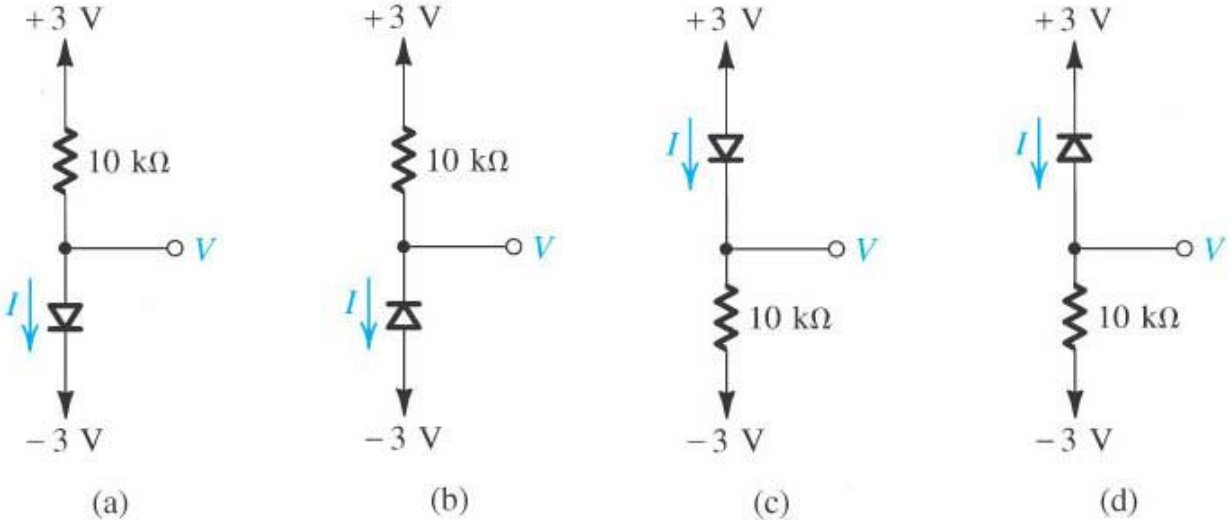
# Sheet 2: PN Junctions

## Problem 1:

For the following circuits employing ideal diodes, find the labeled currents I and voltages V measured with respect to ground?




(Ans. 0.6 mA, -3V) (0mA, 3V) (0.6mA, 3V) (0mA, -3V)

## Problem 2:

1. A small discrete silicon diode is found to conduct 100 $\mu A$ at 0.7 V and 1mA at 0.815 V. Find the values of $I_S$ and $\eta$ which correspond.

   (Ans. $I_S$=8.32x10-11A, $\eta \approx 2$)

2. A diode for which $\eta$=1 conducts 0.1mA at 0.7 V. Find its voltage drop at 1mA. For what current is its voltage drop equal 0.815V?

   (Ans.0.758V,9.95mA)

## Problem 3:

A diode described by the exponential characteristic and the battery & resistor model of Fig.1 is connected to a source as shown in Fig.2. Draw the load line and find operating points ($I_D$ and $V_D$) for:

(a) $V_{DD}$= 1V, R= 100Ω

(b) $V_{DD}$= 0.9V, R= 100Ω

(c) $V_{DD}$= 0.9V, R= 90Ω

(Ans:(a) $V_D$=0.75V, $I_D$=2.5mA, (b) $V_D$=0.73V, $I_D$=1.7mA, (c) $V_D$=0.74V, $I_D$=1.8mA)

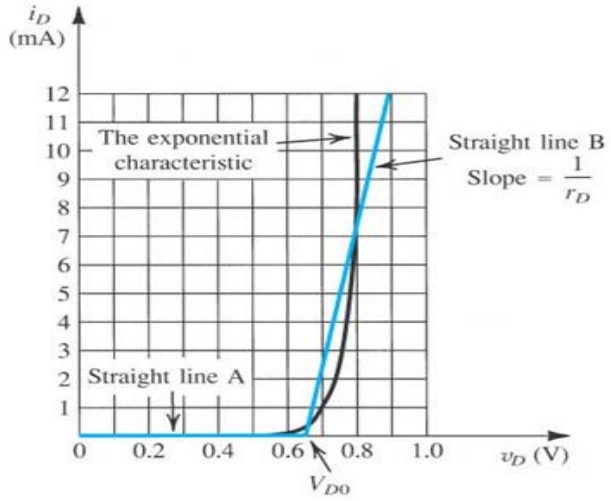



Fig.1

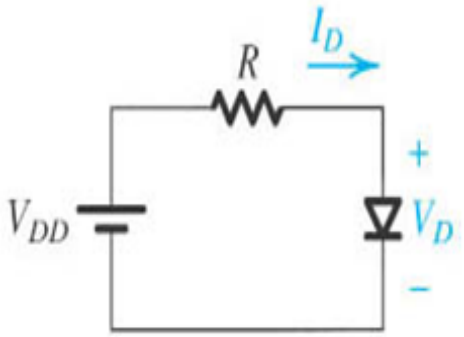



Fig.2

## Problem 4:

For the circuit shown in Fig.3, find the current 'I'? [$V_{Threshold} = 0.6V$]

