EDC
Assignment #1

FA22-BCE-014
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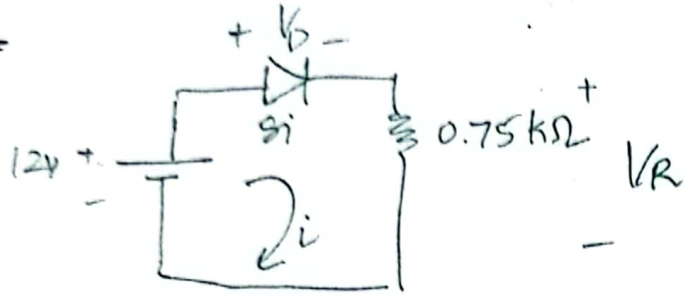
Q1
find I_D, V_D, and V_R

Sol



Calculating I_D and V_D for line of intersection.

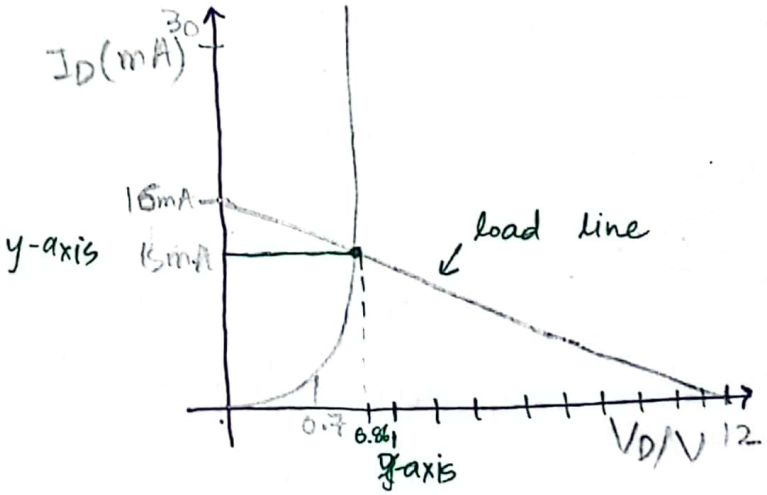
KVL

$-12 + 0.75(1000)i = 0$

$\boxed{i_D = 0.016 = 16mA}$

when $i_D = 0A$

$V_D = 12V$

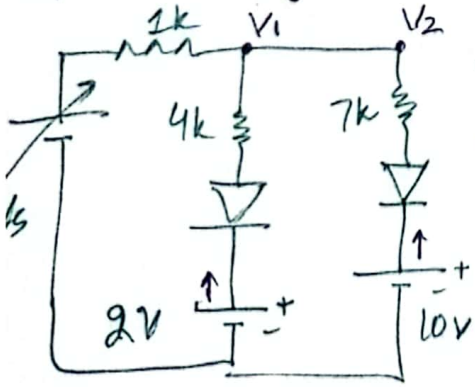


$\boxed{V_{DQ} = 0.86V}$ $I_{DQ} = 15mA$

↳ voltage across the diode ↳ current across diode

Voltage across Resistor $= V_R = V_S - V_{DQ} = 12 - 0.86 = 11.14\ V$

Q2
a) Identify the voltage ....



Voltage at node V_0

$+ \quad V_0 = V_1 - 2V$

V_0 Voltage at node 2

$V_0 = V_2 - 10V$

- Hence, the voltage across V_1 to turn the D_1 on is 2.7 whereas for V_2 is 10.7, since they are in parallel we will apply 10.7V as V_0.

