

MID-TERM EXAMINATION (90 minutes)
EXAMEN DE MI-SESSION (90 minutes)

Professeur/Professor E. Gad **Nom/Name** : _____
Date Feb. 14th 2014 **St./Étudiant #:** _____

This is a closed book exam
Answer all questions
Explain all your answers
Programmable calculators are not permitted

QUESTION	Q1/35	Q2/25	Q3/25	Q4/15	Total/100
Mark					

QUESTION 1

The diode in the circuit shown in Figure 1 is an ideal diode. Plot the relation between v_{out} versus v_{in} .

IMPORTANT

You **MUST** show clearly on your plot the exact coordinates of all the break points and the exact slopes of each linear segment in your graph. A graph lacking this information will not be considered for marking.

You **MUST** also use the graph area provided below to sketch the relation you find.

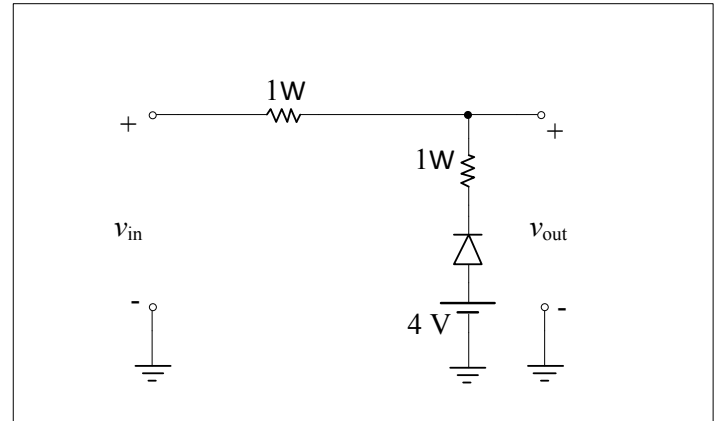
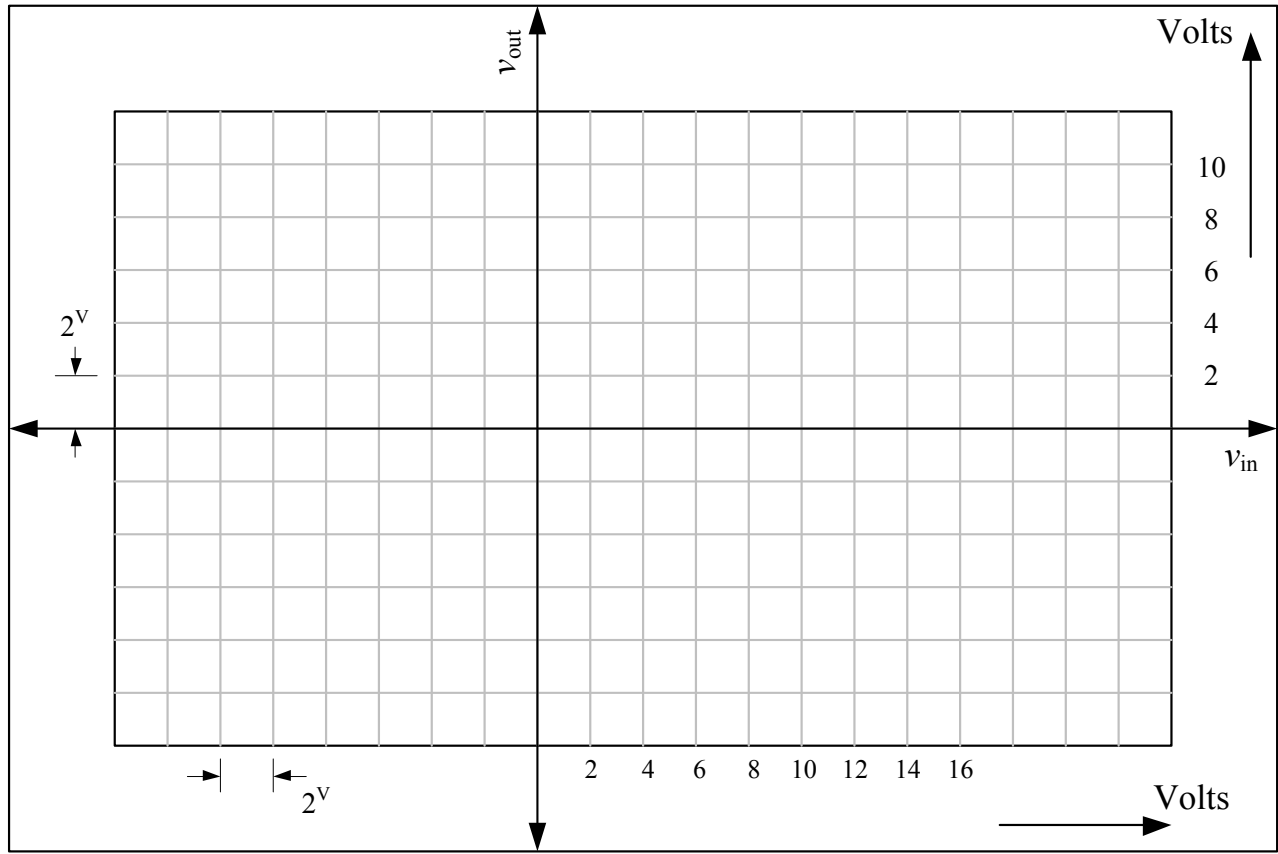


