ENGR4300
Fall 2005
Test 2A

Name_____

Section_____

Question 1 (25 points)_____

Question 2 (25 points) _____

Question 3 (25 points)_____

Question 4 (25 points)_____

Total (100 points): _____

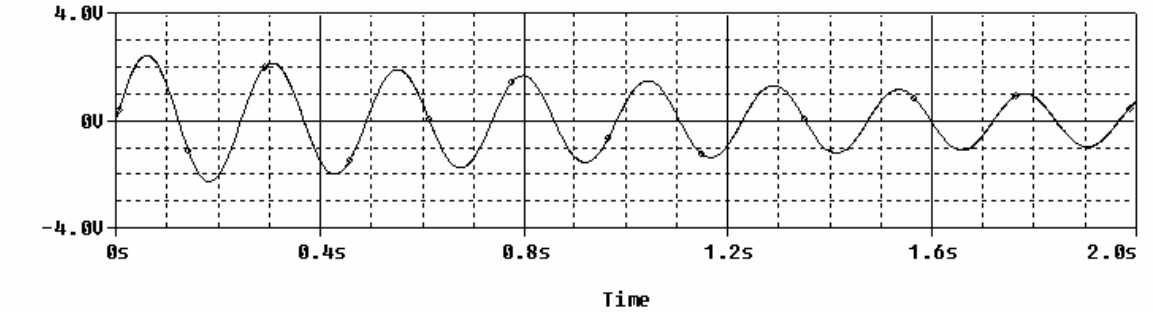
Please do not write on the crib sheets.

On all questions: SHOW ALL WORK. BEGIN WITH FORMULAS, THEN SUBSTITUTE VALUES AND UNITS. No credit will be given for numbers that appear without justification.

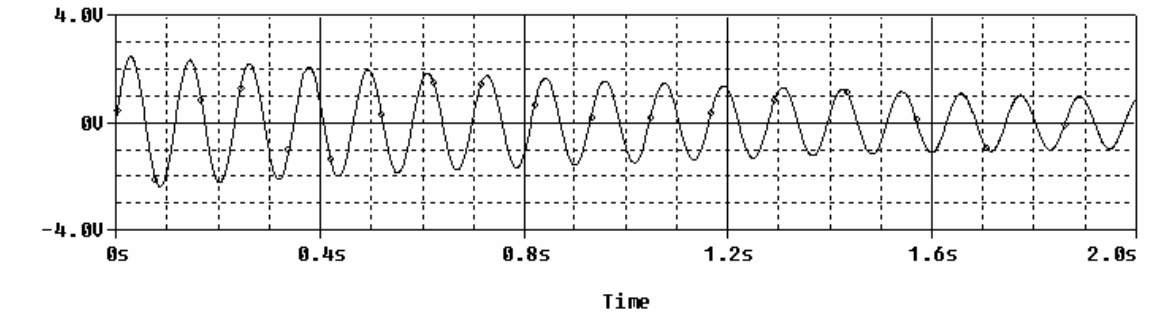
Question 1 – Damped Sinusoids and Strain Gauge Bridge (25 points)

You are given a cantilever beam similar to the one you used in experiment 4. You place two weights on the end of the beam (0.1 kg and 0.5 kg) and you get the following two plots.

Plot 1



Plot 2



1) What is the frequency of plot 1? (Use at least 2 significant figures) (2 points)

2) What is the frequency of plot 2? (Use at least 2 significant figures) (2 points)

3) What is the damping constant for plot 1? (Use at least 2 significant figures) (6 points)

4) Given the following formula, $k = (m + m_n)(2\pi f_n)^2$, and assuming that the two data points that you found are ideal, find values for k and m. (6 points)

5) What is the mass of the beam? (3 points)

6) Using the chart for Young's Modulus, determine the probable material that the beam is made out of given that the dimensions of the beam are: width = 1.5 cm, length = 20 cm, and thickness = 2 mm. (6 points)

