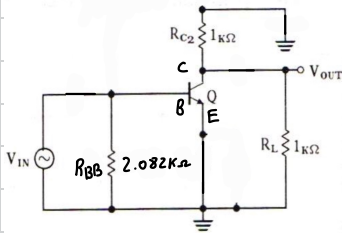


1.

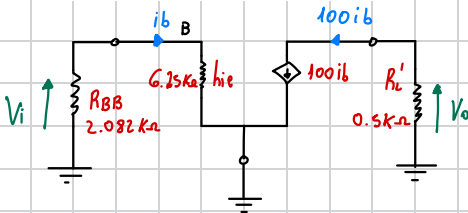


$$R_{BB} = R_2 \parallel R_1 = \frac{9.1 \cdot 2.7}{9.1 + 2.7} = 2.082 \text{ k}\Omega$$

$$R_L' = R_L \parallel R_{C2} = 1 \parallel 1 = 0.5 \text{ k}\Omega$$

$$V_o = 100 i_b \cdot R_L' = 50 i_b$$

$$V_i = i_b \cdot h_{ie} = \overset{R_{in'}}{6.25} i_b$$



$$A_v = \frac{50 i_b}{6.25 i_b} = -8$$

$$2. \quad A_I = \frac{I_o}{I_i} = \frac{50 i_b}{4 i_b} = 12.5$$

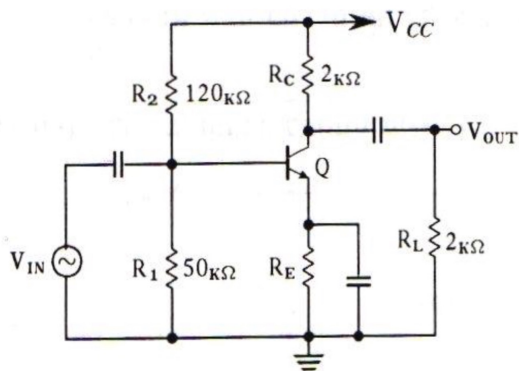
$$I_o = \frac{V_o}{R_L} = \frac{50 i_b}{1} = 50 i_b$$

$$I_{in} = I_{R_{BB}} + I_{h_{ie}} = \frac{V_i}{2.082} + \frac{V_i}{6.25} = 0.64 V_i = 0.64 \cdot 6.25 i_b = 4 i_b$$

$$c. \quad R_{in} = R_{in'} \parallel R_{BB} = \frac{6.25 \cdot 2.082}{6.25 + 2.082} = 1.56 \text{ k}\Omega \quad R_{in} = 1.56 \text{ k}\Omega$$

$$R_{out} = R_L' = 0.5 \text{ k}\Omega$$

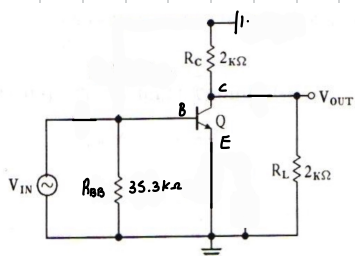
2.



$$h_{fe} = 50$$

$$h_{ie} = 1 k\Omega$$

$$R_{BB} = 50 \parallel 120 = \frac{50 \cdot 120}{50 + 120} = 35.3 k\Omega$$

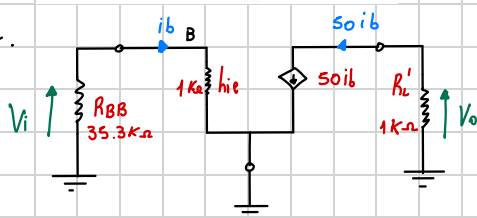


$$R'_L = R_L \parallel R_C = 2 \parallel 2 = 1 k\Omega$$

$$A_v = \frac{V_o}{V_i} = \frac{-50 i_b}{1 i_b} = -50$$

$$A_v = -50$$

c.



$$V_o = 50 i_b \cdot R'_L = -50 i_b$$

$$V_i = h_{ie} \cdot i_b = 1 i_b$$

$$2. A_I = \frac{I_o}{I_{in}} = \frac{-25 i_b}{1.028 i_b} = -24.32$$

$$A_I = 24.32$$

$$I_o = \frac{V_o}{R_L} = \frac{-50 i_b}{2} = -25 i_b$$

$$I_{in} = I_{R_{BB}} + I_{h_{ie}} = \frac{V_i}{35.3} + \frac{V_i}{1} = \frac{1 i_b}{35.3} + 1 i_b = i_b (1.028) = 1.028 i_b$$

