1. For each circuit, the diodes are ideal.
   (i) Clearly explain how the circuit functions by showing conditions when each diode is on and when it is off.
   (ii)   For his design plot the transfer characteristic v_{INB} versus v_{IN} indicating the values of all significant points and the values of the slopes of all segments
   (iii) Which of these circuits **DOES** function as a diode clamp that keeps the output voltage between -5 and +5 volts. **Explain your answer.**
   (iv) Which of these circuits **DOES NOT** function as a diode clamp that keeps the output voltage between -5 and +5 volts. **Explain your answer.**

(a)

(b)
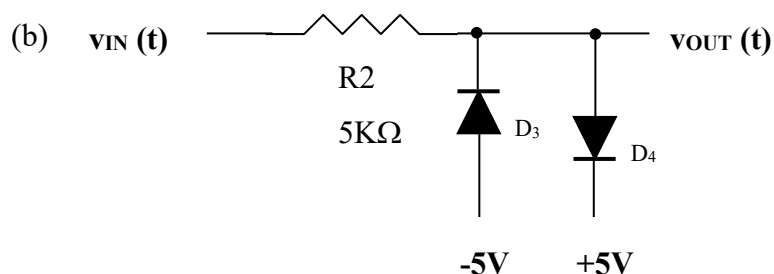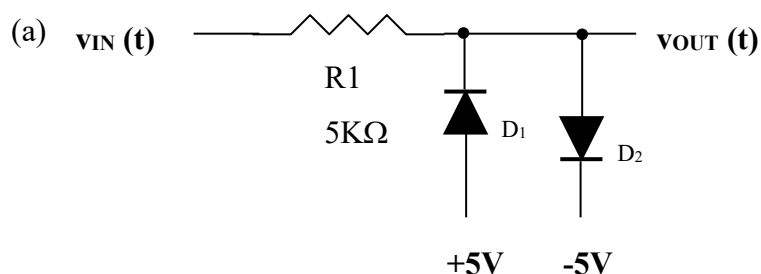
2. A young design engineer decides to try a new configuration for a rectifier. His attempt is the circuit shown in Figure 2 where identical diodes D_a and D_b are used. Assume diodes are ideal. The designer gives the input $v_{in} = 5\sin4\pi t$ to the circuit.
   (i)   For each half cycle indicate the ON and OFF state of the diodes.
   (ii)   Draw the input voltage and the corresponding output voltage v_O vs. time.
   (iii) Find the average value of the output voltage.
   (iv)   Is this rectifier efficient? Explain your answer.
   (v)   Find the peak diode current in each diode.
   (vi)   Find the maximum reverse voltage seen by each diode.
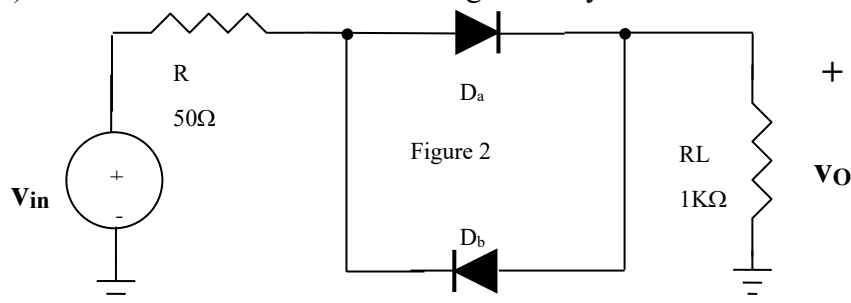
Figure 2

3. **4.74**
4. A designer has to build a regulator circuit as shown in Figure 4 to provide an output voltage v_{OUT} of 5V using one of two types of diodes. Given that **both types of diodes** have a voltage of 0.715V at 1mA current. For the diode **of TYPE A** the voltage changes by 0.1V/decade change in current while for the diode **of TYPE B** the voltage increases by 0.1V when the current through it doubles.   **Do not assume the values for V_T.**

(i)   Which type of diode should the designer pick for building an efficient regulator? Clearly explain the reasons for your choice.

(ii)   How many diodes of the type chosen in (a) would be in the string to obtain the required v_{OUT} at nominal I_{supply} and no load condition.

(iii)   Find the **percentage change** in v_{OUT} when a load current of 5mA is drawn from the circuit.

$V_{supply} = 10V$

$I_{supply} = 15mA$

Figure 4

V_{OUT}

String of diodes
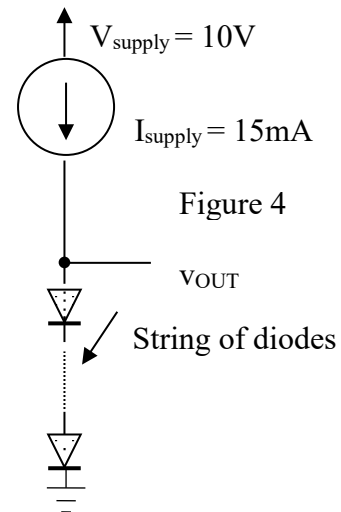
5. The regulator in Figure 5 employs a zener diode D_Z that is specified to have a 8V drop at a test current of 25mA with $r_z = 10\Omega$ and $I_{ZK} = 0.2mA$.

(a) Find **the value of R** needed to obtain an output voltage $V_{out} = 7.8V$ at nominal supply voltage Vs and no load.

(b) With the value of R as obtained in (a) and nominal Vs find the **the value of V_{out}** with a load resistance of

(i) $R_L = 10k\Omega$

(ii) $R_L = 1k\Omega$

$Vs = 10V \pm 15\%$

Figure 5

R

V_{out}

D_Z