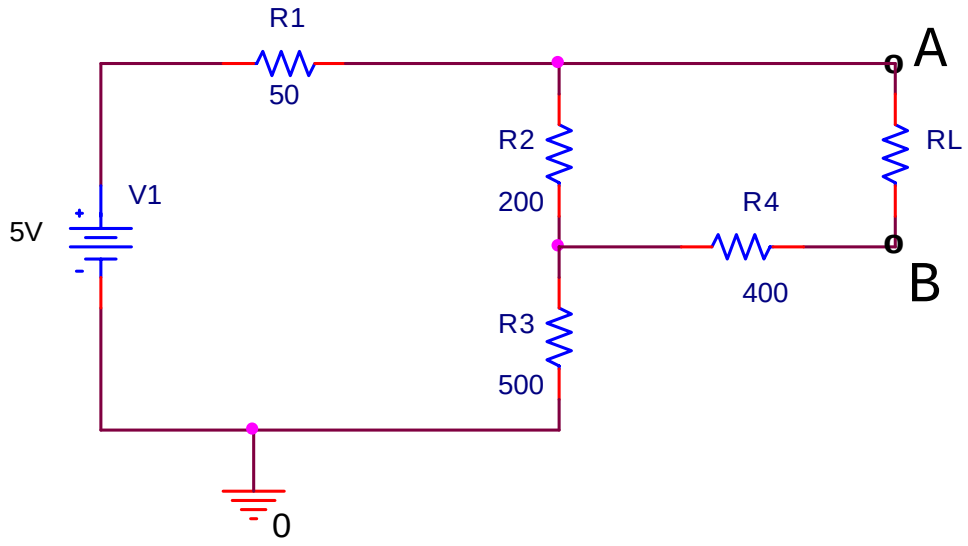
TABLE 9.1

Young's Modulus Table of Values

Metal	Elastic modulus (N/m2)	Metal	Elastic modulus (N/m2)
aluminum, 99.3%, rolled	6.96×10^{10}	lead, rolled	1.57×10^{10}
brass	9.02×10^{10}	platinum, pure, drawn	16.7×10^{10}
copper, wire, hard drawn	11.6×10^{10}	silver, hard drawn	7.75×10^{10}
gold, pure, hard drawn	7.85×10^{10}	steel, 0.38% C, annealed	20.0×10^{10}
iron, wrought	19.3×10^{10}	tungsten, drawn	35.5×10^{10}

Question 2 – Thevenin Equivalent Sources (25 points)

You are told to wire the following circuit in PSpice. All of the parts in this question refer to this circuit.



Part A: Finding the Thevenin Equivalent Source with respect to the load resistor, RL, between points A and B.

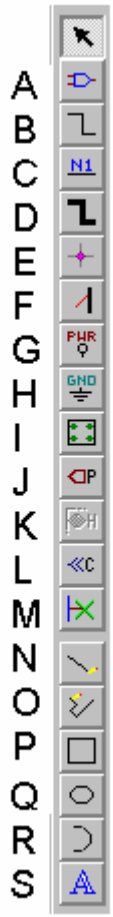
1) Determine the Thevenin Equivalent Voltage, V_{th}, with respect to RL. (6 points)

2) Determine the Thevenin Equivalent resistance, Rth, with respect to RL. (6 points)

3) If RL is 2K, what is the voltage between A and B? (3 points)

4) What is the current through the 2K resistor, RL? (2 points)

Part B: Wiring the circuit in PSpice



1) Of the icons shown at left, which would you use to add the DC source to the circuit? (2 points)