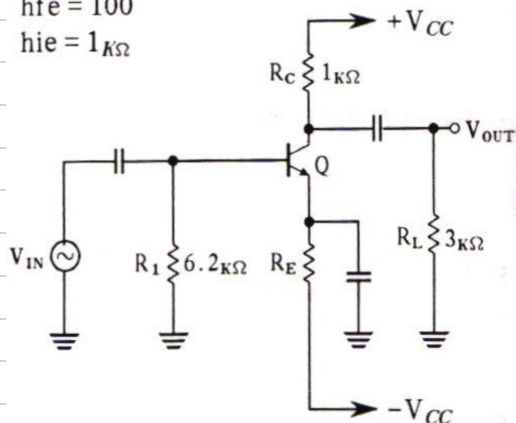
$$d. R_{in} = R_{in}' \parallel R_{BB} = \frac{1 \cdot 35.3}{36.3} = 0.972 k\Omega$$

$$R_{out} = R'_L = 1 k\Omega$$

3.

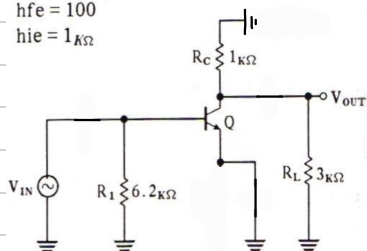
$$h_{fe} = 100$$

$$h_{ie} = 1\text{ k}\Omega$$



$$h_{fe} = 100$$

$$h_{ie} = 1\text{ k}\Omega$$



$$R'_L = R_L \parallel R_C = \frac{3 \cdot 1}{3+1} = \frac{3}{4} \text{ k}\Omega$$

$$A_v = \frac{V_o}{V_i} = \frac{-75 \text{ i}_b}{1 \text{ i}_b} = -75$$

$$A_v = -75$$

$$V_o = -100 \text{ i}_b \cdot R'_L = -75 \text{ i}_b$$

$$V_i = h_{ie} \cdot i_b = 1 \text{ i}_b$$

$$A_I = \frac{I_o}{I_{in}} = \frac{-25 \text{ i}_b}{1.16 \text{ i}_b} = -21.55$$

$$A_I = -21.55$$

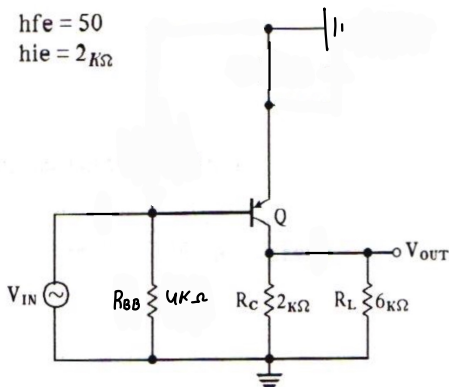
$$I_o = \frac{V_o}{R_L} = \frac{V_o}{3} = \frac{-75 \text{ i}_b}{3} = -25 \text{ i}_b$$

$$I_{in} = \frac{V_i}{6.2} + \frac{V_i}{1} = \frac{1 \text{ i}_b}{6.2} + 1 \text{ i}_b = \text{i}_b \cdot 1.16$$

$$R_{in} = R_{in}' \parallel R_1 = \frac{1 \cdot 6.2}{1+6.2} = 0.861 \text{ k}\Omega$$

$$R_{out} = R'_L = 0.75 \text{ k}\Omega$$

4. $h_{fe} = 50$
 $h_{ie} = 2 \text{ k}\Omega$



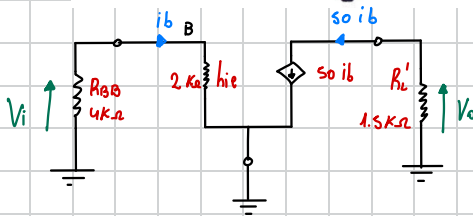
$$R_{BB} = R_1 \parallel R_2 = \frac{5 \cdot 20}{5 + 20} = \frac{100}{25} = 4 \text{ k}\Omega$$

