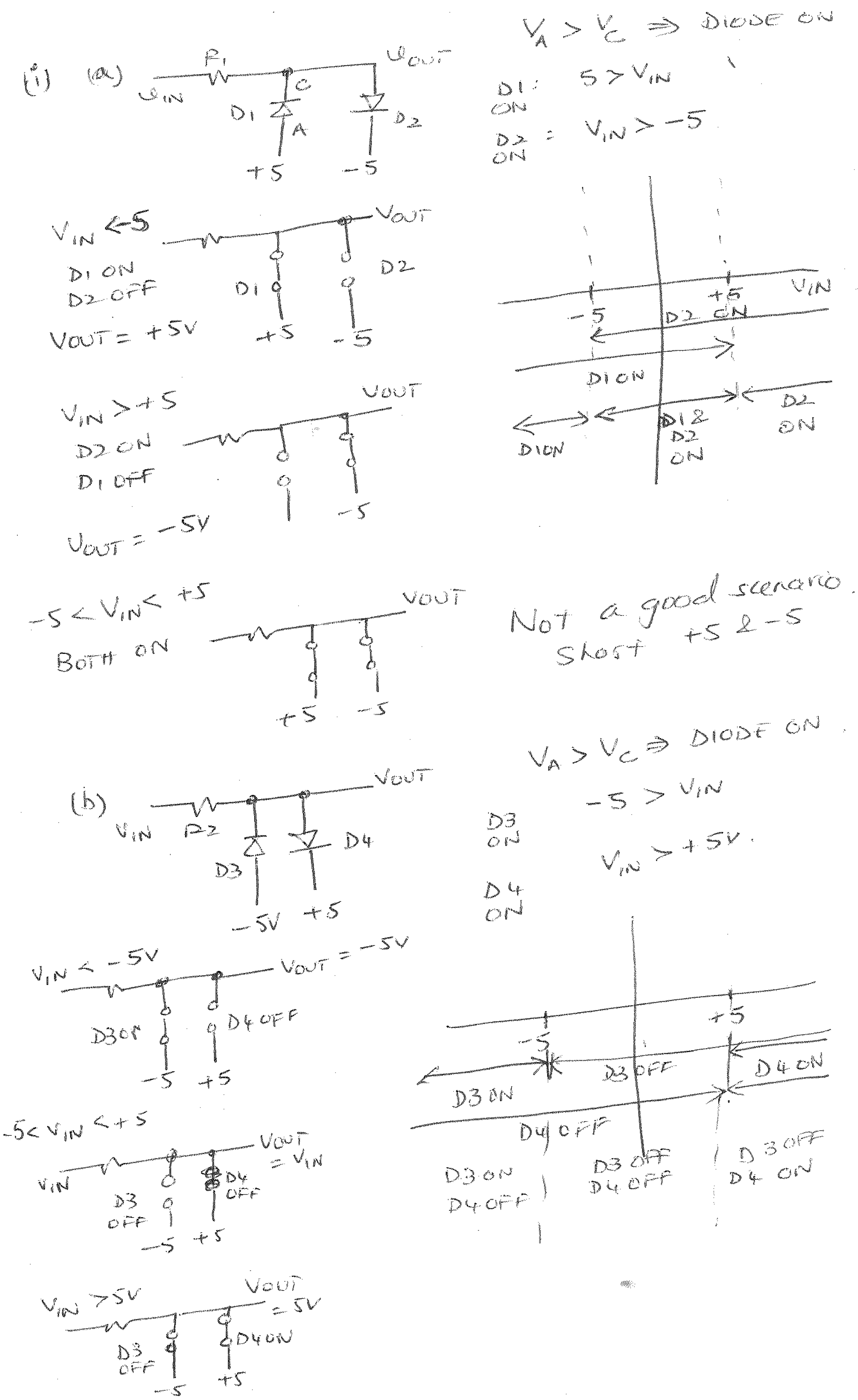
SANTA CLARA UNIVERSITY	ELEN 115 – Spring 2023	S. Krishnan

Homework #6 Solutions

1.

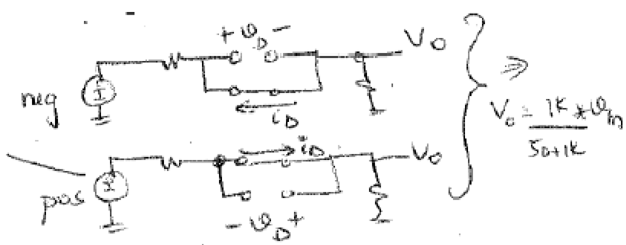


(ii) (b) functions as a clamp.
as Vout stays below +5 & above −5
& for the vin between range Vout = Vin.