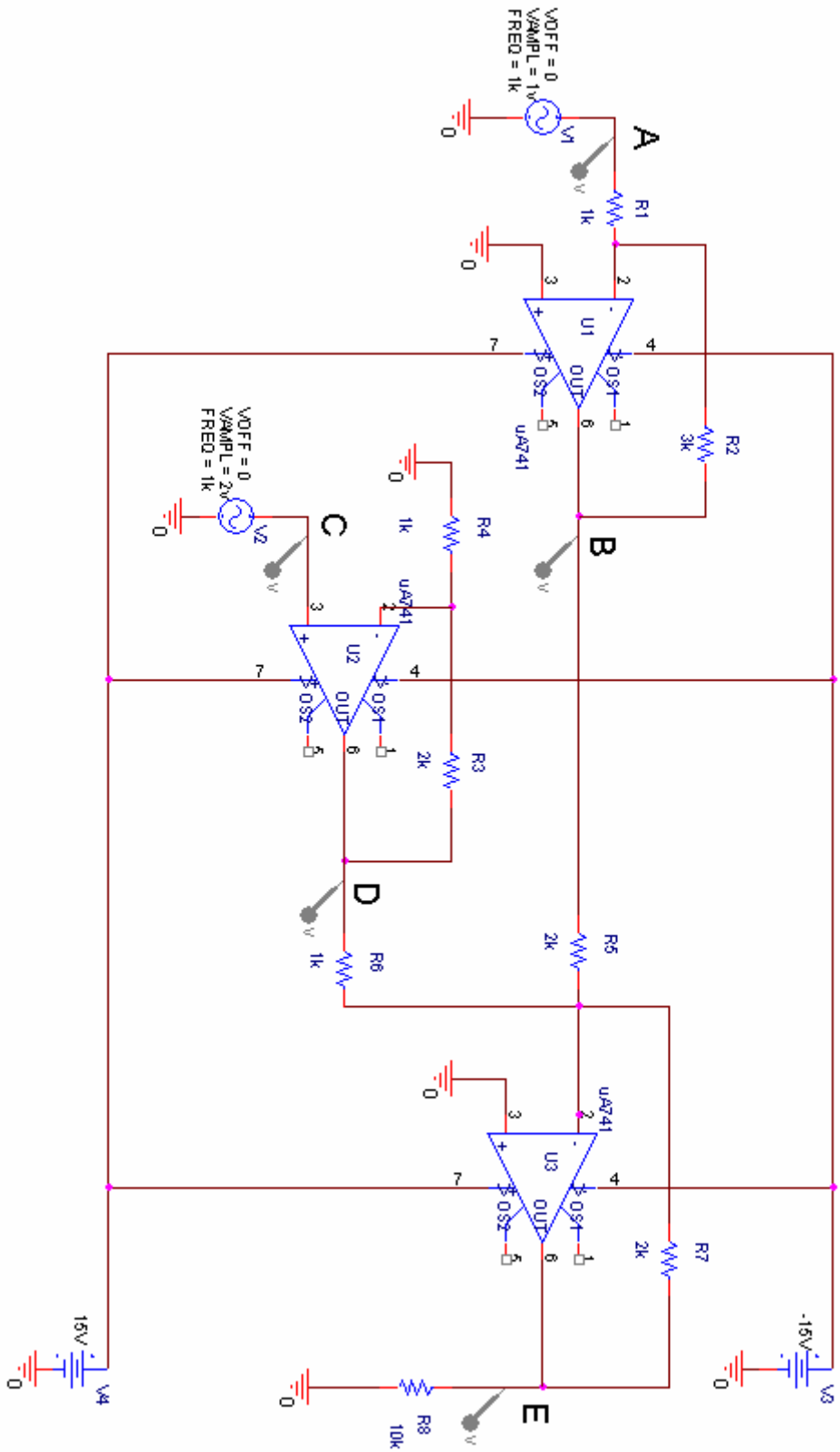
3) Of the icons shown at left, which would you use to add the ground to the circuit? (2 points)

2) Of the icons shown at left, which would you use to add a wire to the circuit? (2 points)

4) Which PSpice library contains the model for the resistors shown in the circuit above (circle one)? (2 points)

SOURCE EVAL ANALOG BREAKOUT

Question 3 – Op Amp Applications (25 points)



The following questions refer to the circuit on the previous page.

1) What type of op-amp circuit is between points A and B? (1 point)

2) What type of op-amp circuit is between points C and D? (1 point)

3) What type of op-amp circuit is between (B and D) and E? (1 point)

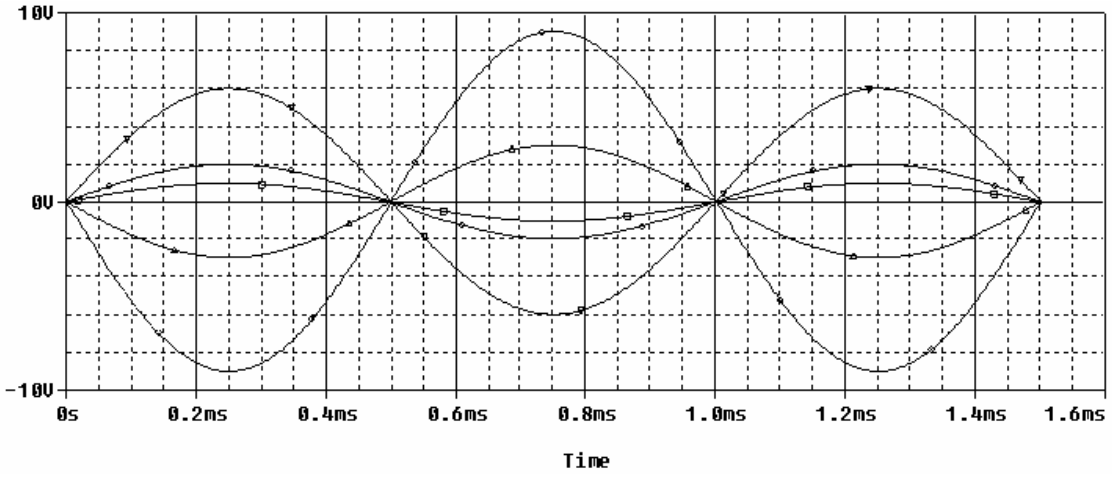
4) Write an expression for the voltage at point B, V_B, in terms of the voltage at A, V_A. Please substitute values. (3 points)