$$R'_L = R_C \parallel R_L = \frac{6 \cdot 2}{6 + 2} = \frac{12}{8} = 1.5 \text{ k}\Omega$$

k. $A_v = \frac{V_o}{V_{in}} = \frac{-75 \text{ mV}}{2 \text{ mV}} = -37.5$ $A_v = -37.5$

$$V_o = -50 i_b \cdot R'_L = -50 i_b \cdot 1.5 = -75 i_b$$

$$V_{in} = h_{ie} \cdot i_b = 2 i_b$$



2. $A_I = \frac{I_o}{I_{in}} = \frac{-12.5 \text{ mV}}{1.5 \text{ mV}} = \frac{-12.5}{1.5} = 8.3$ $A_I = 8.3$

$$I_o = \frac{V_o}{R_L} = \frac{V_o}{6} = \frac{-75 i_b}{6} = -12.5 i_b$$

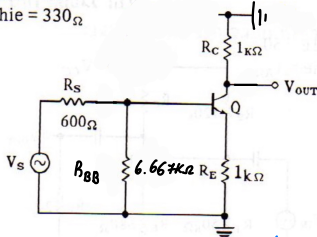
$$I_{in} = I_{R_{BB}} + I_{h_{ie}} = \frac{V_i}{R_{BB}} + \frac{V_i}{h_{ie}} = \frac{V_i}{4} + \frac{V_i}{2} = \frac{2 i_b}{4} + \frac{2 i_b}{2} = 1.5 i_b$$

c. $R_{in} = R_{BB}' \parallel R_{BB} = \frac{2 \cdot 4}{6} = \frac{8}{6} = 1.33 \text{ k}\Omega$ $1.33 \text{ k}\Omega$

$$R_{out} = R'_L = 1.5 \text{ k}\Omega$$

5.

$h_{fe} = 85$
 $h_{ie} = 330 \Omega$



$$R_{BB} = R_2 \parallel R_1 = \frac{20 \cdot 10^3}{3} = 6.667 k\Omega$$

$$A_v = \frac{V_o}{V_i} = \frac{-85 i_b}{94.7 i_b} = -0.89$$

$$V_o = -V_{Ac} = -85 i_b \cdot 1 = -85 i_b$$

$$V_i = V_{As} + V_{Ain'} = 13.95 i_b \cdot 0.6 + i_b \cdot 86.33 = 94.7 i_b$$

$$i_b = i_s \cdot \frac{R_{BB}}{R_{BB} + h_{ie} + R_E \cdot 86} = i_s \cdot 0.071$$

$$i_s = 13.95 i_b$$

$$2. \quad A_I = \frac{I_o}{I_{in}} = \frac{-85 i_b}{-13.95 i_b} = 6.13$$

$$A_I = 6.09$$

$$I_o = \frac{V_o}{R_c} = \frac{-85 i_b}{1} = -85 i_b$$

$$I_i = i_s = 13.95 i_b$$

$$3. \quad R_{in'} = h_{ie} + 86 R_E = 86.33 k\Omega$$

$$R_{in} = (R_{in'} \parallel R_{BB}) + R_S = \frac{86.33 \cdot 6.667}{86.33 + 6.667} + 0.6 = 6.79 k\Omega$$

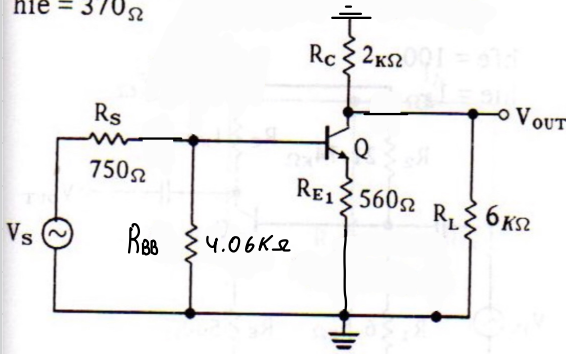
$$R_{in} = 6.79 k\Omega$$

$$R_{out} = R_c = 1 k\Omega$$

6.

