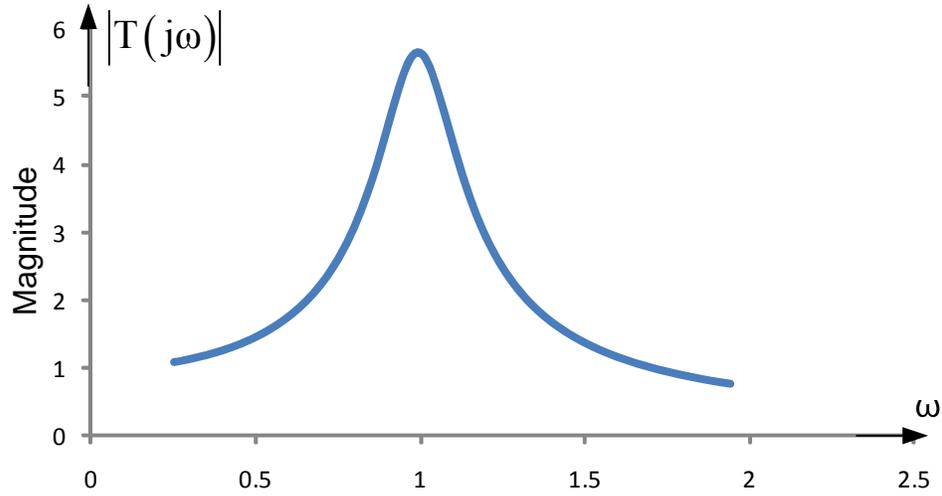


Problem 5 (10 pts): Determine the output of the following amplifier if the input is a 2V step function applied at time $t=0$. Assume an ideal op amp, and assume that the output voltage prior to the step input being applied was 0V.



Problem 6 (10pts) The magnitude and the phase of the gain of an amplifier are shown where the horizontal axis is in rad/sec.

- Determine the half-power bandwidth of the amplifier
- Determine the steady-state response if the input is $V_{IN}=0.2\sin(1.1t+30^\circ)$



Problem 7 (10 pts) Determine the input impedance (input is on the left side of the two-port) of the following amplifier

