ENGR4300
Fall 2005
Test 4A

Name__________________________

Section_________________________

Question 1 (25 points)____________

Question 2 (25 points) ____________

Question 3 (25 points)____________

Question 4 (25 points)____________

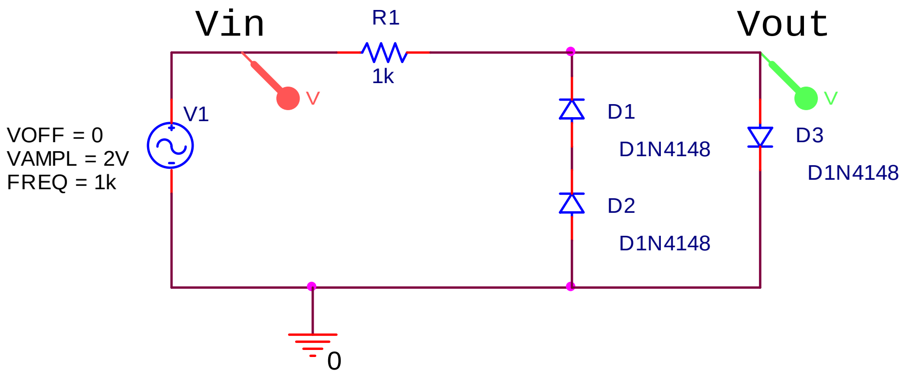
Total (100 points): _______________

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 – Diodes (25 points)

Part A: In the following circuit, assume that Von for all of the diodes is 0.7V.



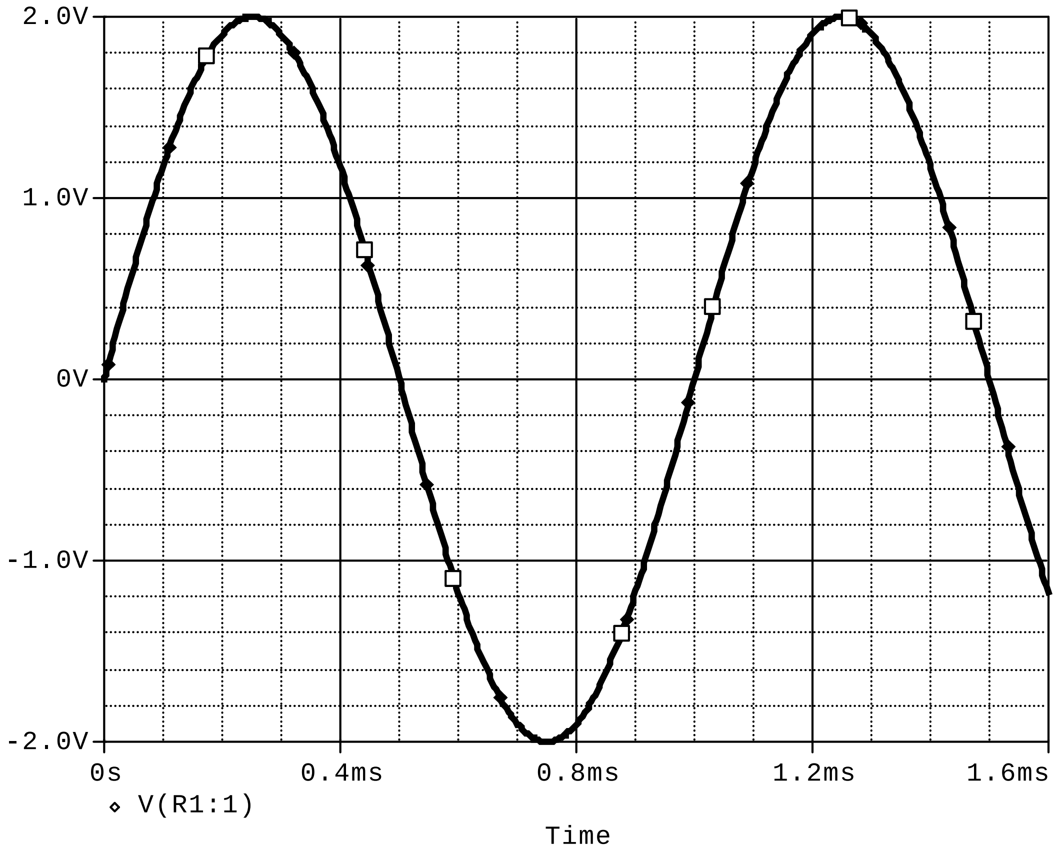
A1) Redraw what the circuit looks like for each of the three input voltages below. Replace the diodes that are on with voltage sources and the diodes that are off with open circuits. Indicate the voltage value of Vout. (3 pt each = 9 pt)

Vin = +2V:

Vin = -2V:

Vin = 0V:

A2) Sketch the output at Vout on this graph of Vin. (4 pt)