$$h_{fe} = 49$$

$$h_{ie} = 370 \Omega$$



$$R_{BB} = \frac{20 \cdot 5.1}{20 + 5.1} = 4.06 K \Omega$$

$$R_L' = \frac{6 \cdot 2}{6 + 2} = \frac{12}{8} = 1.5 K \Omega$$

$$2. A_v = \frac{V_o}{V_{in}} = \frac{-73.5 i_b}{34.355 i_b} = -2.14$$

$$V_o = -V_{R_L'} = -49 i_b \cdot R_L' = -73.5 i_b$$

$$V_i = V_{R_s} + V_{R_{in}'} = 7.98 i_b \cdot 0.75 + i_b \cdot 28.37$$

$$V_{in} = 34.355 i_b$$

$$i_b = i_s \frac{R_{BB}}{R_{BB} + h_{ie} + R_E \cdot 50} = 0.125 i_s$$

$$i_s = 7.98 i_b$$

$$R_{in}' = h_{ie} + 50 R_E = 0.37 + 50 \cdot 0.56 = 28.37 K \Omega$$

$$2. A_I = \frac{I_o}{I_{in}} = \frac{-12.25 i_b}{7.98 i_b} = -1.53$$

$$A_I = 1.53$$

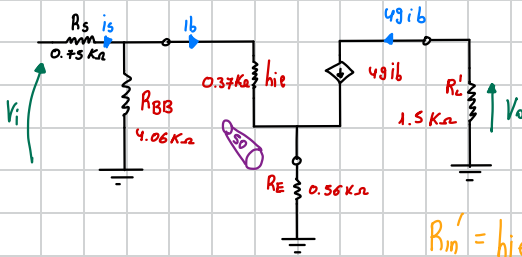
$$I_o = \frac{V_o}{R_L} = \frac{-73.5 i_b}{6} = -12.25 i_b$$

$$I_{in} = i_s = 7.98 i_b$$

$$1. R_{in} = (R_{in}' \parallel R_{BB}) + R_s = \frac{28.37 \cdot 4.06}{28.37 + 4.06} + 0.75 = 3.55 + 0.75 = 4.3 K \Omega$$

$$3. R_{out} = R_L' = 1.5 K \Omega$$

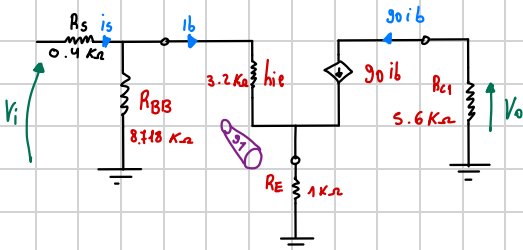
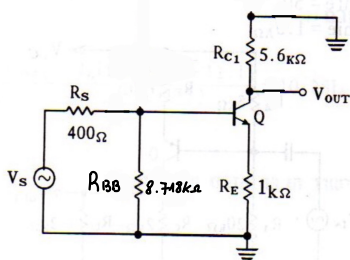
1c.



7.

$$h_{fe} = 90$$

$$h_{ie} = 3.2 \text{ k}\Omega$$



$$R_{BB} = R_1 \parallel R_2 = \frac{68 \cdot 10}{68 + 10} = 8.718 \text{ k}\Omega$$

$$A_v = \frac{V_o}{V_i} = \frac{-504 i_b}{38.92 i_b} = -5.09$$

$$A_v = -5.09$$

$$V_o = -V_{RC1} = -90 i_b \cdot 5.6 = -504 i_b$$

$$V_i = V_{RS} + V_{Rin'} = 11.8 i_b \cdot 0.4 + 94.2 i_b = 38.92 i_b$$

$$i_b = i_s \cdot \frac{R_{BB}}{R_{BB} + h_{ie} + 91 R_E} = 0.0847 i_s$$

$$i_s = 11.80 i_b$$

$$R_{in'} = h_{ie} + 91 R_E = 3.2 + 91 \cdot 1 = 94.2 \text{ k}\Omega$$

$$2. A_I = \frac{I_o}{I_i} = \frac{-90 i_b}{11.80 i_b} = -7.627$$

$$A_I = 7.627$$

$$I_o = \frac{V_o}{R_{C1}} = \frac{V_o}{5.6} = \frac{-504 i_b}{5.6} = -90 i_b$$

$$I_i = i_s = 11.80 i_b$$

$$c. R_{in} = (R_{in'} \parallel R_{BB}) + R_S = \frac{94.2 \cdot 8.718}{94.2 + 8.718} + 0.4 = 8.38 \text{ k}\Omega$$

