EE 230 NAME ______________________

Exam 2

Spring 2010

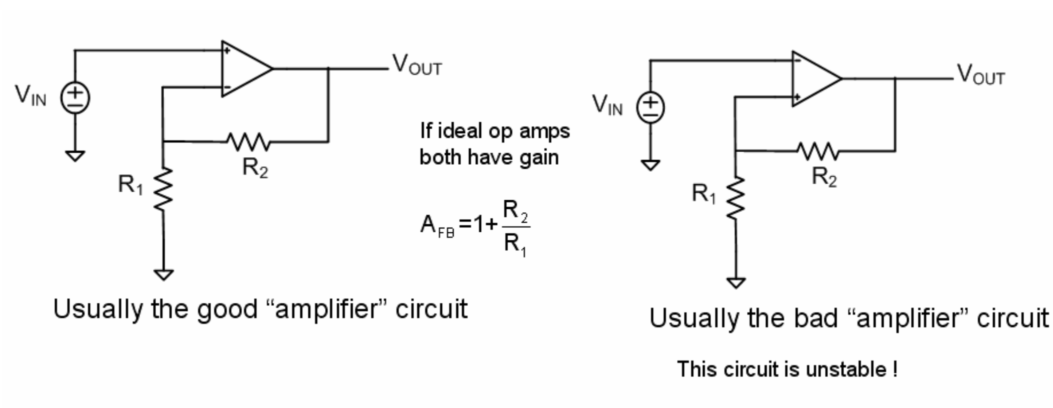
Instructions: There are 8 short questions and 5 problems. The points allocated to each of the questions are as indicated. The problems are all equally weighted with an assigned weight of 16 points each. All work should be included on the exam itself. Attach additional sheets only if you run out of space on a problem. Students may bring 2 pages of notes to the exam. Calculators are permitted but can not be shared.

Questions:

1. (2pts) What is a typical value for the input bias current for an operational amplifier with FET inputs?

2. (2pts) Why are the poles of a sinusoidal oscillator typically placed slightly in the right half plane?

3. (2pts) What model for the op amp was needed to show that if the op amp input terminals of the basic noninverting amplifier are interchanged, that resultant circuit does not behave as an amplifier?




4. (4 pts) If an op amp is modeled by the expression $A(s)=\frac{GB}{s+\tilde{p}}$ and if the GB of the op amp is 2MHz and the pole is located at 10 rad/sec, by how many dB does the gain drop as the frequency is increased from dc up to 10KHz?

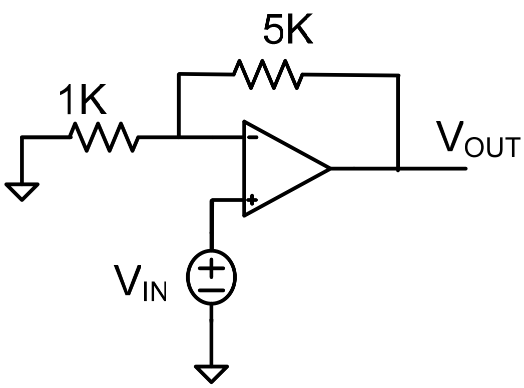
5. (2pts) If an op amp has an offset voltage of 3mV specified, it is often the case that if the offset is actually measured for a large number of op amps that have been shipped by the manufacturer, there will be few components that have an offset voltage that hat lies between that lies in the range from -1mV to 1mV. Why are those op amps with a low offset often not found in the shippment?

6. (2pts) When discussing the design of waveform generation circuits, the first step that we did when investigating the circuit was test for stability. What was the reason that stability tests were always conducted before an analysis was started?

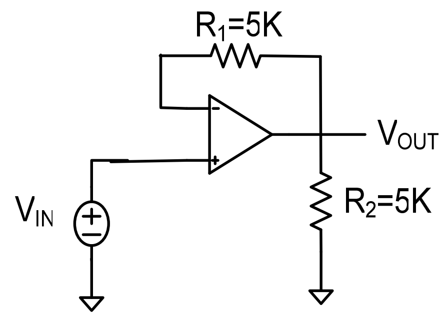
7. (2pts) When forming a “dead network”, what do we do with dependent voltage sources in the circuit?