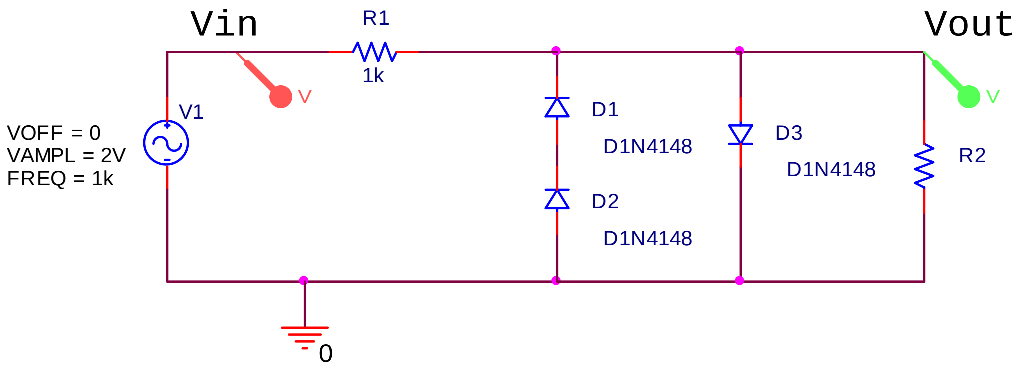


A3) What are the maximum and minimum *currents* through resistor R1? (4 pt)

maximum current:

minimum current:

Part B: We add a load resistor, R2, in parallel with the diodes, as shown below.

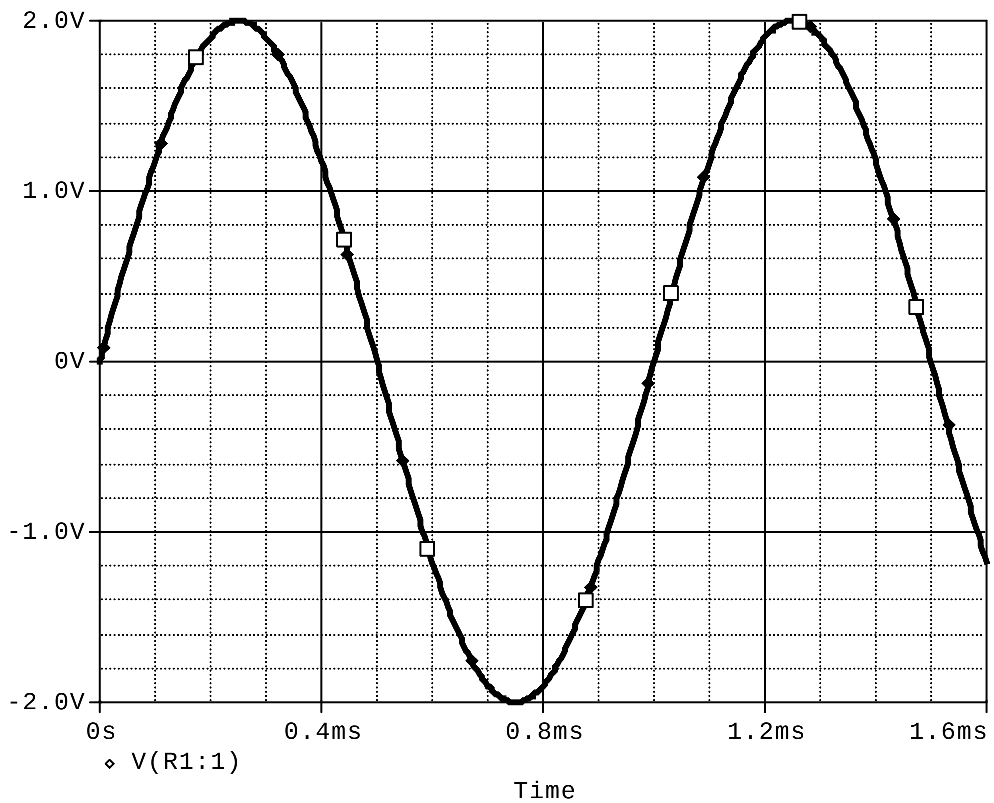


B1) If the load resistor is 1K Ω, what are the minimum and maximum *voltages* at Vout? (2 pt)

minimum voltage:

maximum voltage:

B2) Sketch Vout on the following graph of Vin for the load resistance of 1K Ω. (2 pt)