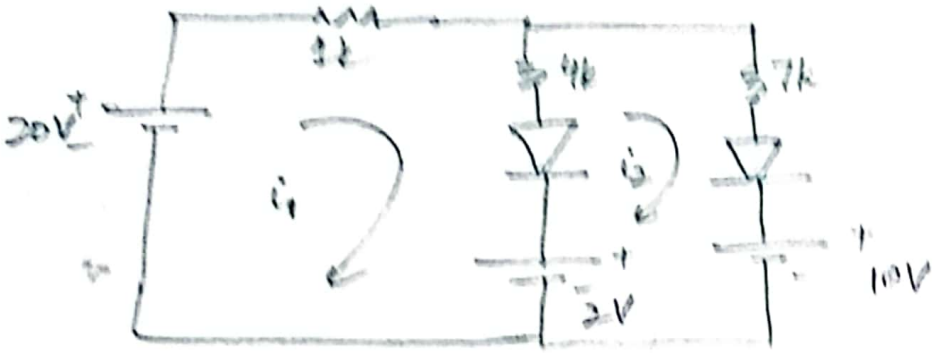
$V_s = V_R + 10.7\,V$

↓

voltage across the 1 k.Ω resistor

$V_s = 12\,V$

b) find I_{D1} , I_{D2} when $V_s = 20V$



Using Mesh Analysis

Loop 1 eq

$-20 + 1000i + 4000(i_1 - i_2)0.7 + 2 = 0$

$-20 + 1000i + 4000i_1 - 4000i_2 + 0.7 + 2 = 0$

$5000i_1 - 4000i_2 = 20 - 2 - 0.7$

$5000i_1 - 4000i_2 = 17.3$

Loop 2 eq

$-2 + 0.7 + 4000(i_2 - i_1) + 7000i_2 + 0.7 + 10 = 0$

$-2 + 0.7 + 4000i_2 - 4000i_1 + 7000i_2 + 0.7 + 10 = 0$

$-4000i_1 + 11000i_2 = -9.4$

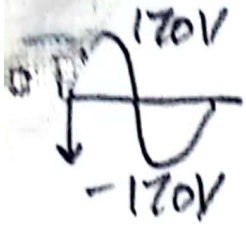
$i_1 = 5.04\,mA$ $i_2 = 0.749 \times 10^{-3}\,A = 0.749\,mA$

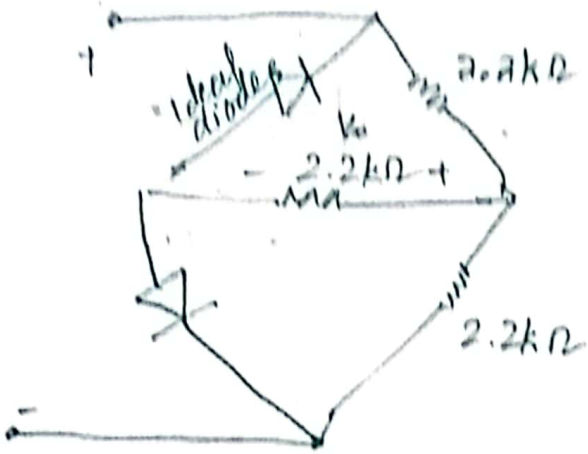
$i_1 = 4.05\,mA$ $i_2 = 0.749\,mA$

↓

approximately $I_{D1} = i_1 - i_2 = 3.3\,mA$ $I_{D2} = 0.749\,mA$

Sketch V_o, and dc voltage

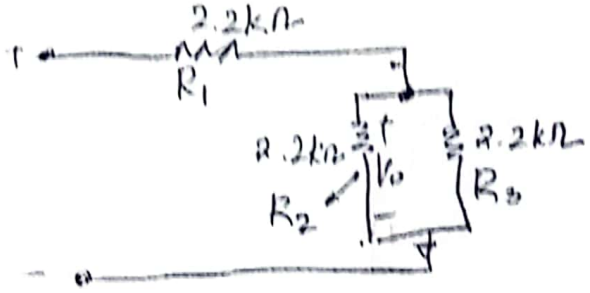




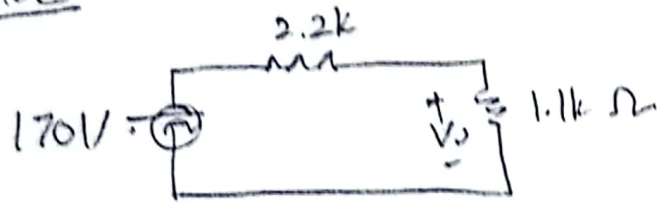
for positive cycle

$$V_{Total} = 1 \div \left(\frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$= 1 \div \left(\frac{1}{2200} + \frac{1}{2200}\right) = 1100\Omega$$