Figure 1



QUESTION 2

A bridge rectifier circuit, shown in Figure 2, is fed by a sinusoidal source of frequency 60 Hz and RMS value of 120 V, and is loaded with a resistor R_L of 1 k Ω . Figure 3 provides the waveforms appearing at the input, v_S , and output v_O , of the bridge circuit. Assuming that the diodes are modeled by the “battery+ ideal diode+ resistance”, where the constant battery has 0.7 volts, the forward resistance r_D is 50 Ω .

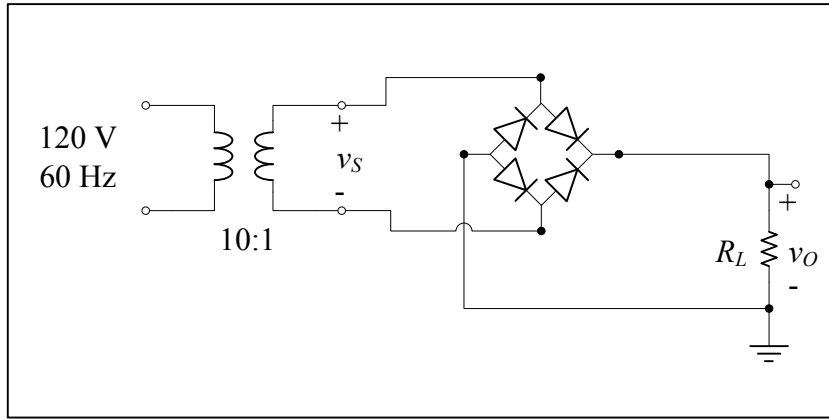


Figure 2

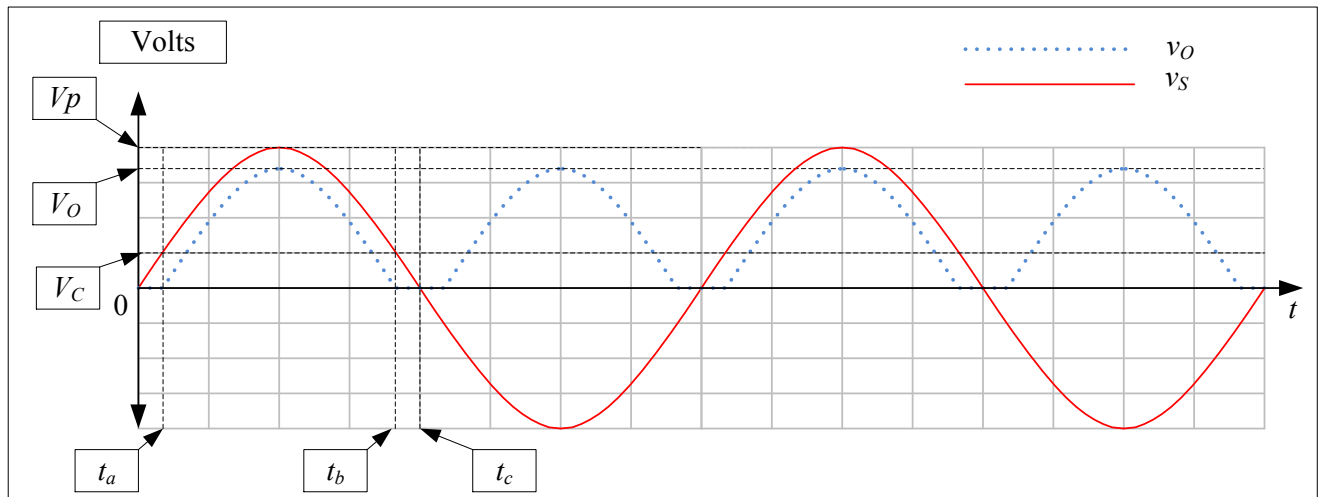


Figure 3

1. Calculate all of the points indicated in Figure 3, and write your answer in the corresponding places given in the table below.