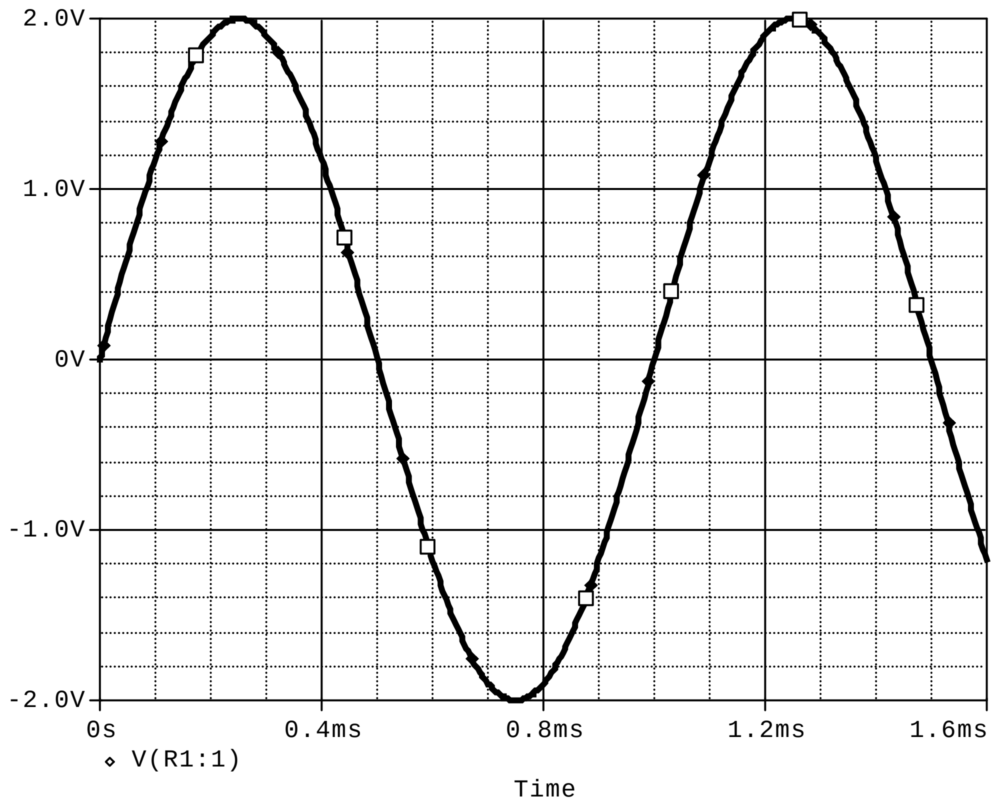


B3) If the load resistor is 200 Ω, what are the minimum and minimum *voltages* at Vout? (2 pt)

minimum voltage:

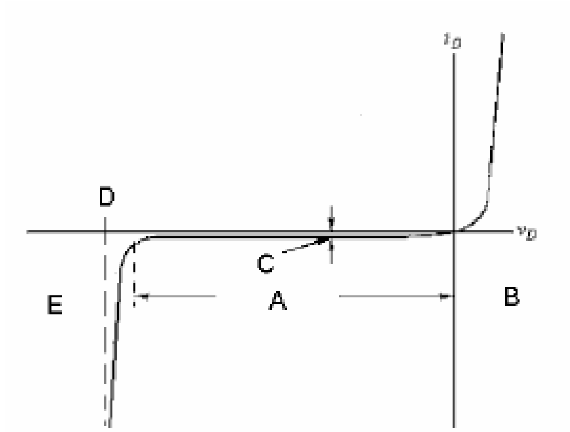
maximum voltage:

B4) Sketch Vout on the following graph of Vin for the load resistance of 200 Ω. (2 pt)



Question 2 – Zener Diodes (25 points)

Part A: Zener Diode Characteristics



a) Identify the following as shown on the characteristic curve above, or indicate if it is not shown or non-existent (NA) (circle one) [4 points]:

Zener Region	A	B	C	D	E	NA
Forward Bias Region	A	B	C	D	E	NA
Asymptotic Current Region	A	B	C	D	E	NA
Reverse Bias Region	A	B	C	D	E	NA
Zener Voltage	A	B	C	D	E	NA
Forward Voltage Limit	A	B	C	D	E	NA
Operating Current	A	B	C	D	E	NA
Saturation Current	A	B	C	D	E	NA

b) You've worked with the 1N750 Zener Diode in the lab. What was its zener voltage? (circle one) [2 point]

0.7V 2.2V 4.7V 9V 12V 13.7V 24V 75V 100V

c) What was its forward voltage drop (Von)? (circle one) [2 point]

0.7V 2.2V 4.7V 9V 12V 13.7V 24V 75V 100V

d) The junction in this zener diode and many other common diodes are made from the following: [1 point]

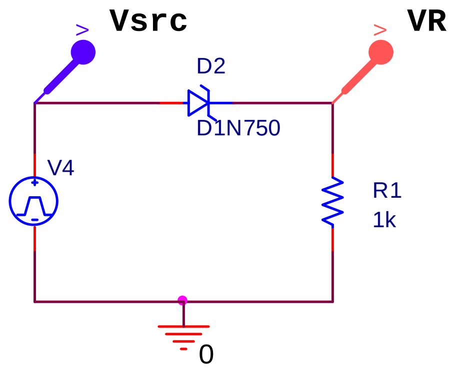
A. Face centered cubic and body centered cubic carbon film.