(Ans: I=0.9mA)

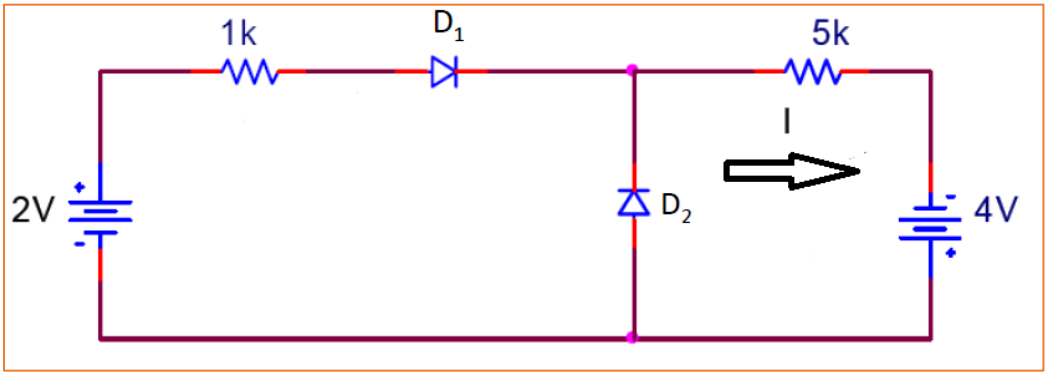



Fig.3

## Problem 5:

For the passive symmetric hard limiter shown in Fig.4:

a. Find the upper and lower limiting levels (including a 0.7 V diode drop), the gain, and the upper and lower input thresholds levels.
b. What is the input current required at twice the upper threshold value?
c. Sketch the output voltage versus time at sinusoidal signal input voltage of amplitude 15V and frequency 1KHz

(Ans.: 3V, -3V, 0.5, 6V, -6V, 0.9mA)

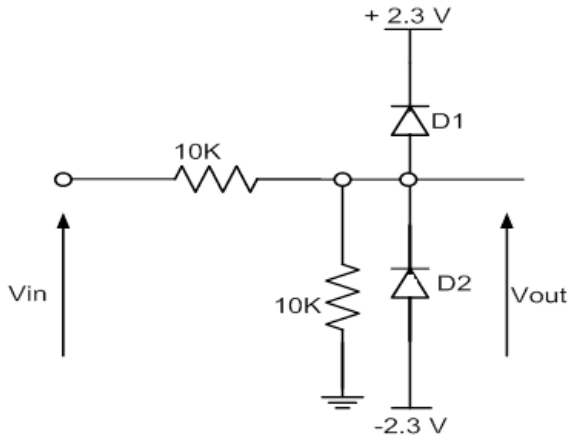



Fig.4

## Problem 6:

Sketch the I-V Input characteristic of the circuit of Fig.5 When:

1. The switch is open
2. The switch is closed

(Assuming the Diode is ideal)