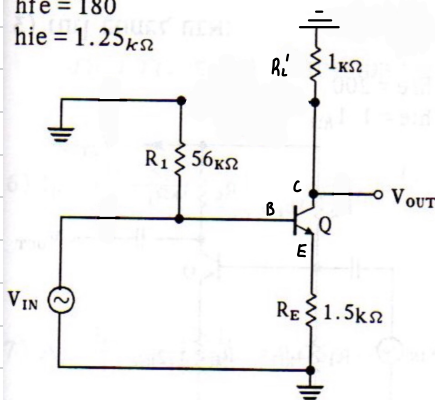
$$R_{in} = 8.38 \text{ k}\Omega$$

$$R_{out} = R_{C1} = 5.6 \text{ k}\Omega$$

8.

$$h_{fe} = 180$$

$$h_{ie} = 1.25 \text{ k}\Omega$$



$$R_1 = R_{BB} = 56 \text{ k}\Omega$$

$$R_L' = R_C \parallel R_L = \frac{1 \cdot 360}{361} = 1 \text{ k}\Omega$$

$$2. A_v = \frac{V_o}{V_i} = \frac{-180 i_b}{272.75 i_b} = -0.66$$

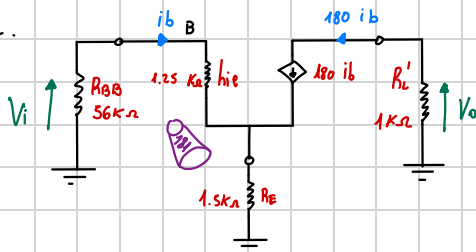
$$A_v = -0.66$$

$$V_o = -V_{RL} = -180 i_b \cdot 1 = -180 i_b$$

$$V_i = V_{h_{ie}} + V_{R_E} = 1.25 i_b + 181 \cdot 1.5 i_b = 272.75 i_b$$

$$R_{in}' = h_{ie} + 181 R_E = 1.25 + 181 \cdot 1.5 = 272.75 \text{ k}\Omega$$

1c.



$$2. A_I = \frac{I_o}{I_{in}} = \frac{-180 i_b}{5.87 i_b} = -30.66$$

$$A_I = -30.66$$

$$I_o = \frac{V_o}{R_L'} = \frac{-180 i_b}{1} = -180 i_b$$

$$I_{in} = \frac{V_i}{R_{BB}} + \frac{V_i}{R_{in}'} = \frac{272.75 i_b}{56} + \frac{272.75 i_b}{272.75} = 5.87 i_b$$

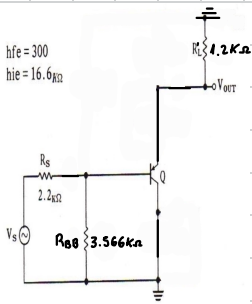
$$c. R_{in} = R_{in}' \parallel R_{BB} = \frac{272.75 \cdot 56}{272.75 + 56} = 46.46 \text{ k}\Omega$$

$$R_{in} = 46.46 \text{ k}\Omega$$

$$R_{out} = R_L' = 1 \text{ k}\Omega$$

9.

$h_{fe} = 300$
 $h_{ie} = 16.6 \text{ k}\Omega$



$$R'_L = R_L \parallel R_{E2} = \frac{1.8 \cdot 3.6}{1.8 + 3.6} = 1.2 \text{ k}\Omega$$

$$R_{BB} = R_1 \parallel R_2 = \frac{6.8 \cdot 7.5}{6.8 + 7.5} = 3.566 \text{ k}\Omega$$

$$2. \quad A_v = \frac{V_o}{V_i} = \frac{361 \text{ i}_b}{613.09 \text{ i}_b} = 0.58$$

$$A_v = 0.58$$

$$V_o = 301 \text{ i}_b \cdot R'_L = 361 \text{ i}_b$$

$$V_i = V_{R_S} + V_{R_{in}'} = i_S \cdot R_S + i_b \cdot R_{in}' = 613.09 \text{ i}_b$$