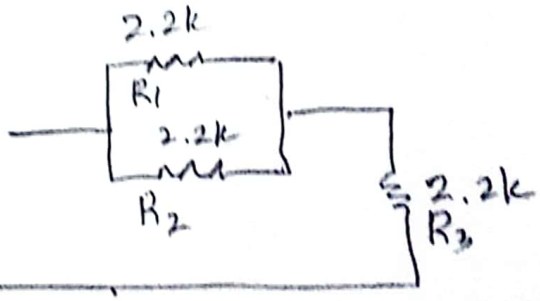
Hence



applying Voltage divider

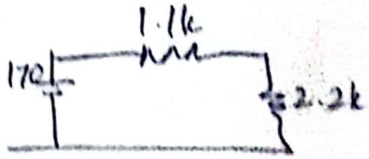
$$V_o = \frac{1.1 \times 1000}{1100 + 2200} \times 170 = \boxed{56.67V}$$

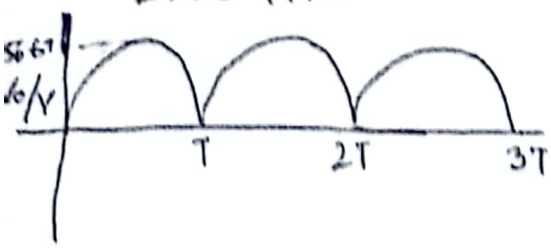
for negative cycle



$$V_{Total} = 1 \div \left(\frac{1}{R_1} + \frac{1}{R_2}\right) = 1100\Omega$$

$$V_o = \frac{1100}{2200 + 1100} \times 170 = \boxed{56.67V}$$

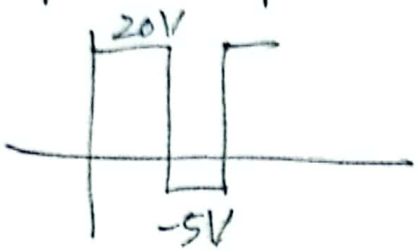


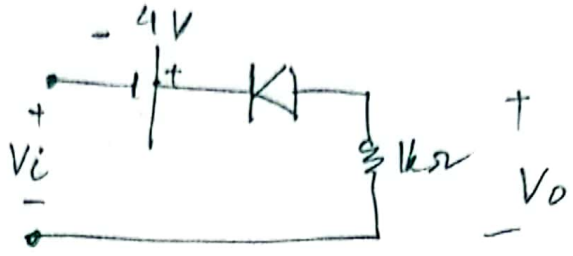


$V_{dc} = 0.636 \times V_0 = 0.636 \times 56.67$

$V_{dc} = 36.04V$

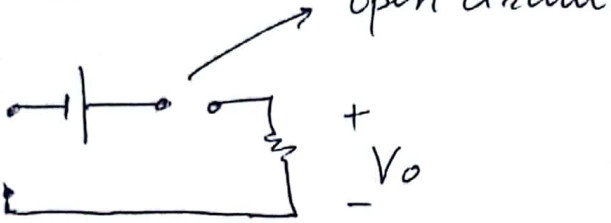
Q4. Compute & Sketch V_0





for +ve cycle

Circuit

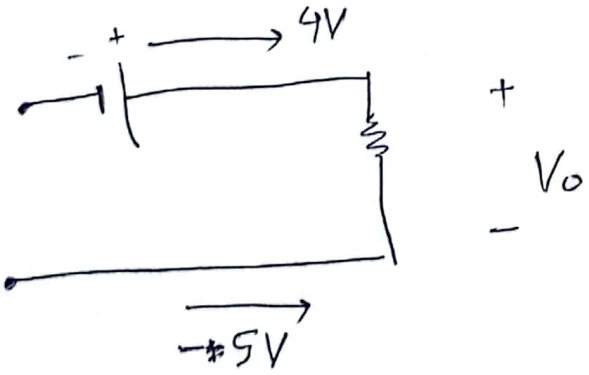


Hence

$V_0 = 0V$

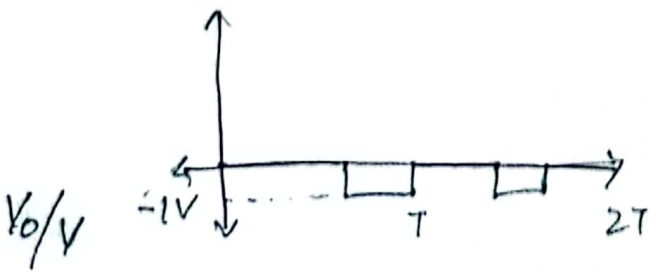
for -ve cycle

Circuit

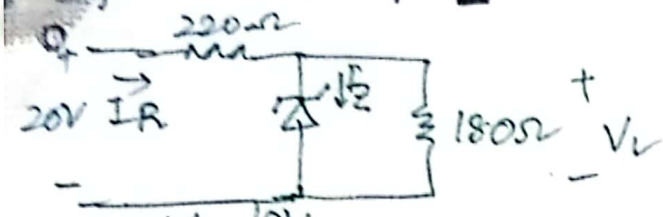


Hence

$V_0 = V_s - V_{internal} = -5 + 4 = -1V$

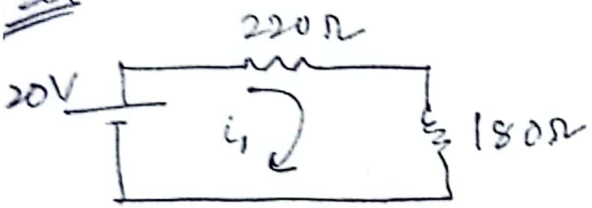


Find V_L, I_L, I_Z and I_R when $R_L = 180$ ohms



$P_{Z_{max}} = 400\,mW$

Sol



apply KVL

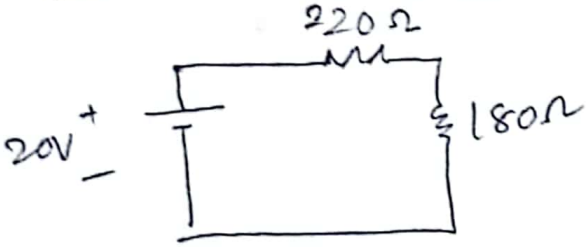
$-20 + 220i + 180i = 0$

$i = 0.05A = 50mA$