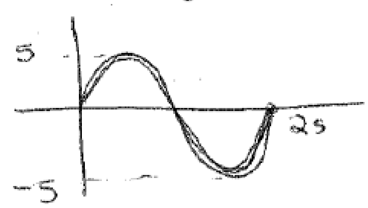
(iii) (a) Does NOT function as a clamp
as it shorts out the +5V & −5V for some
input conditions.

2.

(i) $v_{IN} < 0$ D_b turns on
$v_{IN} > 0$ D_a turn on



(ii) $v_{out} = \frac{1000}{1050} * v_{IN} \approx v_{IN}$



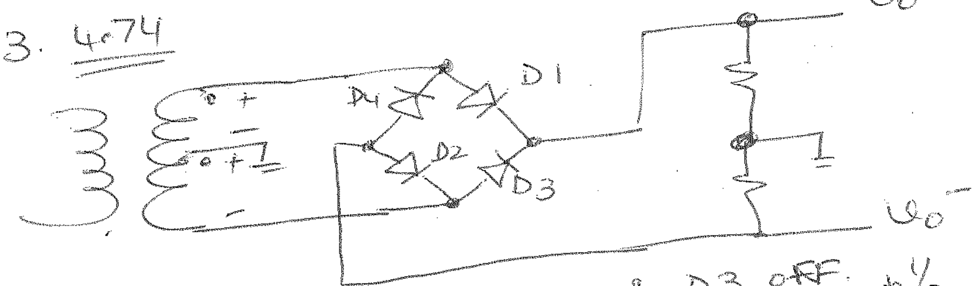
(iii) $v_{avg} = 0$

(iv) Not an efficient rectifier
as get zero average.

$\hat{i}_{Da} = \frac{5V}{1050}$, $\hat{i}_{Db} = \frac{0-(-5)}{1050} \Rightarrow \hat{I}_{Da} = \hat{I}_{bb} = \frac{5}{1050} =$

(v) each diode sees the other diode
shorted across its terminals $\Rightarrow$ $\underline{\underline{PIV = 0V}}$

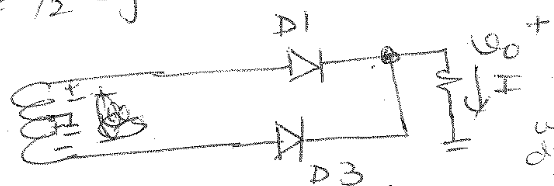
3. 4.74

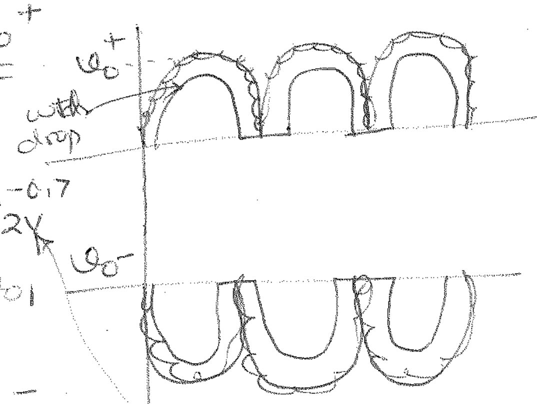


Full wave rectifiers.

positive ½ cycle D1 ON & D3 OFF.

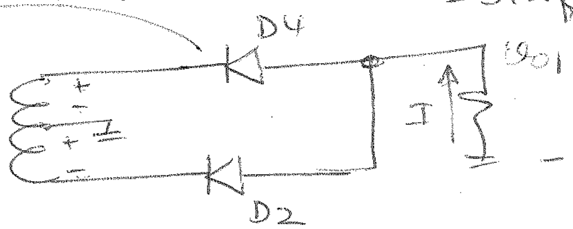
negative ½ cycle D1 OFF D3 ON.





PIV $V_S - V_o = V_S + (V_S - 0.7) = 2V_S - 0.7$

$= 39.2V$



$v_{o\,avg} = \frac{2V_S}{\pi} - V_D$

$12V = \frac{2V_S}{\pi} - 0.7$

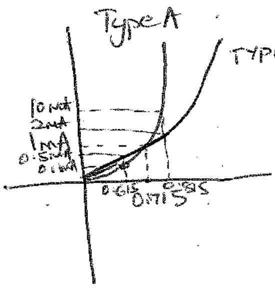
$V_S = 19.95V$

positive ½ cycle D2 ON, D4 OFF

negative ½ cycle D2 OFF, D4 ON.

4.