B. Tantalum diffusion bonded to tungsten.

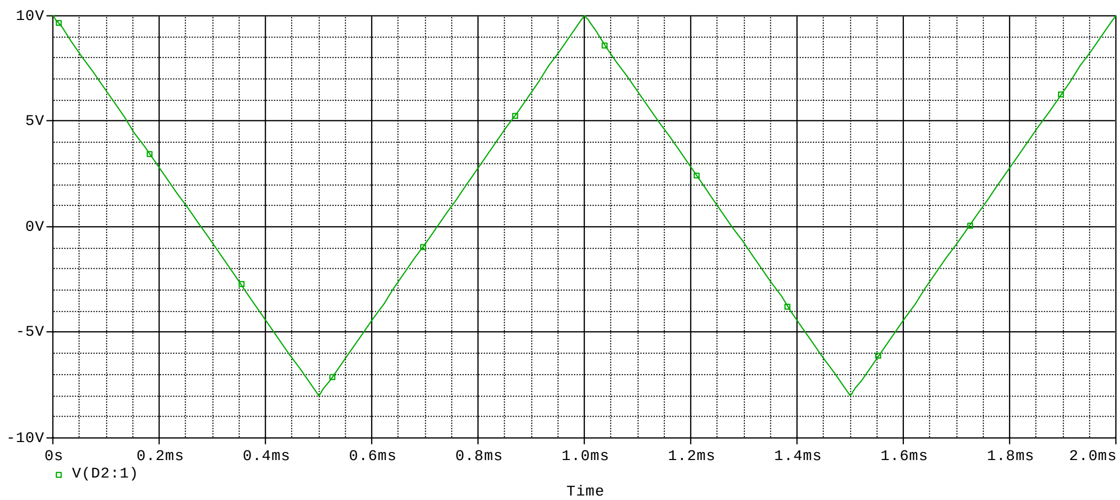
C. Silicon

D. Rare earth super alloys

Part B: Zener Diode Circuit



The circuit shown above is excited by the following waveform at V4:



a) Determine Vsrc and VR for the plot shown above at the listed times. [6 points]

Time	Vsrc [½ pt each]	VR [½ pt each]
0ms		
0.1ms		
0.2ms		
0.3ms		
0.4ms		
0.5ms		

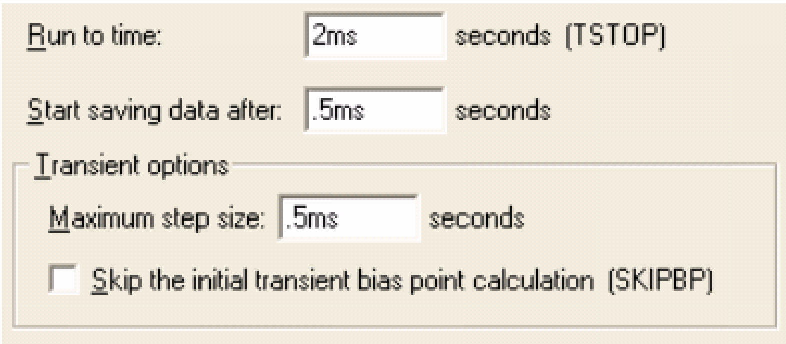
b) Sketch the output of the circuit, VR, on the plot of the input shown. [4 points]

c) What is the (approximate) current flowing in the resistor at: [2 points each = 4 points]

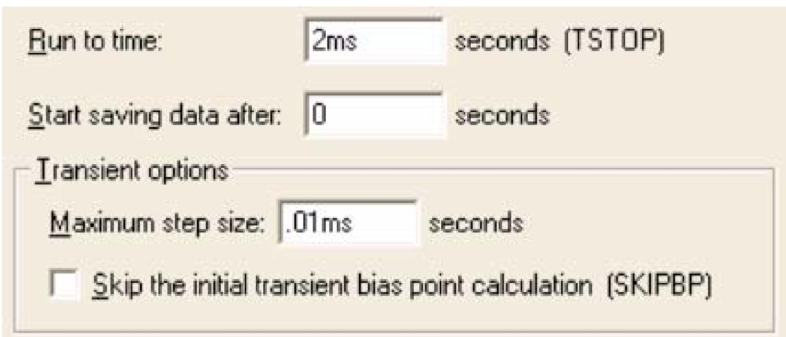
0.9ms: 1.3ms

d) Which of the following PSpice Simulation Settings would have been used have been used to create this graph? (Circle one) [2 point]