5) Write an expression for the voltage at point D, V_D, in terms of the voltage at C, V_C. Please substitute values. (3 points)

6) Write an expression for the voltage at point E, V_E, in terms of the voltage at B, V_B, and the voltage at D, V_D. Please substitute values. (3 points)

7) Write an expression for the output voltage at E, V_E, in terms of the two input voltages in the circuit, V_A and V_C. (3 points)

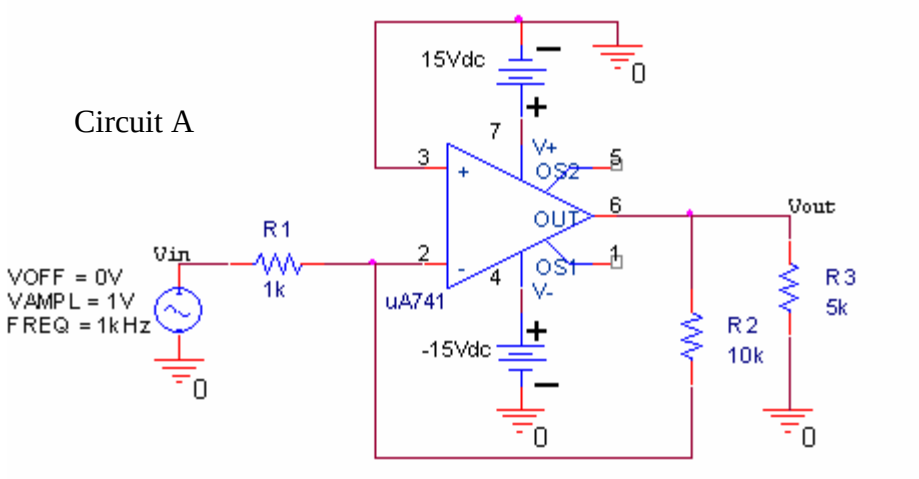
8) Identify the signals at points A, B, C, D and E in the PSpice plot below. (10 points)



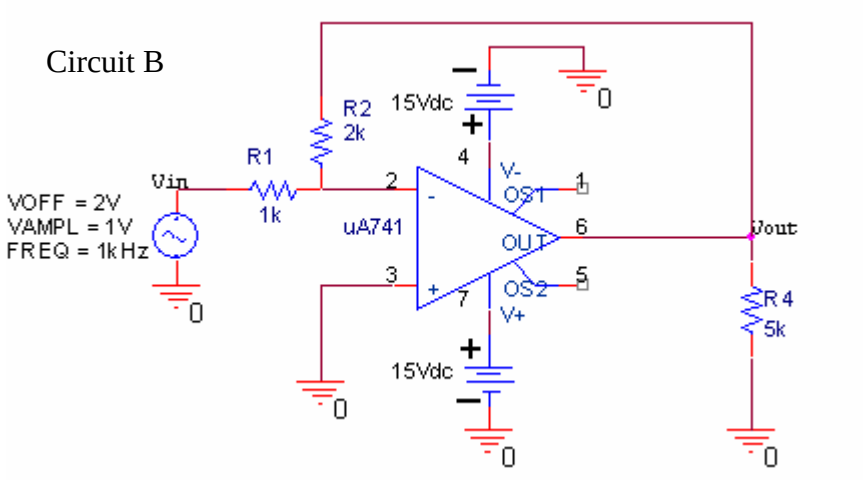
Question 4 – Op Amp Analysis (25 points)

Part A: Below are three op amp circuits you have wired in PSpice. One will function. The other two will not.

