Benha University
Benha Faculty of Engineering
Date: Jan. 20, 2019
Semester: 1 st
Examiner: Prof. Ashraf Shouki Seliem
Total Points: 75

Department: Electrical
Program: Bachelor
Time: 3 Hours
Subject: Electronic circuits (A)
Code: EE 1203
No. of Pages: two pages

Answer all the questions

Question ① ***(15 marks)***

(a) For the circuit shown in Fig.1 (a), assume ideal diodes, find I_{D1}, I_{D2}, I and voltage V.

(b) For the circuit shown in Fig. 1(b), sketch V_{out} against time for the given input signal.

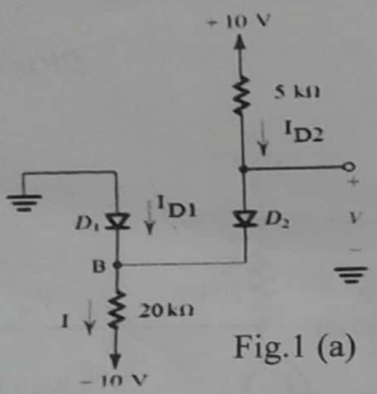


Fig.1 (a)

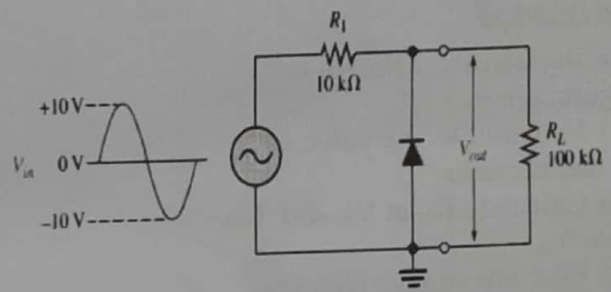


Fig.1 (b)

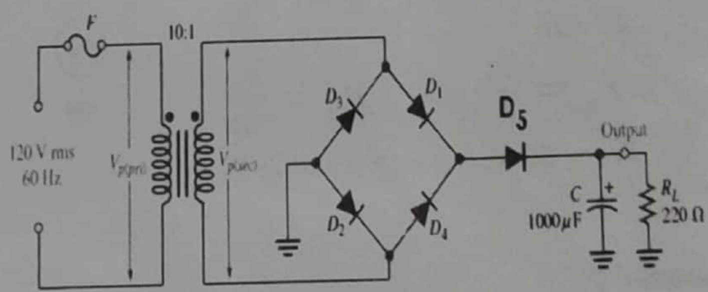
Question ② ***(15 marks)***

For the circuit shown, if the voltage drops on each diode when conduct is 0.7 V, sketch the voltage against time

(a) Before the diode D_5

(b) At the output load R_L.

(c) Calculate the ripple voltage (V_r) and the value of the DC output voltage.



Given $V_{r(PP)} = (\frac{1}{fR_L C})V_{P(Rect)}$ $\quad V_{DC} = (1 - \frac{V_{r(PP)}}{2})V_{P(Rect)}$ $\quad V_{rms} = V_p / \sqrt{2}$

Question ③ ***(15 marks)***

For the circuit shown in figure

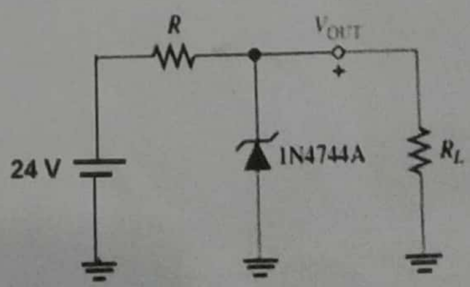
(a) Determine V_Z at each of the currents I_{ZK} and I_{ZM}

(b) What is the value of R that should be used?

(c) Determine the minimum and maximum value of R_L.

Given V_{Zo} = 15 V, I_{Zo} = 17 mA, I_{ZK} = 0.25 mA, and

r_Z = 14 Ω, P_{Zmax} = 1 w.