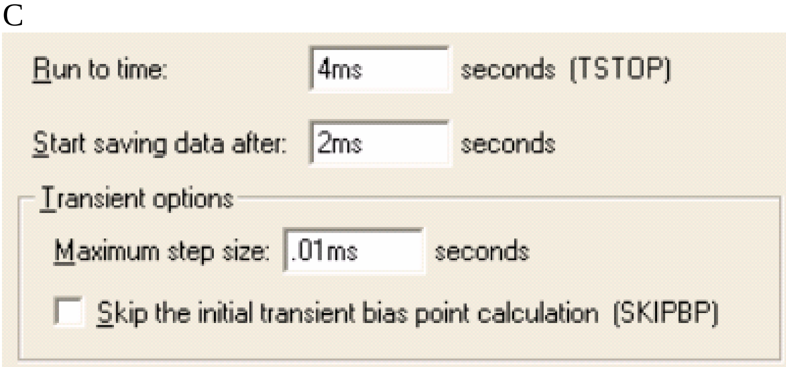
A



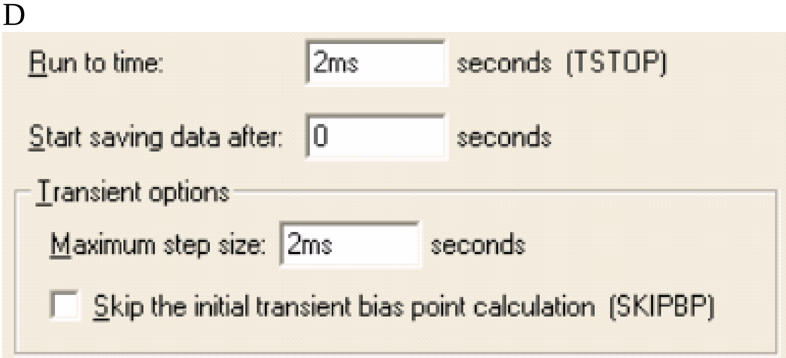
B



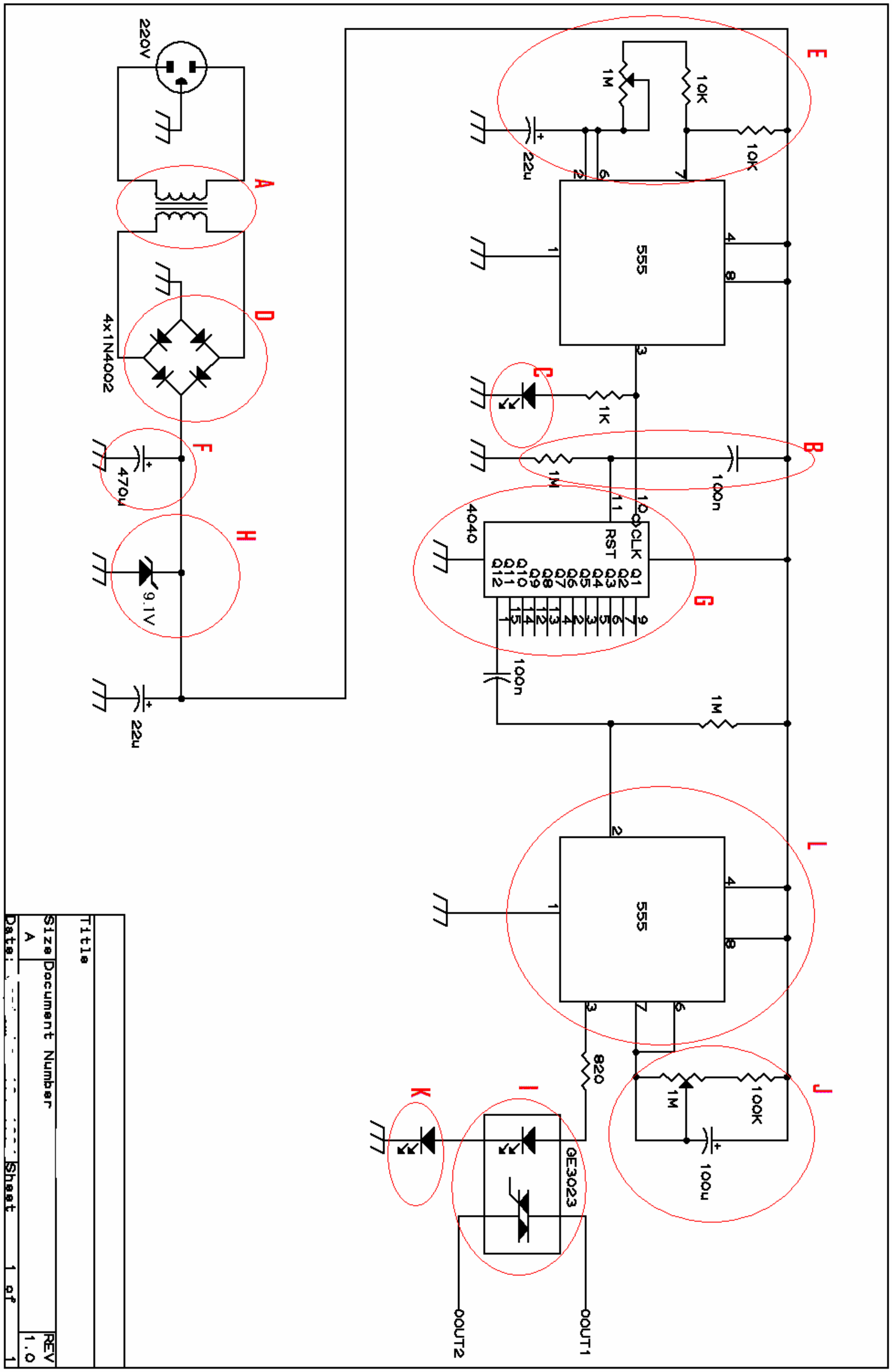
C



D



Question 3 – Circuit Functionality (25 points)



Given the schematic on the previous page, answer the questions that follow. [Hint: Although you have not used every component shown in the circuit, you should have no difficulty inferring functionality based on what you have learned in EI.]

a) What labeled (e.g. A-K) components are part of the power supply sub-circuit? (2 pts)

b) What is the source voltage of the circuit? Indicate (AC or DC) and (amplitude or voltage). (2 pts)

c) Which device in the circuit uses electromagnetism to provide electrical isolation between different parts of the circuit *and* how is this isolation achieved? (3 pts)

d) Does this power supply use a half-wave or full-wave rectifier? (1 pt)

e) What best describes the function of the Zener diode? (circle one) (1 pt)

A) Transistor	B) H-Bridge	C) Battery
D) Transformer	E) Voltage Regulator	F) FM Modulator

f) Which 555 timer is configured in astable mode? (1 pt)

A) The one on the left side of the print C) Neither

B) The one on the right side of the print D) Both

g) Find the on-time of the multivibrator circuit containing the components labeled E, when the resistance of the 1Meg ohm variable resistor 10k ohms. (2 pts)

