

$$A_V = - \frac{R_C}{r_E}$$

$$r_E = \frac{26 \text{ mV}}{I_E}$$

$$-200 = - \frac{4.7 \text{ k}\Omega}{r_E}$$

$$23.5 = \frac{26 \text{ mV}}{I_E}$$

$$r_E = 23.5 \Omega$$

$$I_E = 1.1 \text{ mA}$$

$$I_E = I_B + I_C$$

$$I_B = \frac{V_{cc} - V_{BE}}{R_B}$$

$$I_E = I_B + \beta I_B$$

$$I_E = (1 + \beta) I_B$$

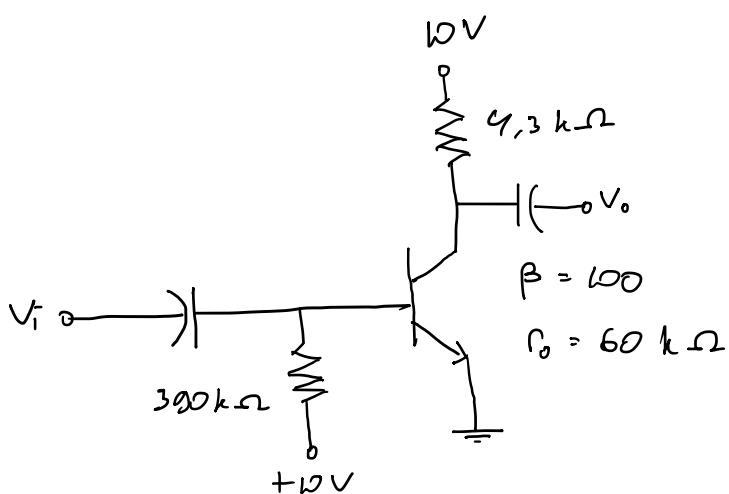
$$I_B = \frac{1.1 \text{ mA}}{91}$$

$$12.1 \mu\text{A} = \frac{V_{cc} - 0.7}{1 \text{ M}\Omega}$$

$$V_{cc} - 0.7 = 12.1$$

$$I_B = 12.1 \mu\text{A}$$

$$V_{cc} = 12.9 \text{ V}$$



$$a. \quad I_B = \frac{V_{CC} - V_{BE}}{R_B}$$

$$I_B = \frac{10 - 0,7}{390 \text{ k}\Omega}$$

$$I_B = \frac{9,3}{390 \text{ k}} = 23,85 \mu\text{A}$$

$$I_C = \beta I_B$$

$$I_C = 100 \cdot 23,85 \mu\text{A}$$

$$I_C = 2,385 \text{ mA}$$

$$I_E = I_B + I_C$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$I_E = 23,85 \mu\text{A} + 2,385 \text{ mA}$$

$$r_e = \frac{26 \text{ mV}}{2,4 \text{ mA}}$$

$$I_E = 2,4 \text{ mA}$$

$$r_e = 10,0 \text{ }\Omega$$

$$b. \quad h_{ie} = \beta \cdot r_e$$

$$= 100 \cdot 10,0$$

$$= 1000 \text{ }\Omega$$

$$Z_o = R_C \parallel r_o$$

$$Z_o = \frac{R_C \cdot r_o}{R_C + r_o}$$

$$Z_o = \frac{4,3 \text{ k} \cdot 60 \text{ k}}{4,3 \text{ k} + 60 \text{ k}}$$

$$Z_o = 4012,44 \text{ }\Omega$$

$$Z_i = R_A \parallel h_{ie}$$

$$Z_i = \frac{R_B \cdot h_{ie}}{R_B + h_{ie}}$$

$$Z_i = \frac{390 \text{ k} \cdot 1000}{390 \text{ k} + 1000}$$

$$Z_i = 1077,02 \text{ }\Omega$$

$$c. \quad A_V = - \frac{R_C}{r_e}$$

$$= - \frac{4,3 \text{ k}}{10,0}$$

$$= - 390,15$$

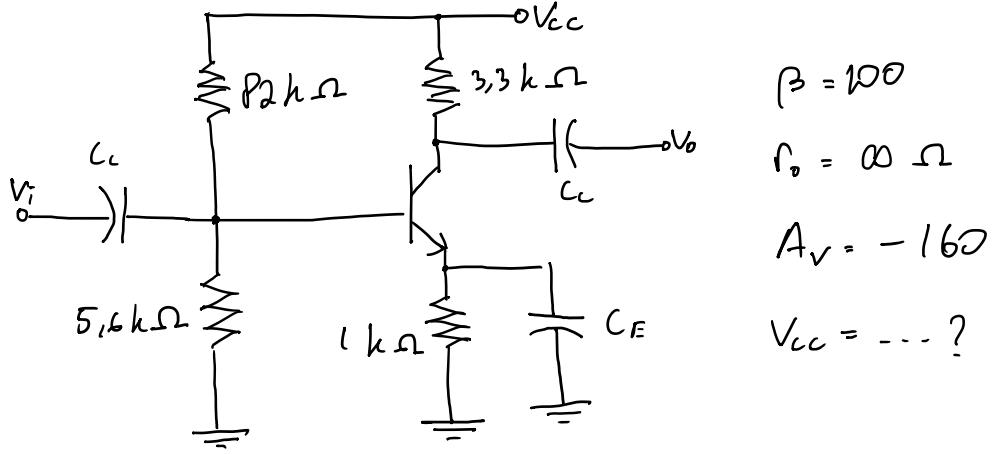
$$A_i = \frac{R_B \parallel h_{ie}}{r_e}$$

$$A_i = \frac{1077,02}{10,0}$$

$$A_i = 99$$

d. $r_o = 30 \text{ k}\Omega$ tidak berpengaruh terhadap A_V dan A_i

5.