$V_L = IR = 50 \times 10^{-3} \times 180 = 9V$

Since $9V < 10V$

the diode will remain off



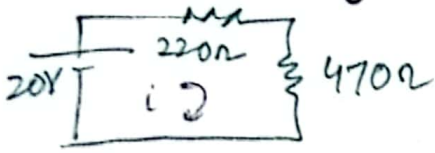
$V_L = 9V$

$I_L = 50mA$

$I_Z = 0A$

$I_R = 130mA$

b) repeat for $R_L = 470\Omega$



KVL

$-20 + 220i + 470i = 0$

$i = 0.02899A = 28.99mA$

$R_L = IR = 28.99 \times 10^{-3} \times 470$

$V_L = 13.6V$

Since $13.6 > 10V$ so

the diode will turn on

$V_L = 10V$

$I_L = \frac{V}{R} = \frac{10}{470} = 0.0213 = 21.28\,mA$

$I_Z = \frac{P}{V} = \frac{400 \times 10^{-3}}{10} = 40mA$

$I_R = \frac{V_s - 10}{220} = \frac{20-10}{220} = 45.45mA$

c) R_L = ? for maximum power of Zener diode

find I_L

$P = IV$

$I_Z = \frac{400 \times 10^{-3}}{10} = 40mA$

$I_{Lmin} = I_R - I_Z = (45.45 - 40)mA = 5.45mA$

$R_L = \frac{V}{I}$ (ohm's law) $= \frac{10}{5.45 \times 10^{-3}} = \boxed{1834.9\Omega}$

the larger the R_L the lower the I_L, hence greater Power

d) minimum value of R_L to turn Z_D on.

applying the voltage divider

$V_L = 10 = \frac{R_L(20)}{R_L + 220}$

$10R_L + 2200 = 20R_L$

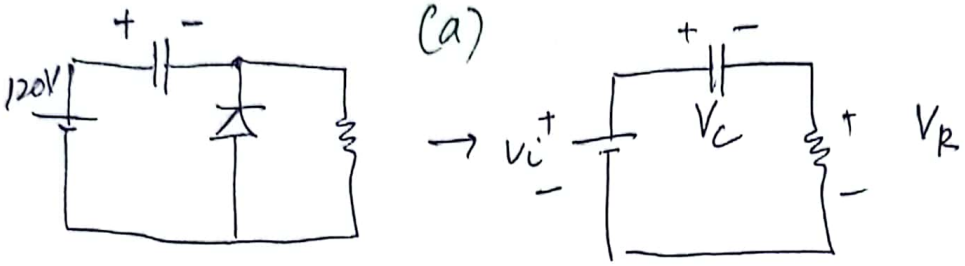
$10R_L = 2200$

$\boxed{R_L = 220\Omega}$

Sketch V_o

b)

