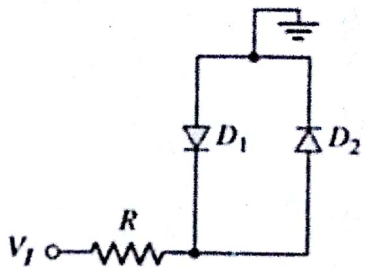
Question 1

a) The parameters for both D_1 and D_2 in the circuit shown are V_γ =1.7V and r_f = 20 Ω. The current in each diode is to be limited to 15mA when V_I = ± 9V. Determine the value of R given that the breakdown voltage for each diode is 100 V and r_z =30 Ω.



$V_\gamma = 1.7\,V$ $\quad r_z = 30$

$r_f = 20\,\Omega$ $\quad I_D = 15\,mA$

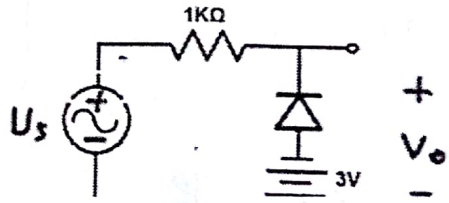
$R + r_f = \frac{V_I - V_\gamma - 0}{i}$

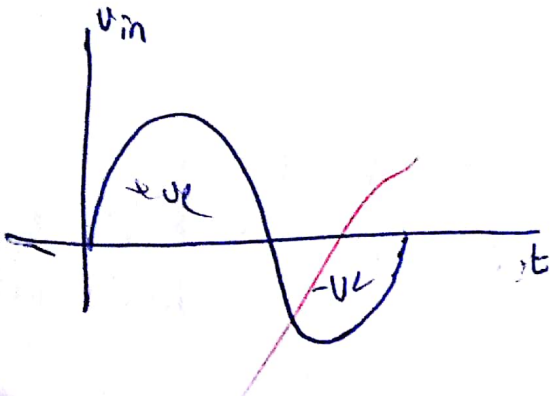
$i = \frac{V_I - V_\gamma - 0}{R + r_f} \Rightarrow \frac{9 - 1.7}{15 \times 10^{-3}} = R + 20$

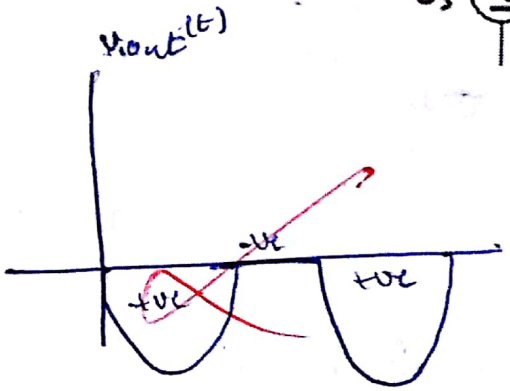
$\Rightarrow R + 20 = \frac{8.7}{15 \times 10^{-3}} \Rightarrow R + 20 = 48$

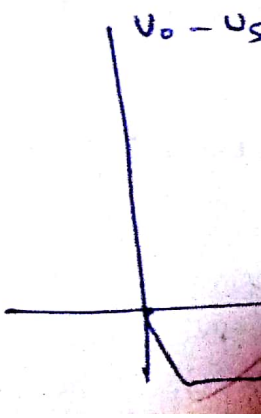
$R = 466.6\,\Omega$

b)Given the circuit shown where $v_s = 9\sin(\omega t)$. Sketch $\mathbf{v_o(t)}$ and the $\mathbf{v_o}$-$\mathbf{v_s}$ characteristic.







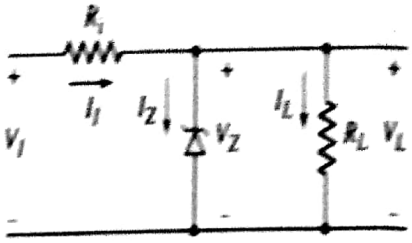


	V_{PS}	I_L
min	min	max
max	max	min

Question 2

a)Consider the Zener diode circuit shown Let V_I =60V, R_i =150 Ω , and V_Z =16V. Assume $r_z = 0\ \Omega$. The power rating of the diode is 4 W and the minimum diode current is to be 5 mA.

(a) Determine the range of load currents.



$I_L = \frac{V_Z}{R_L}$ $\quad I_Z = \frac{V_{PS} - V_Z - I_L}{R_i}$ $\quad P = 4\ W$

$V_Z = V_L = 16\ V$

$P_Z = I_Z V_Z$

$\frac{4}{16} = I_Z$

$I_{Z\,max} = 0.25\ A$

$I_{min} = \frac{V_{PS\,min} - V_Z}{R_i} - I_{L\,max}$

$\frac{60 - 16}{150} - 0.25 = 0\ A$

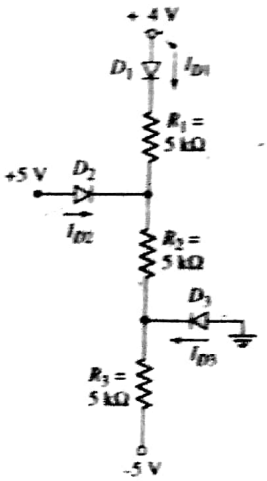
(b) Determine the range of load resistance.