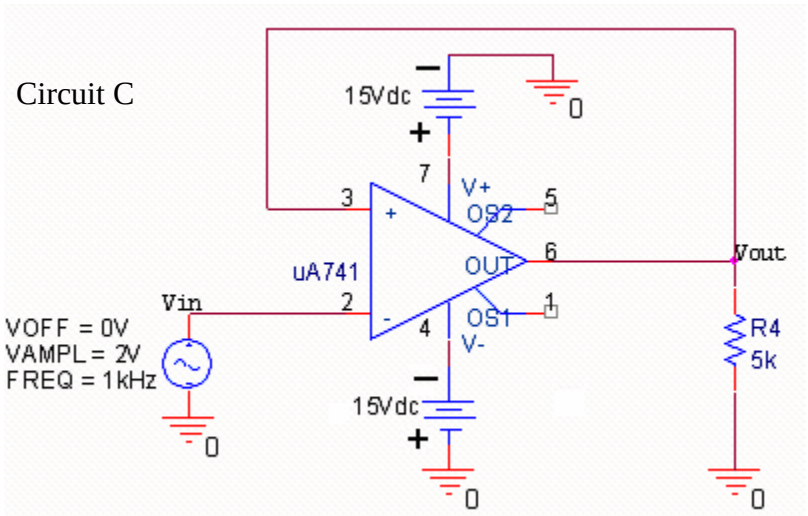
Circuit A



Circuit B



Circuit C



1) Which two of the three circuits will not function? For each circuit explain why you know it will not function. (2 points each = 4 points)

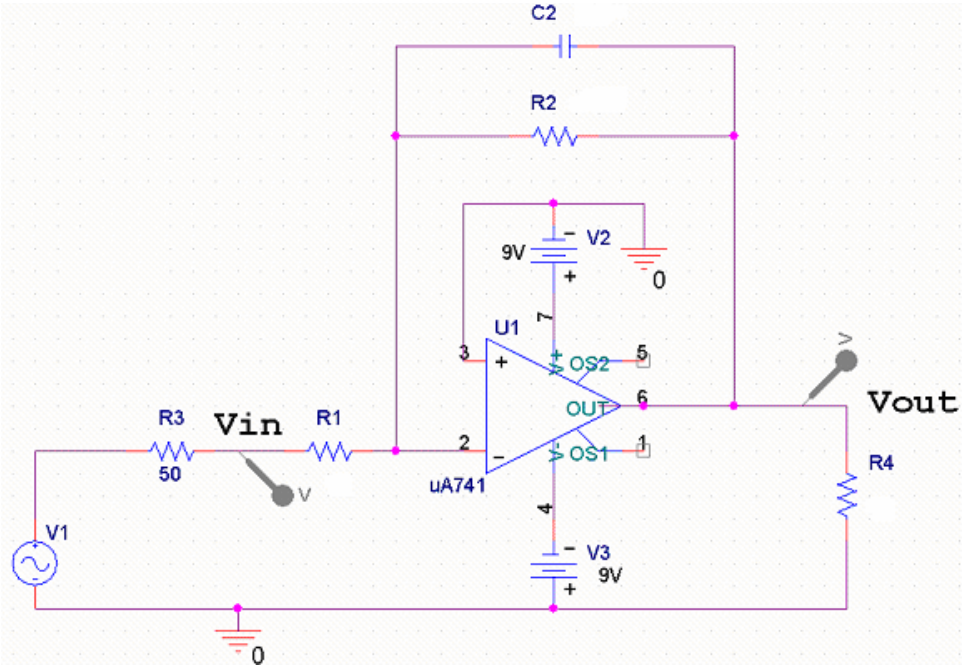
1]

2]

2) Which of the circuits does function? What type of amplifier is it? (2 points)

3) Draw two cycles of the input and corresponding output waveforms for the functioning circuit you identified in part 2. Specifically identify the amplitude for Vin and Vout. Label the time scale of the plot. (3 points)

Part B In the circuit below, R1 = 2K ohms, R2 = 47K ohms, C2=0.01μF, R4=1k ohms



1) Find the transfer function of this circuit in the form: $H(j\omega) = \dfrac{x_1 + jy_1}{x_2 + jy_2}$. Please substitute values. (3 points)

2) Find an expression (in terms of ω) for the phase of this circuit for any frequency. The phase is given by: $\phi = \tan^{-1}\left(\dfrac{y_1}{x_1}\right) - \tan^{-1}\left(\dfrac{y_2}{x_2}\right)$. (2 points)

3) What is the corner frequency of this circuit in Hz? (2 points)

4) For each of the following input frequencies, calculate the phase shift of the circuit AND use the phase to justify whether the circuit is behaving approximately as an inverting op-amp, an ideal integrator, or neither. (3 points each = 9 points)

5 Hz:

345 Hz:

34500 Hz