8. (4pts) Describe a practical method for measuring the slew rate of an op amp.

Problem 1 Four circuits are shown. Determine the 3dB bandwidth and the worst case output offset voltage if the offset voltage is 2mV and the GB of the op amps is 5 MHz.




(a)

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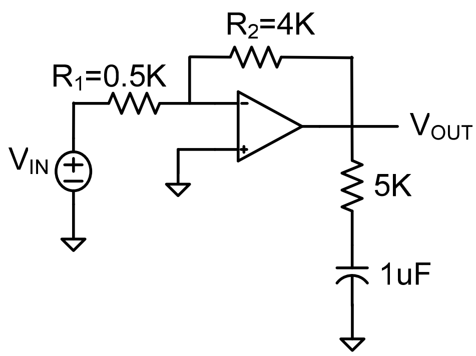


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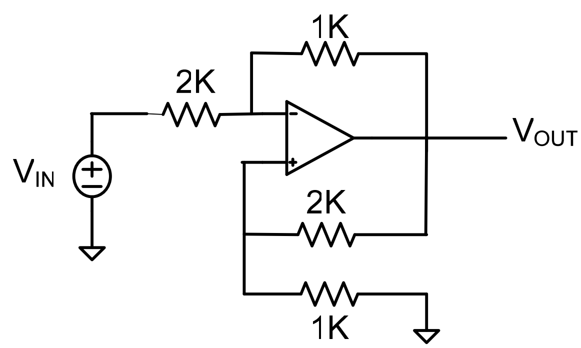
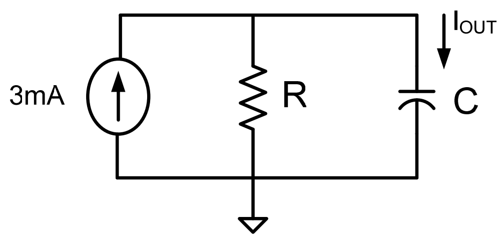
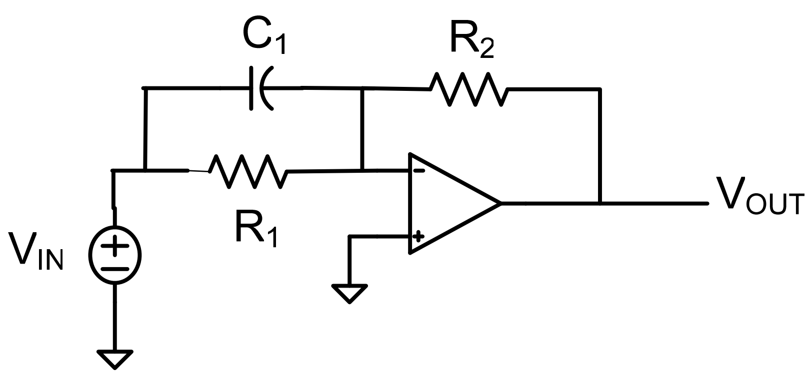
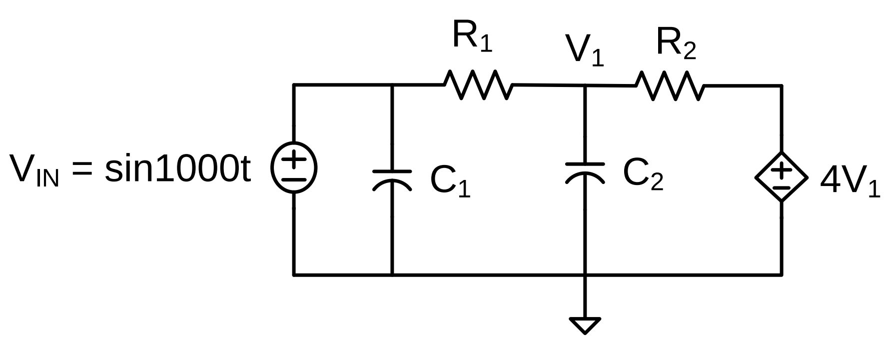



(d)