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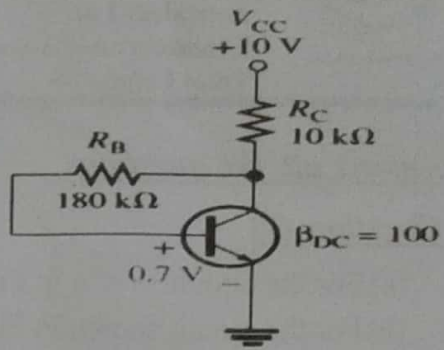
Question ④

(10 marks)

For the BJT circuit shown, Given B=100

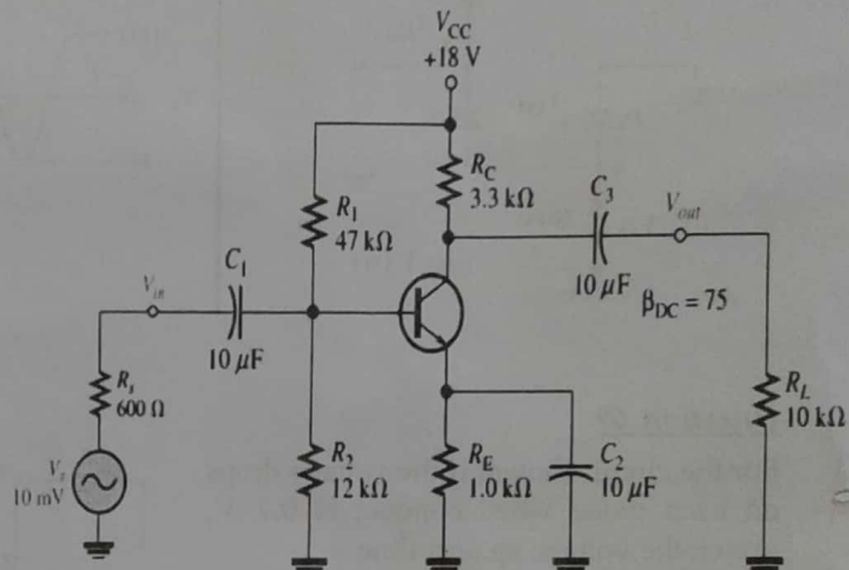
(a) Calculate all the DC voltages and currents
(b) What is the transistor region of operation
(c) What is the value of I_C to make transistor in deep saturation



Question ⑤

(20 marks)

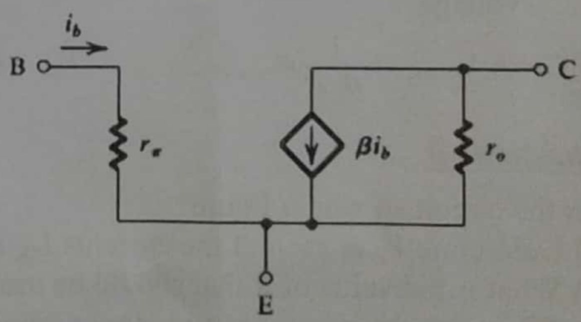
For the transistor shown in figure, given β=75
(a) Find all Dc the voltages and currents
(b) Calculate R_{in}, at V_{in} and Ro at V_{out}
(c) Find the voltage gain G_{Vo}
(d) For the given ac input, calculate the corresponding value of V_{out}.



Given

$$r_\pi = \frac{V_T}{I_B}, \qquad r_O = \frac{V_A}{I_C}$$

V_A= 50 V, V_T=0.025 V



Good Luck

Q(1)

~~assume~~ ideal diode

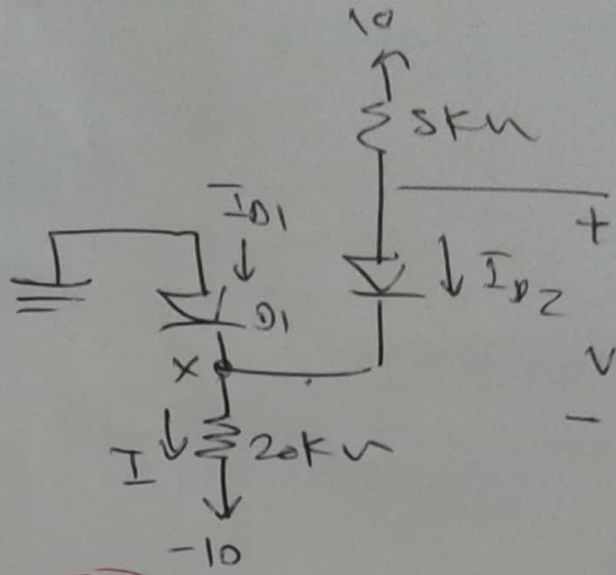
assume D1 on

$\therefore V_x = 0$

$\therefore I = \frac{0-10}{20} = 0.5 mA$

at node x ,

$I_{D2} = \frac{10-0}{5} = 2 mA$



(1½)