t_c	t_b	t_a	V_p	V_O	V_C

2. Assume that the load resistance, R_L the above circuit is $10\text{ k}\Omega$ and that the diodes are modeled by a constant battery of 0.7 volts , and a forward resistance of $r_D = 0\ \Omega$. Modify the circuit shown in Figure 4 (by adding a suitable circuit element, specifying its value and showing how you calculated this value), so that the output voltage will have a maximum of $\pm 0.5\text{ V}$ ripple.

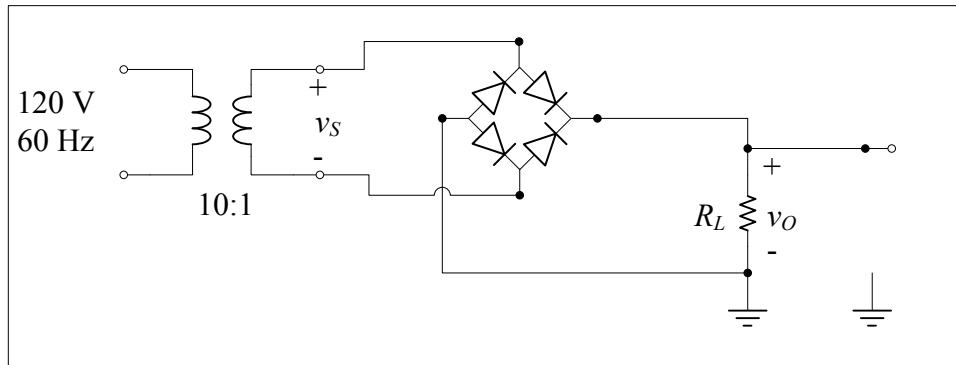


Figure 4

QUESTION 3

The diode in the circuit shown in Figure 5 is an ideal diode. Assuming an input sinusoidal signal, v_{in} , having a 10V peak value, and 1 kHz frequency, as indicated by Figure 6, sketch on **the same graph of Figure 6**, the output voltage v_{out} .