$$i_b = i_S \frac{R_{BB}}{R_{BB} + h_{ie} + 301 R'_L} = 9.35 \cdot 10^{-3} i_S$$

$$i_S = 106.95 \text{ i}_b$$

$$R_{in}' = h_{ie} + 301 R'_L = 377.8 \text{ k}\Omega$$

$$c. \quad A_I = \frac{I_o}{I_i} = \frac{200.55 \text{ i}_b}{106.95 \text{ i}_b} = 1.87$$

$$I_o = \frac{V_o}{R_L} = \frac{361 \text{ i}_b}{1.8} = 200.55 \text{ i}_b$$

$$A_I = 1.87$$

$$I_{in} = i_S = 106.95 \text{ i}_b$$

$$3. \quad R_{in} = (R_{in}' \parallel R_{BB}) + R_S = (377.8 \parallel 3.566) + 2.2 = 5.73 \text{ k}\Omega \quad R_{in} = 5.73 \text{ k}\Omega$$

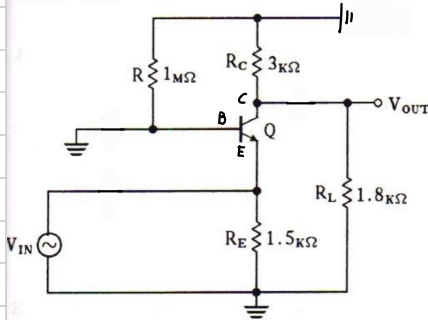
$$R_{out} = R'_L = 1.2 \text{ k}\Omega$$

10.

$$h_{ie} = 2.7 \text{ k}\Omega$$

$$h_{fe} = 145$$

(10)



$$R_L' = R_C \parallel R_L = \frac{3 \cdot 1.8}{3 + 1.8} = 1.125 \text{ k}\Omega$$

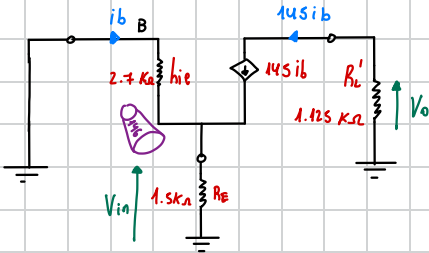
$$2. A_v = \frac{V_o}{V_i} = \frac{-163.125 i_b}{-2.7 i_b} = 60.4$$

$$V_o = -V_{R_L'} = -145 i_b \cdot 1.125 = -163.125 i_b$$

$$V_i = -h_{ie} \cdot i_b = -2.7 \cdot i_b$$

$$A_v = 60.4$$

10.



$$R_{in}' = (R_E \parallel \frac{h_{ie}}{146}) = 1.5 \parallel 0.018 = 18 \Omega$$

$$\frac{h_{ie}}{146} = \frac{2.7}{146} = 18.5 \Omega$$

$$d. A_I = \frac{-90.625 i_b}{146 i_b} = -0.62$$

$$A_i = 0.62$$

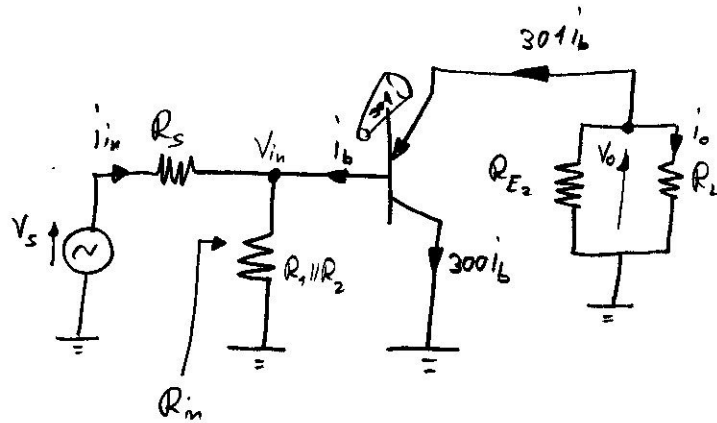
$$I_o = \frac{V_o}{R_L} = \frac{-163.125 i_b}{1.8} = -90.625 i_b$$

$$I_{in} = i_e = 146 i_b$$

$$R_{in} = R_{in}' = 18 \Omega$$

$$R_{out} = R_L' = 1.125 \text{ k}\Omega$$

[9]