at x $\quad I_{D1} + I_{D2} = I$

$I_{D1} + 2 = 0.5$

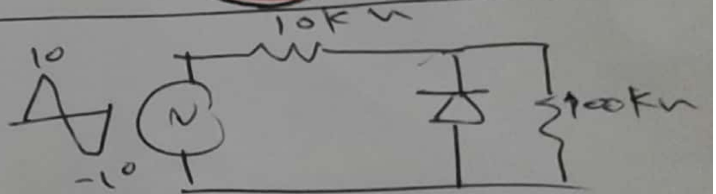
So $I_{D1} = -1.5$, So D1 off $\boxed{I_{D1} = 0}$

$\therefore I_{D2} = I = \frac{10-(-10)}{25} = \frac{20}{25} mA$ (3)

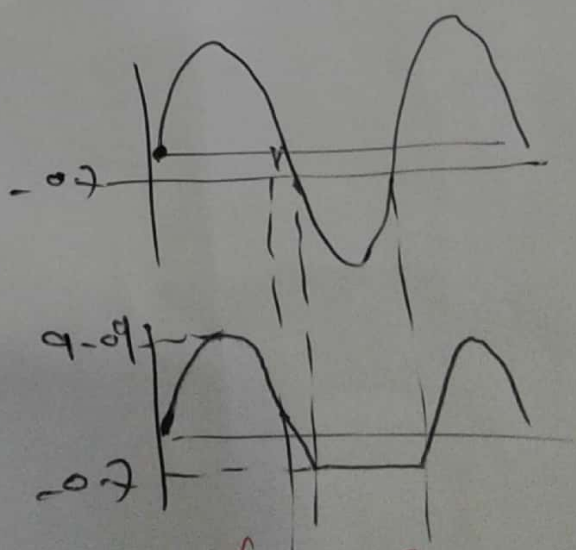
$V = 10 - \frac{20}{25} * 5 = 6 V$ (3)

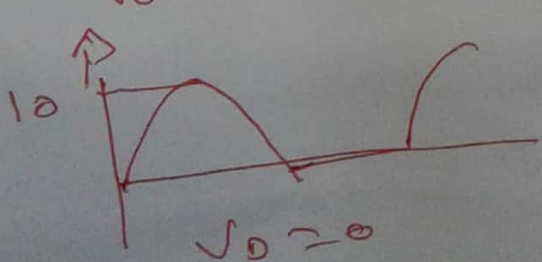
(b) diode will conduct when $v_i < -0.7$

$V_o = 10 * \frac{100}{110} = 9.09$



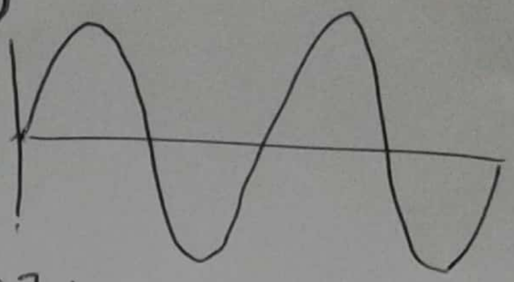
(7½)





Q(2)

$V_{in\,pp} = 120\sqrt{2} = 169.7\ V$ ✓ (2)