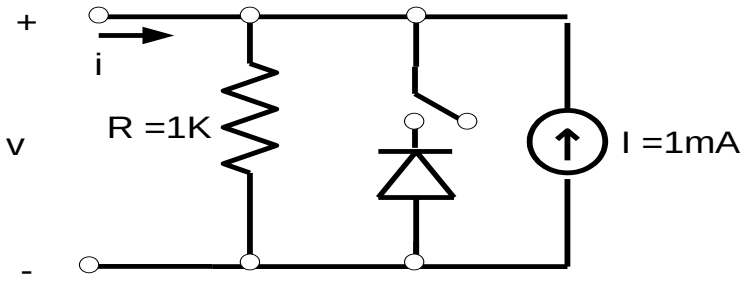
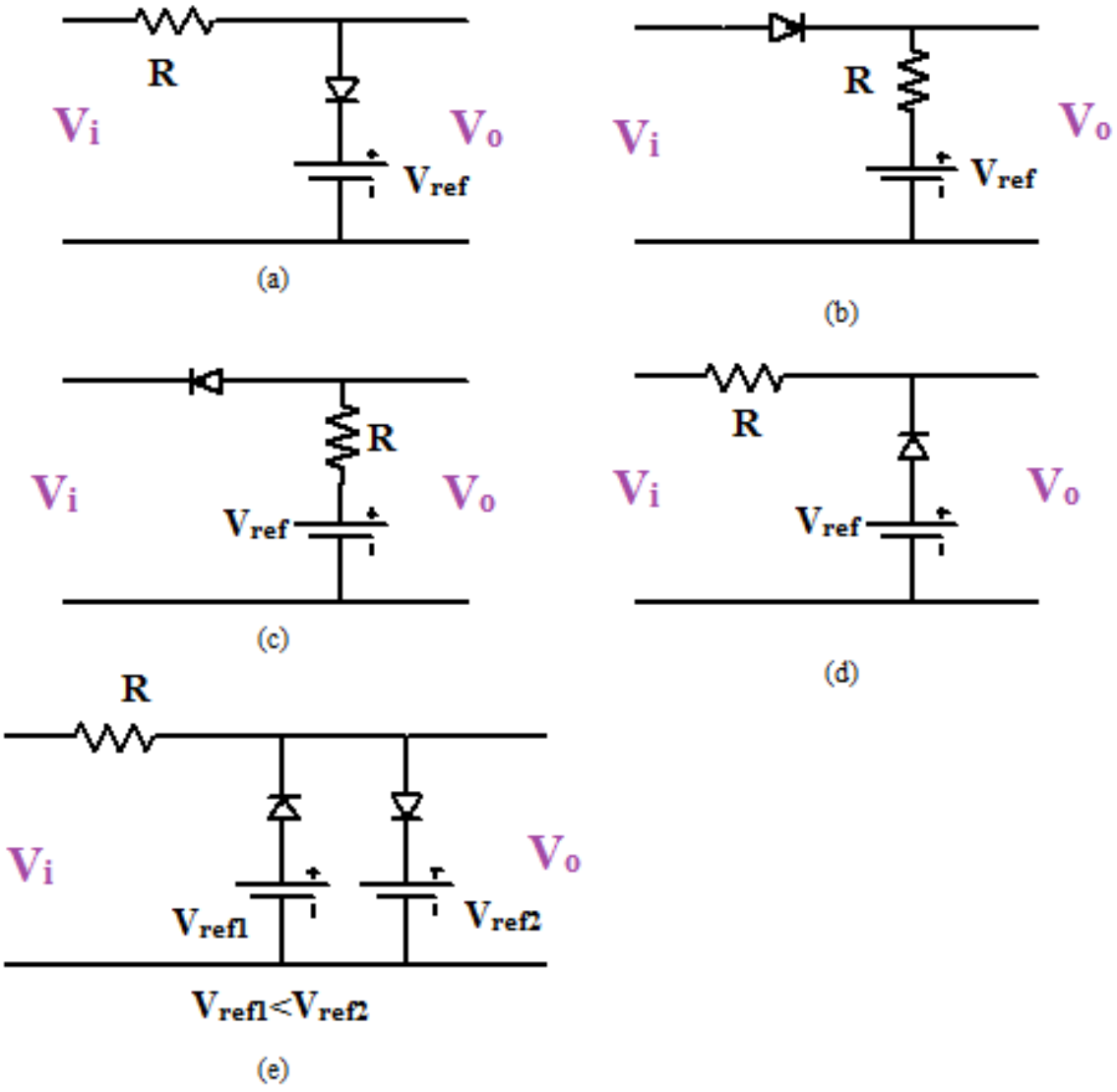



Fig.5

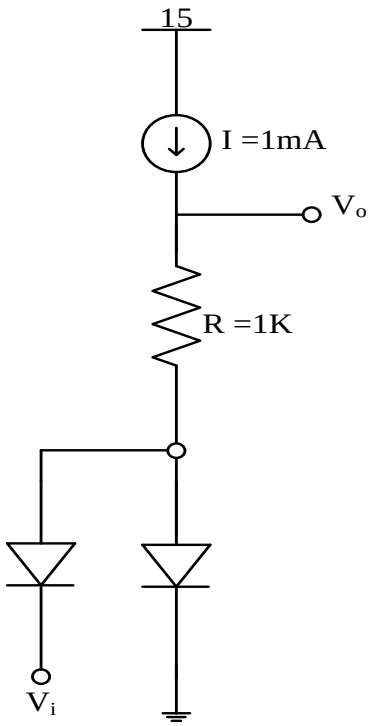
## Problem 7:

For the following circuits, assume the diodes are ideal diodes, find '$V_o$'? Draw '$V_o$' versus '$V_i$'



## Problem 8:

Sketch the waveform resulting at '$V_o$' for '$V_i$' is a 1-kHz 10-V peak sine wave (assuming ideal diode approximation)




## Problem 9:

The circuit shown is a model for a battery charger, '$V_i$' is a 10-V peak sine wave, $D_1$ and $D_2$ are ideal diodes, I is a 100-mA current Source and B is a 4.5-V battery. Sketch the waveform of the battery current.