h) Assume the 555 timer is powered with 9VDC, how much current is likely flowing in the LED labeled C? Assume that Von for the LED is 2.1 volts. Show all work. (3 pts)

i) Pin 2 of the 555 timer is a: [Hint: Recall where pin 2 (trigger) is connected inside the 555-timer.] (1 pt)

A) Low-impedance input B) High-impedance input

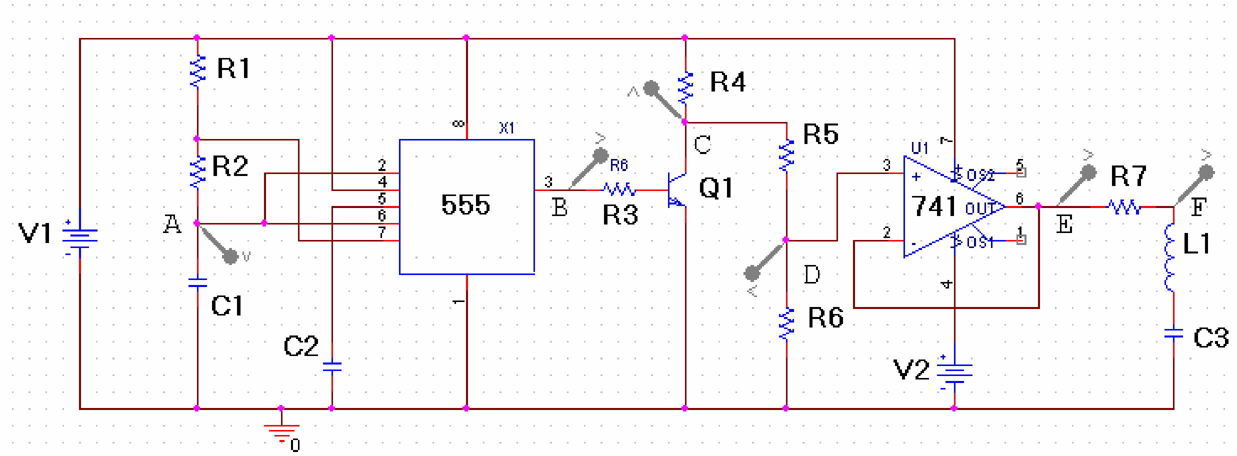
C) Low-impedance output D) High-impedance output

j) Assume that when power is first applied to the circuit, all capacitors are discharged. Explain what the R-C circuit labeled B does and how it accomplishes this. [Hint: What is the equation for the behavior of a capacitor? What happens when the circuit is first given voltage? ...once the desired voltage is achieved?] (3 pts)

k) Assuming that the outputs on the counter (labeled G) are ordered in the same way that the outputs on the 393 counter we used in experiment 7 are, how many pulses has the counter counted when it sends a pulse to the 555 timer labeled L? (3 pts)

l) If you decided to build this circuit and found a transformer with a turns ratio of 22:1, assuming other transformer parameters are suitable, would this work to provide our 555 timers with about 9VDC? Justify your answer. Show all work. (3 pts)