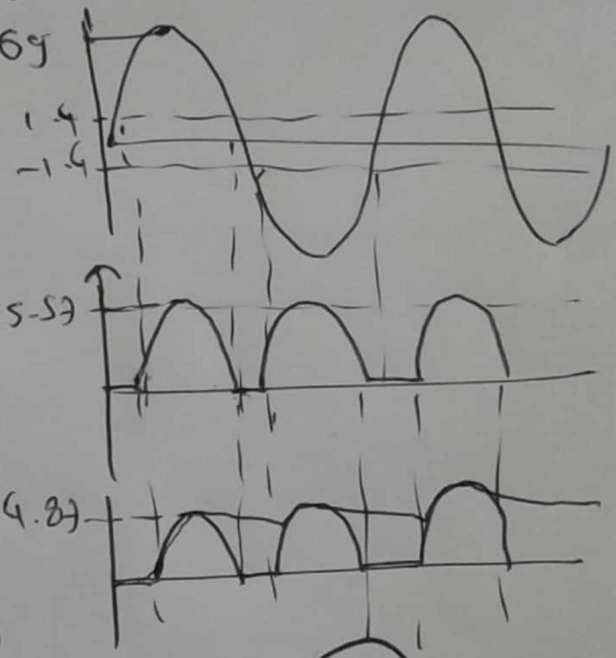


$V_{sec} = 16.97\ V$ ✓

$V_{befor\ DS} = 16.97 - 1.4 = 15.57\ V$

after DS

$V_{p\,DS\,rp} = 15.57 - 0.7 = 14.87\ V$ ✓ (2)



$V_{rpp} = \frac{V_P}{f R_L C}$

$= \frac{14.87}{120 \times 220 \times 100 \times 10^{-6}}$

$= 0.56325$ ✓ (2)

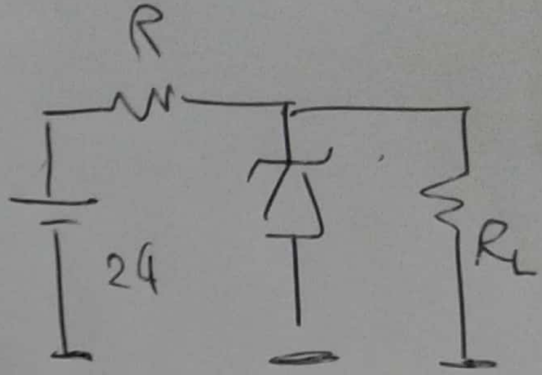
$V_{DC} = \left(1 - \frac{V_{rpp}}{2}\right) V_{p\,rect}$

$= \left(1 - \frac{0.56325}{2}\right) \times 14.87$

$= 10.682\ V$ # ✓ (2)

(7)

Q(3)



$V_{ZK} = V_{Z0} - (I_{Z0} - I_{ZK}) r_z$

$= 15 - (17 - 0.25) * 14$

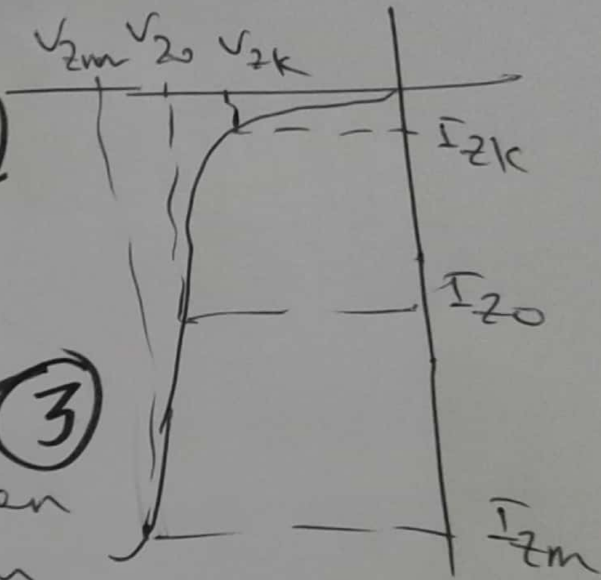
$= 14.7655\,V$ # (3)

$I_{Zmax} = \frac{P_{Dmax}}{V_{Z0}} = \frac{1W}{15}$ (3)

$= 66.66\,mA$

$V_{Zmax} = 15 + (66.66 - 17) * 14$ (3)