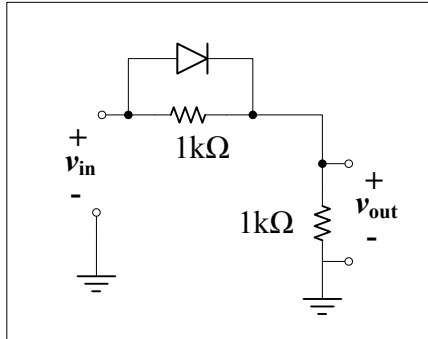


Figure 5

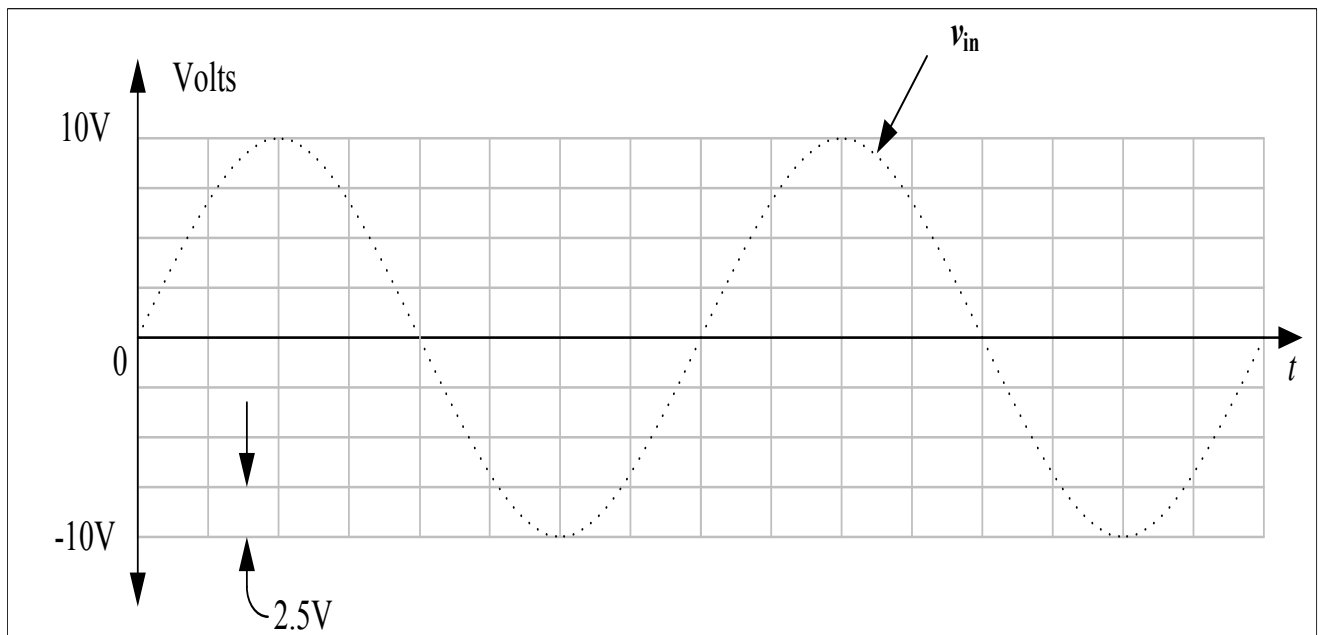


Figure 6

QUESTION 4

Consider that a bar of Silicon is placed along the x-axis as shown in Figure 7, and let there be an electric field, E , directed along the x-axis in the positive direction as indicated by the same figure. Assume that the Silicon material has been doped by donor atoms, N_D , i.e. atoms that donate one free electron per atom, and that the distribution of the density of those atoms along the x-axis follows the exponential distribution shown in Figure 8. Give a symbolic expression, (i.e. an expression in terms of E , W , L , h , L_p , L_n , N_{D0} , Δ_D , and all other necessary parameters from your formula sheet), for the total current **at the middle** of the Silicon bar.

NOTE You must clearly show your derivations.

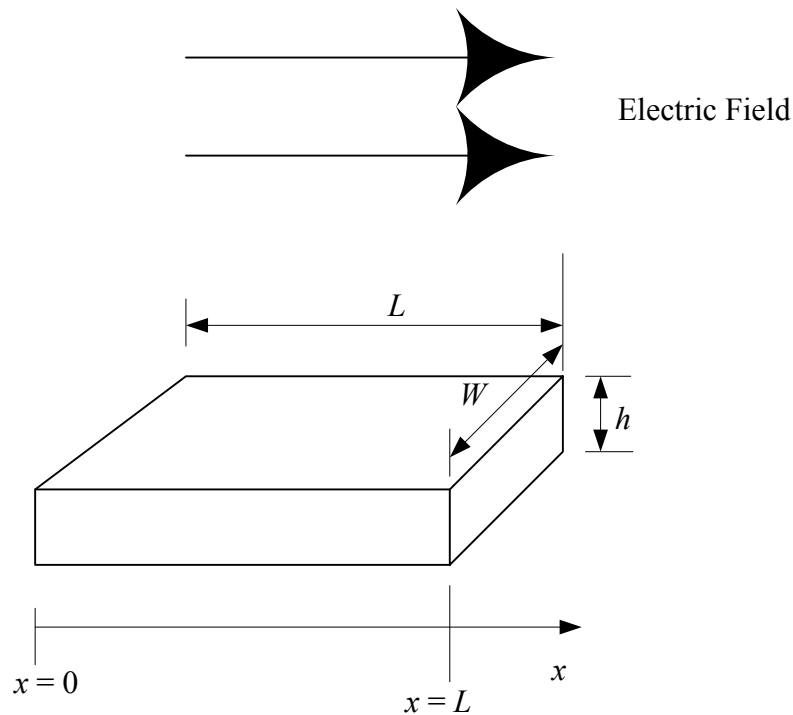


Figure 7

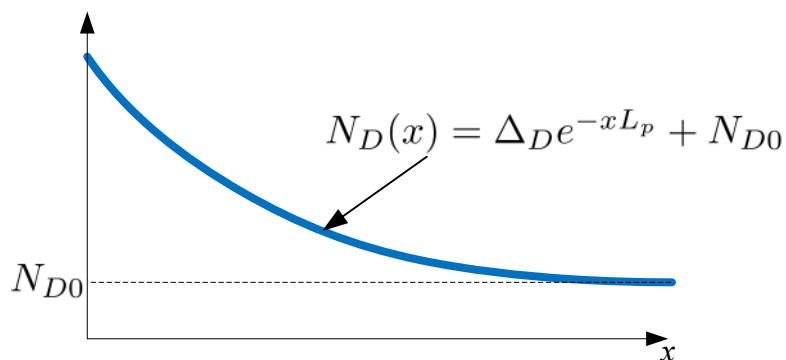


Figure 8

Extra space