Question 4 – Ringing Pulse Circuit (25 points)



The circuit above generates a ringing pulse. Assume the components have the following values:

C1 = 0.1µF, C2 = 0.01µF, C3 = 0.068µF
R1 = 1K Ω, R2 = 10K Ω, R3=1KΩ, R4 = 1KΩ, R5=9K Ω, R6=1K, R7=50Ω
R_L (the internal resistance of the fluorescent bulb) varies as the lamp functions.
L1 = 10mH
V1 = +12 V, V2 = -12V

1) Circle and identify the following circuit elements (5 pt)

a. A voltage divider
b. An astable multivibrator
c. An RLC circuit
d. A transistor circuit
e. An op-amp circuit

2) What kind of op-amp circuit is e? (1 pt)

3) Calculate the frequency of the astable multivibrator in Hertz. (2 pt)

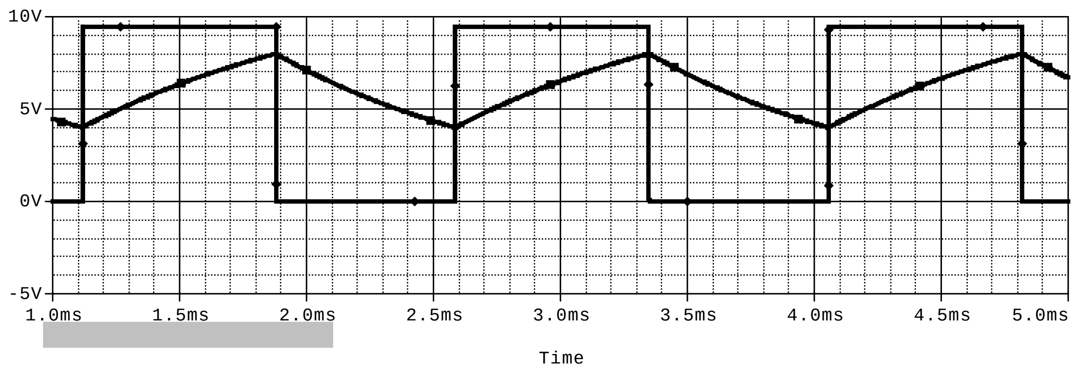
4) Fill in the voltages in the chart below based on the theoretical behavior of the circuit. In the row labeled LOW, give the voltages for all signals when the output at pin 3 of the 555 is low and in the row labeled HIGH, give the voltages for all signals when the output at pin 3 of the 555 is high. Assume all devices have no internal losses .(10 pt)

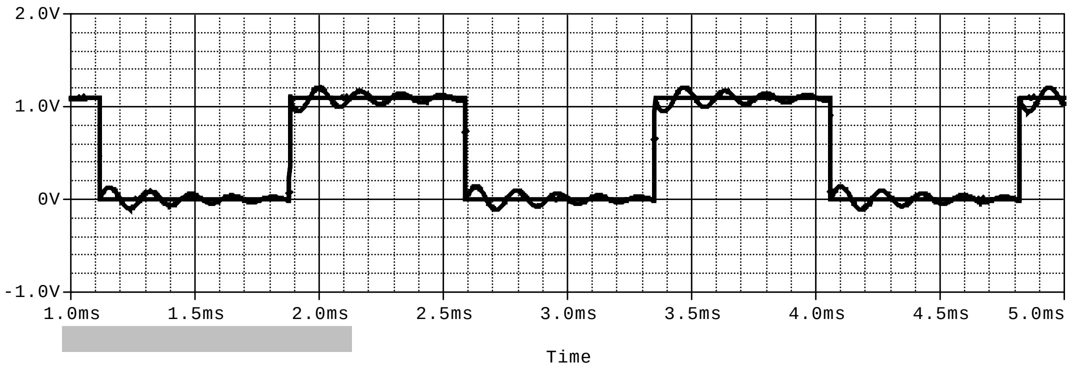
Output at pin 3	point A (voltage)	point B (voltage)	point C (voltage)	point D (voltage)	point E (voltage)
LOW					
HIGH					