$= 15.6953\,V$ #



$R = \frac{V_i - V_{Z0}}{I_{Zmax}} = \frac{24-15}{66.66}$

$= 135\,\Omega$ # (3)

minimum value of R_L when I_L is max or I_Z min

$I_{Z max} = I_T - I_{Zmin}$

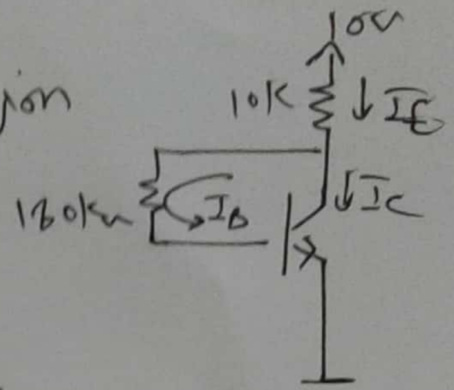
$= \frac{24-15}{0.135} - 0.25 = 66.4166\,mA$ (3)

$R_{Lmin} = \frac{V_Z}{I_{Zmax}} = \frac{15}{66.4166} = 225.8\,\Omega$ #

(3)

Q(4)

assume operate in active region



(a)

$V_E = 0$ (#) (1)

$V_B = 0.7$ (#) (1)

$10 = 10 I_E + 180 I_B + 0.7$

$10 - 0.7 = 10 I_E + \frac{180}{101} I_E$ (1)

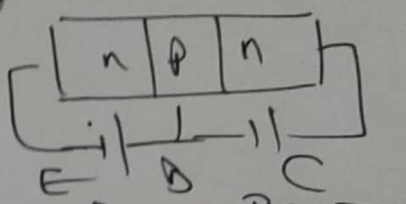
$I_E = 0.78932 \text{ mA}$ (#) (1)

$I_C = \alpha I_E = \frac{100}{101} * 0.78932 = 0.7815 \text{ mA}$ (#) (1)

$I_B = \frac{I_C}{\beta} = 0.007815 \text{ mA}$ (#) (1)

$V_C = 10 - 10 I_E = 2.1068 \text{ V}$ (#) (1)

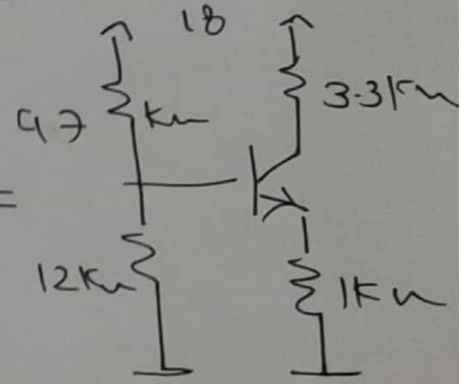
(b) active ✓ (2)



(c) for deep saturation

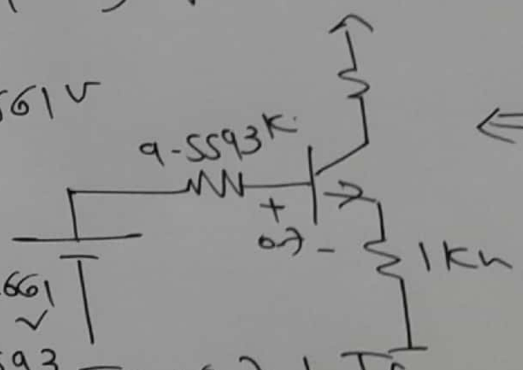
$V_{CE} = 0.2 \quad \therefore I_C = \frac{10 - 0.2}{10} = 0.98 \text{ mA}$ (2)

Q(5) DC analysis, $\beta = 75$



$47 // 12 = 9.5593$

$V_{BB} = \frac{18 * 12}{12 + 47} = 3.661 \text{ V}$



$3.661 = \frac{9.5593}{76} I_E + 0.7 + I_E$

(a)

$I_E = 2.63 \text{ mA}$ (#)

$I_C = \alpha I_E = 2.59556 \text{ mA}$ (#)

$I_B = 0.0346 \text{ mA}$ (#)

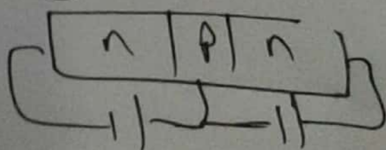
$V_E = I_E * 1 = 2.63 \text{ V}$ (#)

$V_B = V_E + 0.7 = 3.33 \text{ V}$ (#)

$V_C = 18 - 3.3 * 2.595 = 9.43 \text{ V}$ (#)

check active ✓

(5)