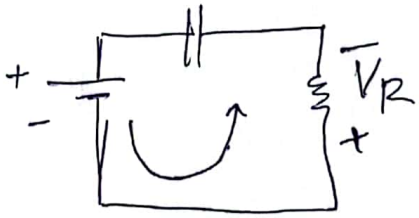
(a)



$-V_i + V_C + V_R = 0$ } +ve cycle

$V_C = 120 - V_R$

-ve cycle



$+V_i + V_R - V_C = 0$

$V_R = -V_i + V_C$

$= +120 + 120 - V_R$

$V_R = +240 - V_R$

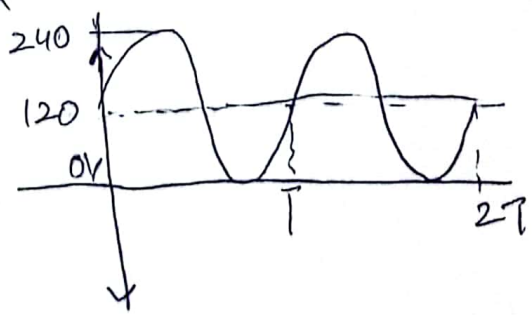
$2V_R = +240$

$\boxed{V_R = +120}$

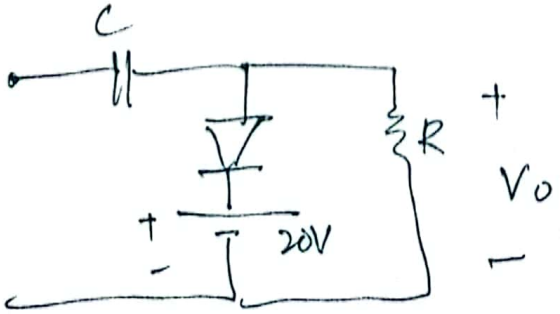
$V_o = 120 - V_R = 120 - 120 = 0$ V

$V_{dc} = \frac{240 + 0}{2} = +120$

Hence V_o / V



b)



+ve cycle

diode is on

eq KVL

$$-V_i + V_c + 20 = 0$$

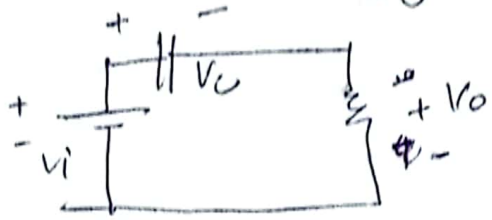
$$V_c = V_i - 20$$

$$V_c = 120 - 20 = 100\ V$$

$$\boxed{V_o = 20V}$$

for −ve cycle

diode is off

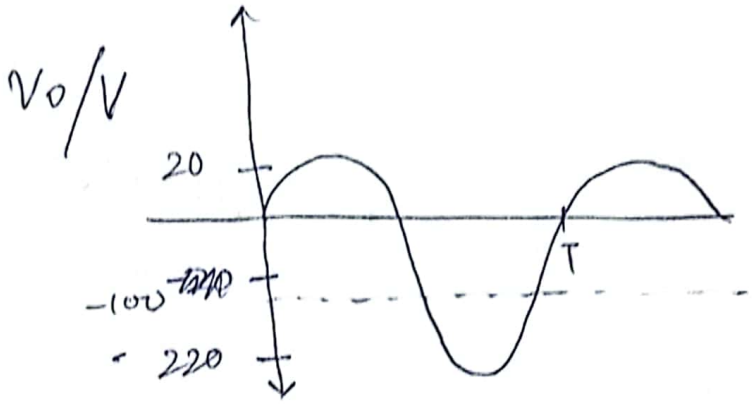


KVL

$$V_i - V_o - V_c = 0$$

$$-V_o = V_c - V_i$$

$$V_o = -100 - 120 = -220$$



$$V_{dc} = \frac{-220 + 20}{2} = -100$$

The end.