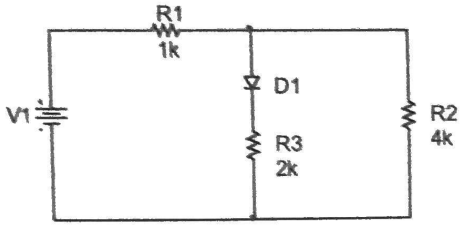
ECSE-2050 **Introduction to Electronics**
Spring 2020 **Name** _____

Homework 6

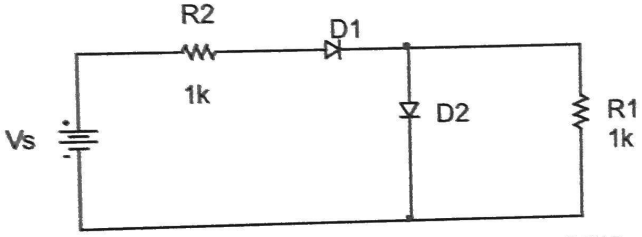
Reading: 2.7-8, (Chapter 3 concepts), 4.1-3
Problem 1) Ideal diodes, on/off conditions



a) Determine the range of voltages for which the above diode is 'on' when the turn-on voltage of the diode is 0V. Diode = "on" for $V1 > 0V$

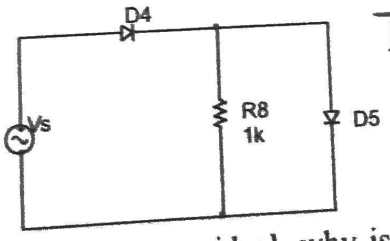
b) Determine the range of voltages for which the above diode is 'on' when the turn-on voltage of the diode is 1V. $V_1(4k)/(1k+4k) = 1 = 1.25V$

$V_1 \geq 1.25V$



c) For Vs = 1V and ideal diodes with a turn-on voltage of 0V, determine the voltage across and current through each diode. $V_{D_1} = V_{D_2} = 0V$ $I_{D_1} = I_{D_2} = 1mA$

d) For Vs = 1V and ideal diodes with a turn-on voltage of 0.7V, determine the voltage across and current through each diode. $V_{D_1} = .7V$ $V_{R_2} = .3V$



$I_{D_2} = 0A$ $I_{D_1} = .15mA$

e) If the diodes in the above circuit are ideal, why is the circuit problematic? (The turn-on voltage is not necessary for this question.)

- If the diodes are ideal this is just a short circuit for Vs.

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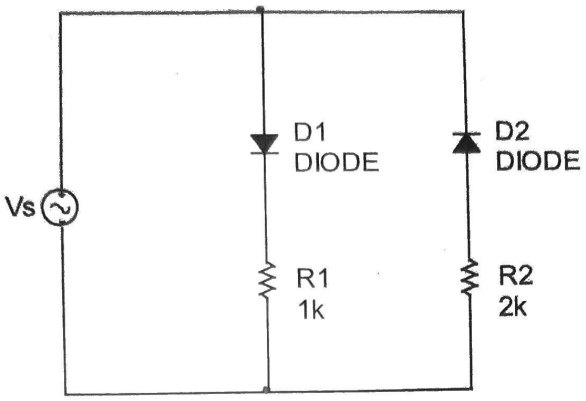
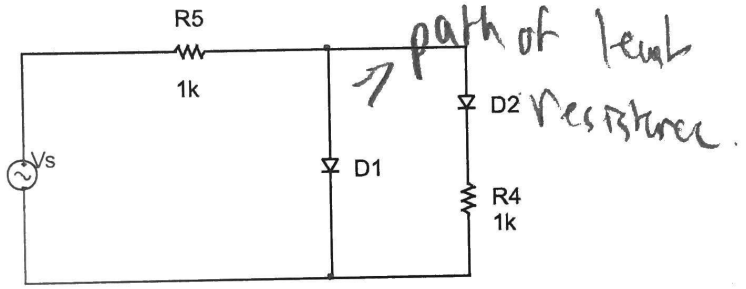
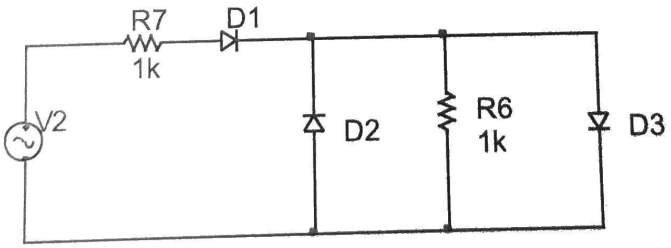
Problem 2) Sinusoidal sources



a) For ideal diodes with turn-on voltages, 1V, plot the current through each diode as a function of time. The source voltage is Vs = 2sin(ωt). Include a plot of Vs for reference.