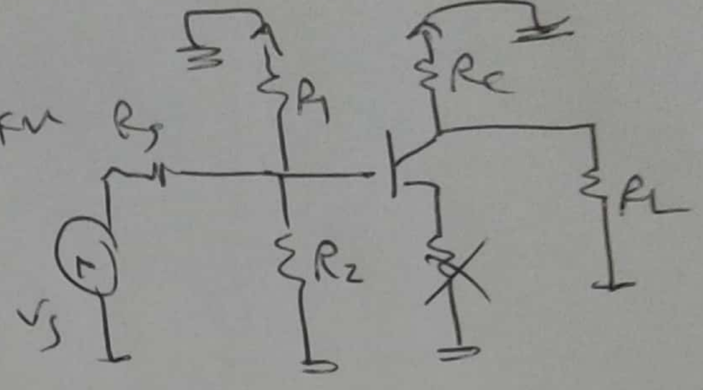
AC analysis

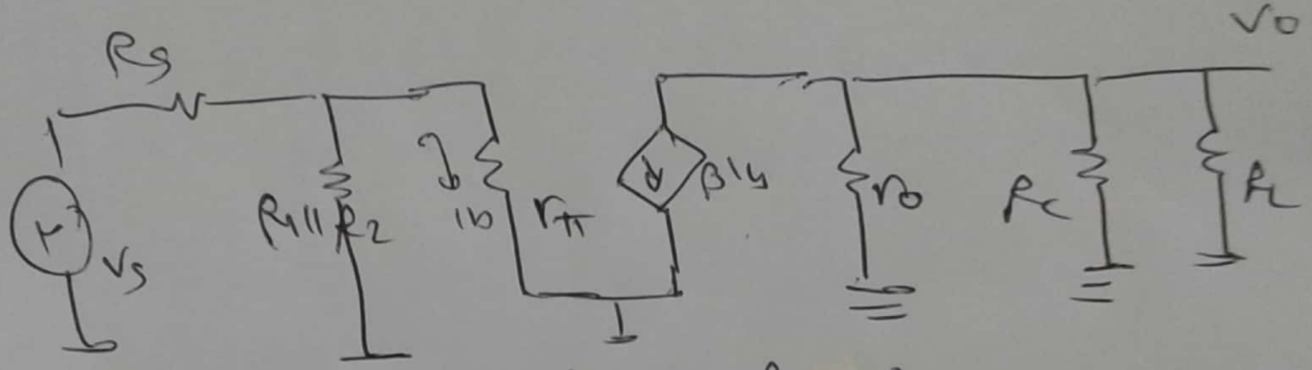
- all caps are s.c
- all DC are s.c

$r_\pi = \frac{V_T}{I_B} = \frac{0.025}{0.0346} = 0.723\,K\Omega$

$r_o = \frac{V_A}{I_C} = 19.26\,K\Omega$

(2)





$\therefore V_{o_{without}} = -\beta i_b (r_o \| R_c)$

$V_{o_{with}} = -\beta i_b (r_o \| R_L \| R_c)$

(5)

$V_i = i_b r_\pi$

$R_i = R_1 \| R_2 \| r_\pi = 0.6722\,K\Omega$ #

$\therefore R_o = r_o \| R_c = 2.817\,K\Omega$ #

$A_v = \frac{V_o}{V_i} = \frac{-\beta (r_o \| R_L \| R_c)}{r_\pi}$

$A_{v_o} = \frac{V_o}{V_i} = \frac{-\beta (r_o \| R_c)}{r_\pi}$

$V_i = \frac{V_{sig} * R_1 \| R_2 \| r_\pi}{R_s + R_1 \| R_2 \| r_\pi}$

$\therefore \frac{V_i}{V_{sig}} = \frac{R_1 \| R_2 \| r_\pi}{R_s + R_1 \| R_2 \| r_\pi}$

(5)

$A_{vo} = \frac{V_o}{V_i} \cdot \frac{V_i}{V_{sig}} = \frac{-\beta (r_o \| R_c)}{r_\pi} \cdot \frac{R_1 \| R_2 \| r_\pi}{R_s + R_1 \| R_2 \| r_\pi}$

$= \frac{-75 * 19.26 \| 3.3}{0.723} * \frac{0.6722}{0.6 + 0.6722}$

$= -154.44$

$V_{o_{ac}} = -1.544177\,V$ (3)