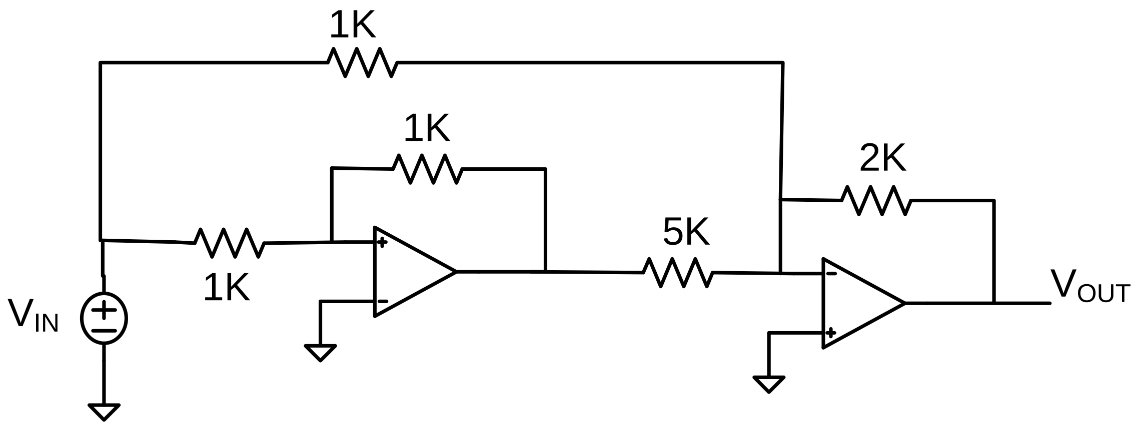
Problem 2 Determine the characteristic equation and the poles for the following circuits. Assume the op amps are ideal.



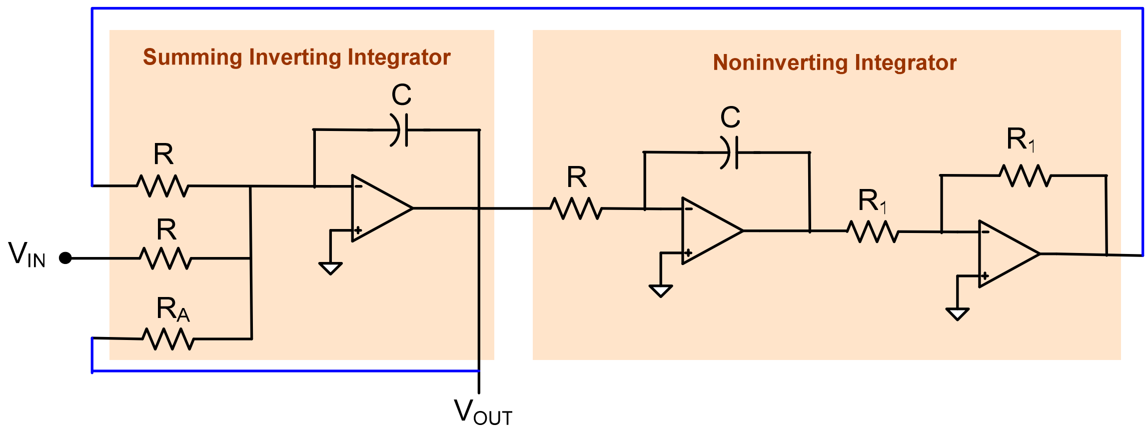



Problem 3 Assume the op amps have saturation voltages of $V_{SATH}$=16V and $V_{SATL}$= -16V. Obtain the transfer characteristics that relate $V_{OUT}$ to $V_{IN}$.



Problem 4 The filter circuit shown below has a transfer function from the designated input voltage to the designated output voltage of

$$T(s)=\frac{-\frac{1}{RC}s}{s^2+\frac{1}{R_AC}s+\left(\frac{1}{RC}\right)^2}$$




If $R=R_1=10K$, $C=0.1uF$ and $R_A=40K$, determine the frequency where the gain is a maximum, the 3dB bandwidth, and the maximum gain. Assume the op amps are ideal.

Problem 5 Design a circuit that implements the following I/O relationship:

$$V_{OUT} = 10\left(V_{IN1} - V_{IN2}\right) + 1000\int V_{IN3}dt$$

where $V_{IN1}$, $V_{IN2}$ and $V_{IN3}$ are three independent input voltages. Assume you have available ideal op amps and any number of resistors and capacitors.