$$\textcircled{e} V_o = -301 i_b (R_{E2} \parallel R_L) = -301 i_b (3.6 \parallel 1.8) = -301 i_b \cdot 1.2 = -361.2 i_b$$

$$V_{in} = -i_b \cdot h_{ie} - 301 i_b (R_{E2} \parallel R_L) = -16.6 i_b - 361.2 i_b = -377.8 i_b$$

$$\textcircled{c} R_{in} = R_1 \parallel R_2 \parallel [h_{ie} + (R_{E2} \parallel R_L) \cdot 301] =$$

$$= 6.8 \parallel 7.5 \parallel [16.6 + 1.2 \cdot 301] = 3.533 k\Omega$$

$$V_{in} = V_s \frac{R_{in}}{R_s + R_{in}}$$

$$-377.8 i_b = V_s \frac{3.533}{3.533 + 2.2} \Rightarrow V_s = -613.056 i_b$$

$$A_{V_s} = \frac{V_o}{V_s} = \frac{-361.2 i_b}{-613.056 i_b} = 0.59$$

$$\textcircled{d} R_o = R_{E2} \parallel R_L \parallel \frac{h_{ie} + (R_1 \parallel R_2 \parallel R_s)}{301} = 3.6 \parallel 1.8 \parallel \frac{16.6 + (6.8 \parallel 7.5 \parallel 2.2)}{301} =$$

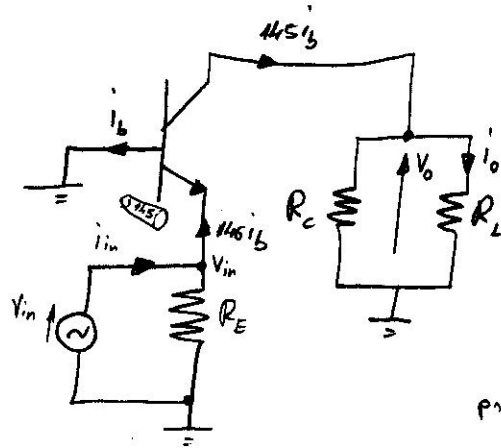
$$= 1.2 \parallel \frac{16.6 + 1.36}{301} = 56.8 \Omega$$

$$\textcircled{a} i_o = \frac{V_o}{R_L} = \frac{-361.2 i_b}{1.8} = -200.666 i_b$$

$$i_{in} = \frac{V_s}{R_s + R_{in}} = \frac{-613.056 i_b}{2.2 + 3.533} = -106.934 i_b$$

$$A_I = \frac{i_o}{i_{in}} = \frac{-200.666 i_b}{-106.934 i_b} = 1.876$$

[10]



ע'מ! עם! הסמל' של ה-BJT מראה
 ש- I_E 147 מראה, צה בוא' נבין, יאק
 יש לזכור שזוהי צה נכונה בהכרח לנתוח
DC ולא בהכרח ל-AC, סמולר ש' יכול
 להכנס למחלק למחלק של-DC הוא יוצא!

$$\textcircled{E} V_o = 145 I_b (R_c \parallel R_L) = 145 \cdot 1.125 I_b = 163.125 I_b$$

$$V_{in} = 146 I_b \cdot \frac{h_{ie}}{146} = 2.7 I_b$$

oper. freq

$$A_v = \frac{V_o}{V_{in}} = \frac{163.125}{2.7} = 60.416$$

$$\textcircled{2} I_o = \frac{V_o}{R_L} = \frac{163.125 I_b}{1.8} = 90.625 I_b$$

פרספקט

$$146 I_b = I_{in} \cdot \frac{R_E}{R_E + \frac{h_{ie}}{146}}$$

$$146 I_b = I_{in} \cdot \frac{1.5}{1.5 + \frac{2.7}{146}} \Rightarrow I_{in} = 147.8 I_b$$

$$A_i = \frac{I_o}{I_{in}} = \frac{90.625 I_b}{147.8 I_b} = 0.613$$

$$\textcircled{d} R_{in} = R_E \parallel \frac{h_{ie}}{146} = 1.5 \parallel \frac{2.7}{146} = 18.1 \Omega$$

$$\textcircled{3} R_o = R_c \parallel R_L = 3 \parallel 1.8 = 1.125 k\Omega$$