(i)



Type B
ΔV change larger
~~for~~ large change in I.

So should
choose Type A.

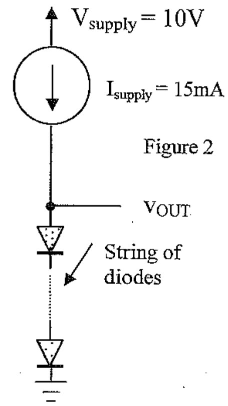


Figure 2

(ii) $v_2 = v_1 + nV_T \ln \dfrac{i_2}{i_1}$

$0.1V = nV_T \ln \dfrac{10mA}{1mA}$

$nV_T = 0.0434mV$

$V_{out} = N * v_{diode}$

$v_2 = 0.715 + 0.0434 \ln \dfrac{15mA}{1mA} = 0.8326V = v_{diode}$

To get 5V $\quad N * 0.8326 = 5 \Rightarrow N = 6.005$
≈ 6 diodes.

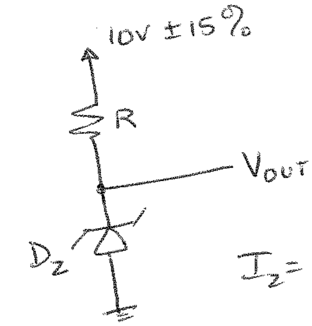
(iii) when $I_L = 5mA \Rightarrow I_{diode} = 15mA - 5mA = 10mA$.

$\Rightarrow v_{diode} = 0.815$ as seen in graph

$V_{out} = 6 * 0.815 = 4.89V$

% change $= \dfrac{4.89 - 5}{5} * 100 \cong \underline{\underline{-2.2\%}}$

5.



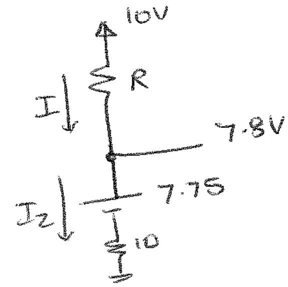
$V_z = V_{zo} + I_z r_z$

$8V = V_{zo} + 25mA \times 10\Omega$

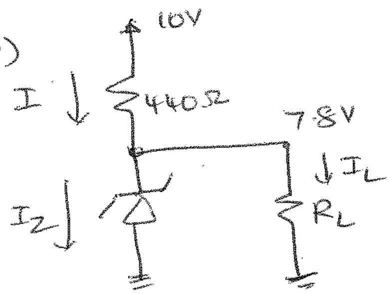
$V_{zo} = 7.75V$

(a) $\frac{10 - 7.8}{R} = \frac{7.8 - 7.75}{10} = I_z$

$I_z = 5mA \quad R = \underline{\underline{440\Omega}}$

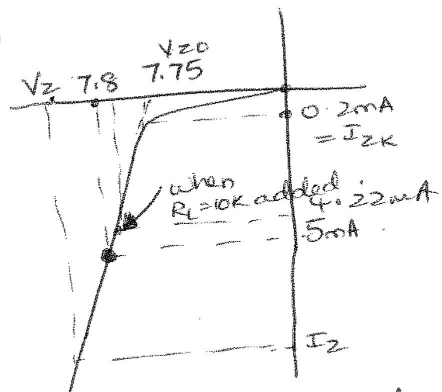


(b)



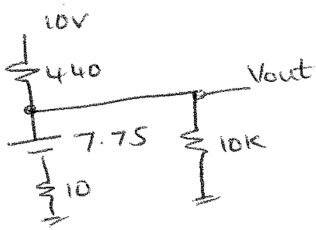
I (about 5mA)

$= I_z + I_L$



(i) $R_L = 10K\Omega \Rightarrow I_L \approx \frac{7.8}{10K} = 0.78mA$

So If R_L added I_z drops $\approx$ 5-0.78 to 4.22mA ✓



$\frac{10 - V_{out}}{440} = \frac{V_{out} - 7.75}{10} + \frac{V_{out}}{10K}$

$V_{out} \approx 7.8$

<u>slightly lesser</u>

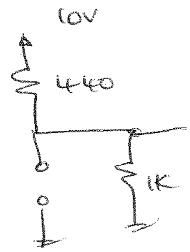
(2)

(ii) $R_L = 1k\Omega$

$I_L \approx \frac{7.8V}{1K} = 7.8mA$. So I_Z drops very low below I_{ZK}

I from supply cannot be sufficient & keep zener biased & keep V_{out} @ 7.8V

$\Rightarrow$ Zener turns off



$$V_{out} = 10 \times \frac{1K}{1K+440} = \underline{\underline{6.94V}}$$