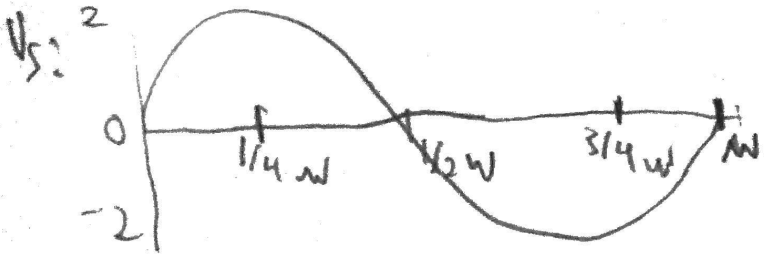


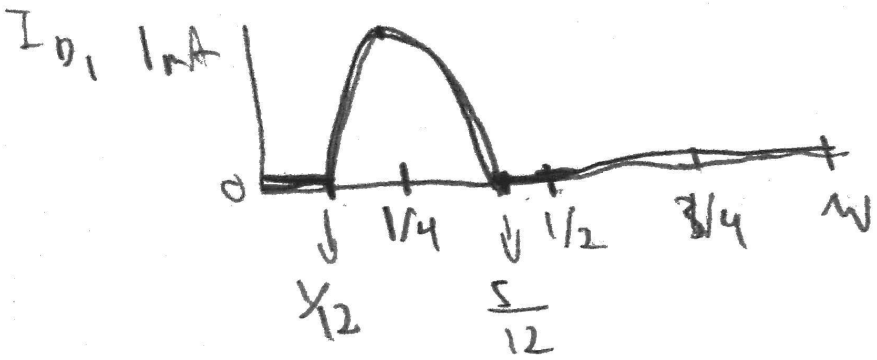
b) For ideal diodes with turn-on voltages, 1V, plot the current through both diodes (separate plots for ID1 and ID2) as a function of time. The source voltage is Vs = 4sin(ωt). Include a plot of Vs for reference.



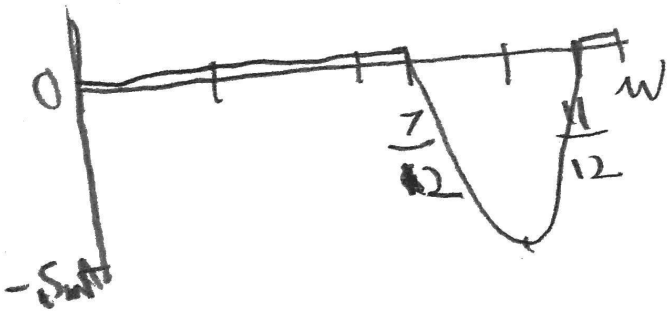
c) For ideal diodes with turn-on voltages, 1V, plot the voltage across R6 as a function of time. The source voltage is Vs = 4sin(ωt). Include a plot of Vs for reference.

2A:

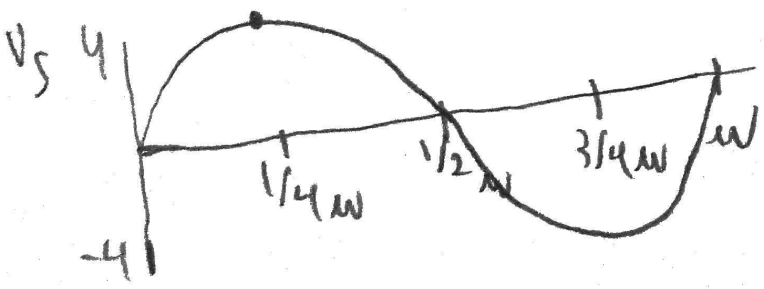

V_S:
2
0
-2
1/4 w
1/2 w
3/4 w
w

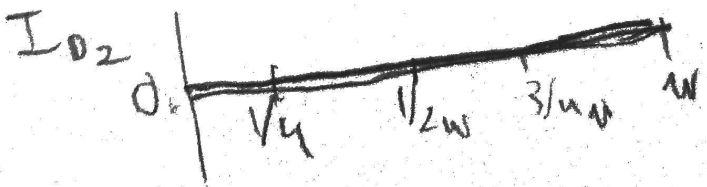

I_{D_1} 1mA
0
1/4
1/2
3/4
w
1/12
5/12

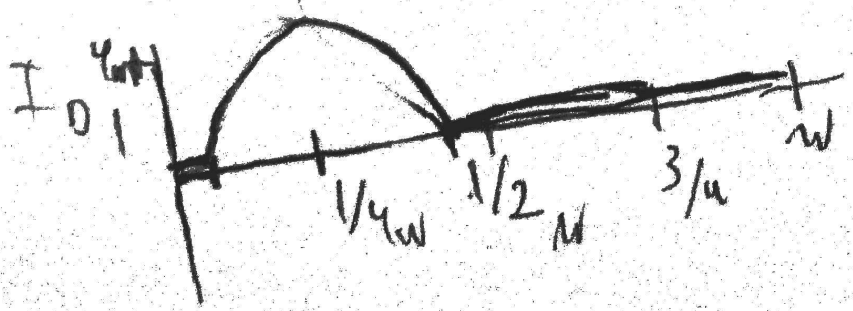
I_{D_2}


0
7/12
11/12
w
-5mA

2B:


V_S 4
1/4 w
1/2 w
3/4 w
w
-4


I_{D_2}
0
1/4
1/2w
3/4w
w


I_{D_1}
4mA
1/4w
1/2 w
3/4
w

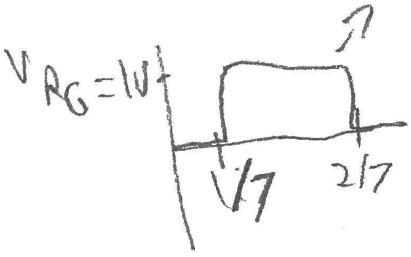
2C:

D_1 on for $V_S > 1$

ignore D_2 because (current can't) flow

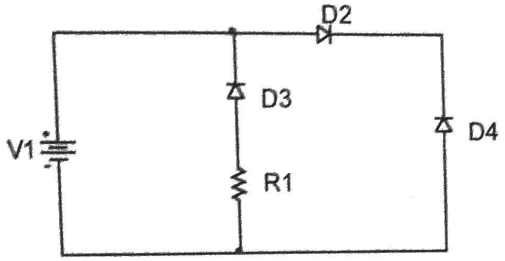
$V_{RG} = V_{D3}$

$V_{RG} = (V_S - V_{D1}) \frac{1k}{2k} = 0.5(V_S - 1) = V_{RG}$.

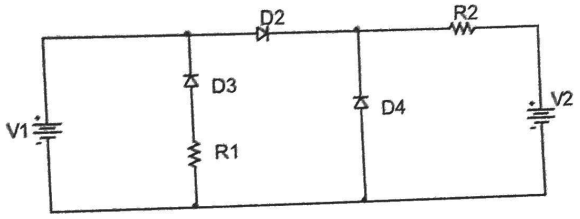


capped because diode

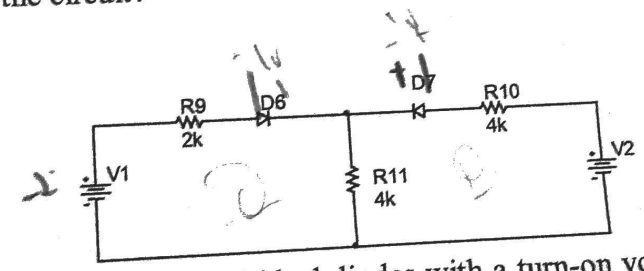
Problem 3) Guessing



a) For some V1, which rows in the on/off 'truth table' can be ignored when analyzing the circuit?



b) For some V1 and V2, which rows in the on/off 'truth table' can be ignored when analyzing the circuit?



c) For V1 = 2V, V2 = 6V and ideal diodes with a turn-on voltage of 1V, determine the voltage across and current through each diode.

d) For V1 = -2V, V2 = -2V and ideal diodes with a turn-on voltage of 1V, determine the voltage across and current through each diode.

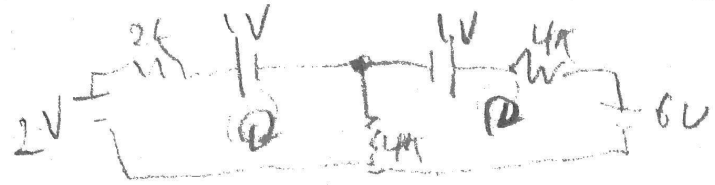
A: D_2 D_3 D_4

0 0 0 → ignore
0 0 1 → ignore
0 1 0
0 1 1 → ignore
1 0 0 → ignore
1 0 1 → ignore
1 1 0 → ignore
1 1 1 → ignore

B: D_2 D_3 D_4

0 0 0 → ignore
0 0 1
0 1 0
0 1 1
1 0 0
1 0 1
1 1 0
1 1 1

3C:

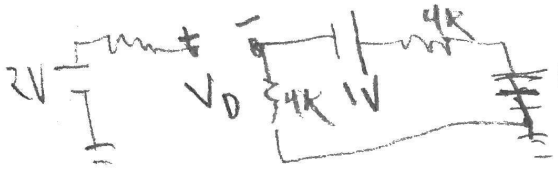


$6k\,i_1 - 4k\,i_2 = 1V$ $i_1 = -3mA$ -> invalid

$8k\,i_2 - 4k\,i_1 = -5V$ $i_2 = -8.33\times10^{-4}\,A$

must be one off and one on

Try d7 on d6 off



$V_{D_6} = -0.5V$ $I_{D6} = 0A$

$V_{D_7} = 1V$ $I_{D7} = 6.25\times10^{-4}\,A$

D: both off is trivial. One on and one off is impossible because current flows other way. Try both on

$i_1\,6k - i_2\,4k = -3$ $i_1 = -0.01$ -> invalid.

$i_2\,8k - i_1\,4k = -3$ $i_2 = -9.3\times10^{-4}$

Thus both diodes are off: $V_{D_1} = -2V$ $I_{D_1} = 0A$

$V_{D_2} = -2V$ $I_{D_2} = 0A$