$V_L = 16\ V \longrightarrow V_L = I_L R_L$

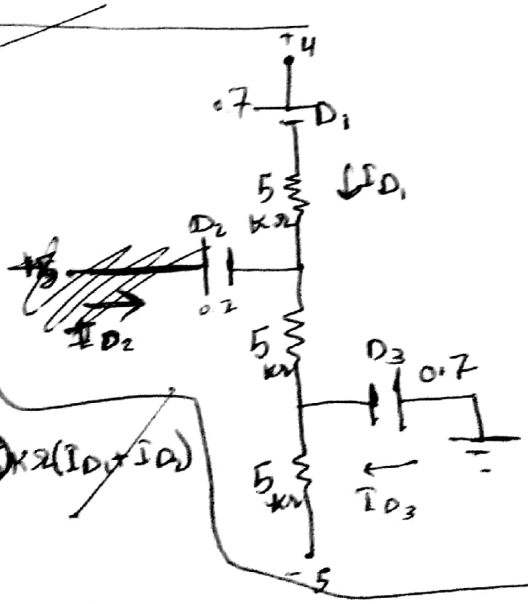
$R_L = \frac{16}{0.43} = 37.20\ \Omega$

1.5

b)The cut-in voltage of each diode in the circuit shown is 0.7V. Determine I_{D1}, I_{D2}, and I_{D3}. Use the **assumption that all diodes are ON**.



assume $D_3 \rightarrow$ off



D_1 ON

D_2 ON

loop ①

$-4 + 0.7 + I_{D1}(5k\Omega) + 10k\Omega(I_{D1} + I_{D2}) - 5 = 0$

loop ②

$-5 + 0.7 + 10k\Omega(I_{D1} + I_{D2}) - 5 = 0$

$10\ k\Omega(I_{D1} + I_{D2}) = 9.3$

loop ① gives

$1 + I_{D1}(5k\Omega) = 0$

$I_{D1} = \frac{-1}{5k\Omega} = -0.2\ mA$ (-ve)

Assumption incorrect, so D_1 is OFF

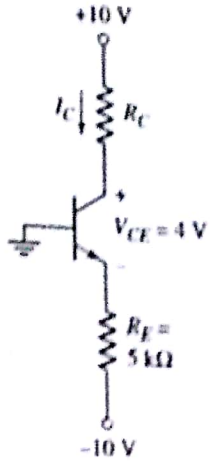
$-0.2 + I_{D2} = 0.93$

$I_{D2} = 1.13\ mA$ (+ve) correct

2.5

Question 3

a)consider the circuit shown where $\beta = 120$, and $V_{BEON} = 0.7V$. Calculate R_C , and I_C .



$V_{BE} + I_E R_E - 10 = 0$

$5K\, I_E = 10 - 0.7$

$I_E = 1.86mA$

$I_C = \frac{\beta}{\beta + 1} * I_E$

$I_C = 1.84\ mA$

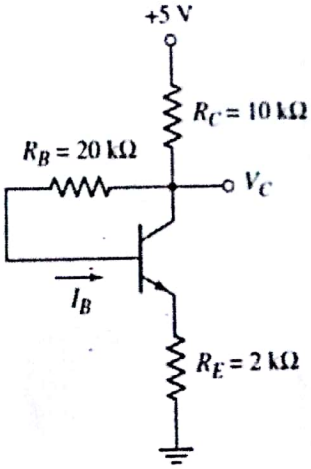
$-10 + I_C R_C + 4 + I_E R_E - 10 = 0$

$1.84m * R_C + 1.86m + 5K = 10$

$R_C = \frac{6.7}{1.84_m} = 3641.21\ \Omega$

3.

b)consider the circuit shown where $\beta = 120$, and $V_{BEON} = 0.7V$. Calculate V_C , and I_B .



$I_E = I_C + I_B$

$I_B \cdot R_B + V_{BE} + I_E R_E = 0 \Rightarrow V_C \neq 0$

$20K\, I_B + 0.7 + 2K I_E = 0$

$3 + I_1\, 10K + V_{CE} + I_E R_E = 0$

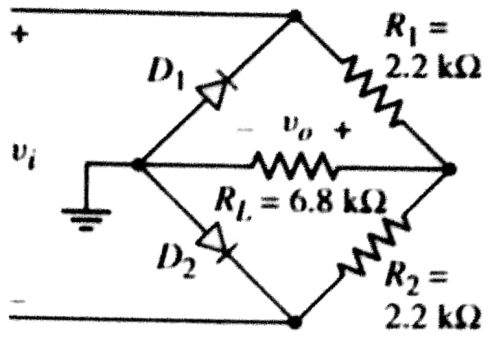
$20K\, I_B + 0.7 + 2K(\beta + 1) I_B = 0$

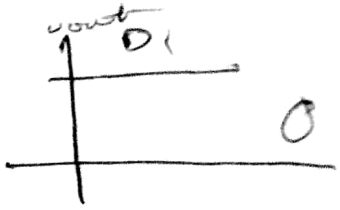
$20K\, I_B + 242\, I_B = 0.7$

$262K\, I_B = -0.7$

$I_B = 374.28\ A$

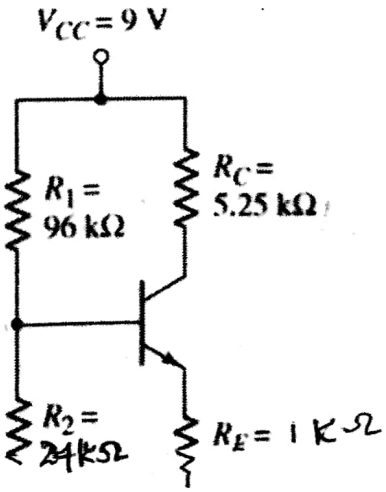
use the oversk ↑ kage , Sketch v_o versus v_i is a sine wave of **10** sume **V_γ =0.7V**





2

very circuit simulation package to



Find

I_B = ?

I_C = ?

V_{CE} = ?

I_B = 9.01 ~~X~~

I_C = 9.01 , 901 μA

V_{CE} = 3.36 V

2