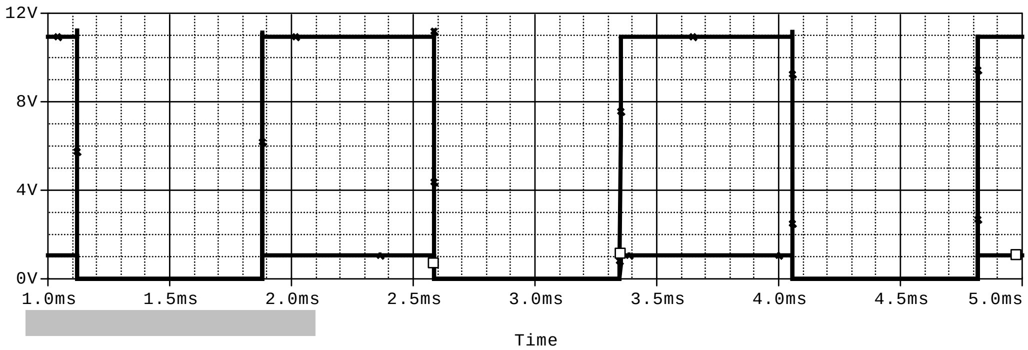
Calculations:

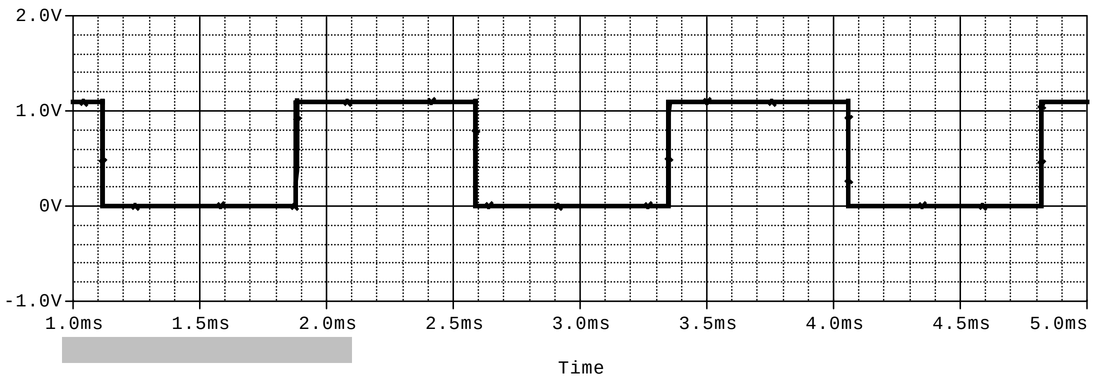
5) Calculate the resonant frequency in Hertz of the signal at F. (2 pt)

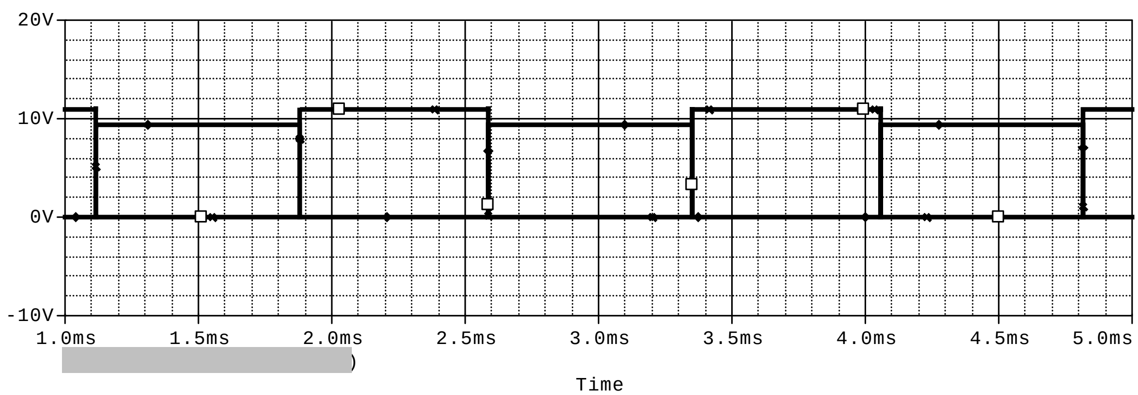
6) Identify which of the following plots goes with which block of the circuit (A-B, B-C, C-D, D-E, E-F) All graphs have two signals. (5 pt)




2.0V
1.0V
0V
-1.0V
1.0ms 1.5ms 2.0ms 2.5ms 3.0ms 3.5ms 4.0ms 4.5ms 5.0ms
Time


12V
8V
4V
0V
1.0ms 1.5ms 2.0ms 2.5ms 3.0ms 3.5ms 4.0ms 4.5ms 5.0ms
Time


2.0V
1.0V
0V
-1.0V
1.0ms 1.5ms 2.0ms 2.5ms 3.0ms 3.5ms 4.0ms 4.5ms 5.0ms
Time


20V
10V
0V
-10V
1.0ms 1.5ms 2.0ms 2.5ms 3.0ms 3.5ms 4.0ms 4.5ms 5.0ms
Time