$$A_V = - \frac{R_C}{r_e}$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$-160 = - \frac{3.3 \text{ k}}{r_e}$$

$$20.625 = \frac{26 \text{ mV}}{I_E}$$

$$r_e = 20.625 \Omega$$

$$I_E = 1.26 \text{ mA}$$

$$I_E = (\beta + 1) I_B$$

$$1.26 \text{ mA} = (100 + 1) I_B$$

$$I_B = \frac{1.26 \text{ mA}}{101}$$

$$I_B = 12.47 \mu\text{A}$$

$$R_B = R_1 \parallel R_2$$

$$= R_2 h \parallel 5.6 \text{ k}$$

$$I_B = \frac{V_{BB} - V_{BE}}{R_B + (\beta + 1) R_E}$$

$$12.47 \mu\text{A} = \frac{0.06 \text{ V}_{CC} - 0.7}{5242 + (101) \cdot 1 \text{ k}}$$

$$12.47 \mu\text{A} = \frac{0.06 \text{ V}_{CC} - 0.7}{106242}$$

$$0.06 \text{ V}_{CC} - 0.7 = 1.32$$

$$= 5242 \Omega$$

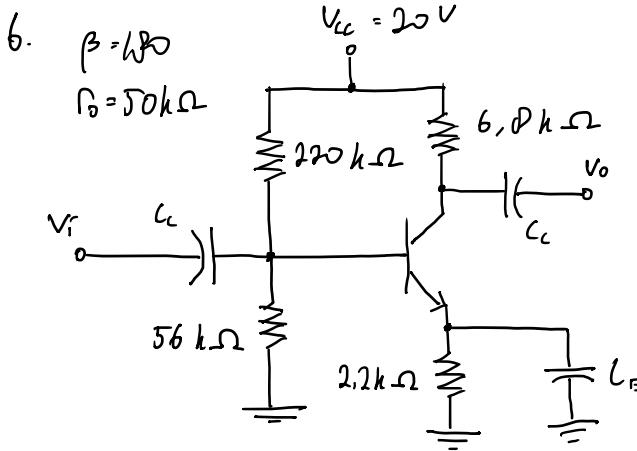
$$0.06 \text{ V}_{CC} = 2.02$$

$$V_{BB} = \frac{R_2}{R_1 + R_2} V_{CC}$$

$$\underline{\underline{V_{CC} = 33.75 \text{ V}}}$$

$$V_{BB} = \frac{5.6 \text{ k}}{R_2 h + 5.6 \text{ k}} \cdot V_{CC}$$

$$V_{BB} = 0.06 \text{ V}_{CC}$$



- a. $r_e = \dots ?$
 b. $V_B = \dots ?, V_C = \dots ?$
 c. $Z_i = \dots ?, A_v = \dots ?$

a. $\beta R_E = 180 \cdot 2,2k = 396k\Omega$

$b. R_2 = 20 - 56k = 560k\Omega$

$\beta R_E \leq 10 R_2$

$$\begin{aligned} R_B &= R_1 \parallel R_2 \\ &= 220k \parallel 56k \\ &= 44637,68 \Omega \end{aligned}$$

$$V_B = \frac{R_2}{R_1 + R_2} V_{CC}$$

$$V_B = \frac{56k}{220k + 56k} \cdot 20V$$

$$V_B = 4,06 V$$

$$I_B = \frac{V_B - V_{BE}}{R_B + (\beta + 1)R_E}$$

$$I_B = \frac{4,06 - 0,7}{44637,68 + (181)2,2k}$$

$$I_B = \frac{3,36}{44637,68}$$

$$I_B = 7,59 \mu A$$

$$I_E = (\beta + 1) I_B$$

$$I_E = (181) \cdot 7,59 \mu A = 1,37 mA$$

$$r_e = \frac{26 mV}{I_E}$$

$$r_e = \frac{26 mV}{1,37 mA}$$

$$r_e = 18,93 \Omega$$

b. $V_B = 4,06 V$

$$I_C = \beta I_B = 180 \cdot 7,59 \mu A$$

$$I_C = 1,37 mA$$

$$V_{CE} = V_{CC} - I_C (R_C + R_E)$$

$$\Rightarrow 20 - 1,37 mA (6,0k + 2,2k)$$

$$\Rightarrow 20 - 12,3$$

$$= 7,7 V$$

$$V_{CE} = V_C - V_E$$

$$7,7 = V_C - I_E R_E$$

$$7,7 = V_C - 1,37 mA \cdot 2,2k$$

$$V_C = 7,7 + 3,01$$

$$V_C = 10,71 V$$

$$C. h_{ie} = \beta r_e$$

$$= 100 \cdot 10,93$$

$$= 3407,4 \Omega$$

$$A_v = - \frac{R_c}{r_e}$$

$$= - \frac{6,8 k}{10,93}$$

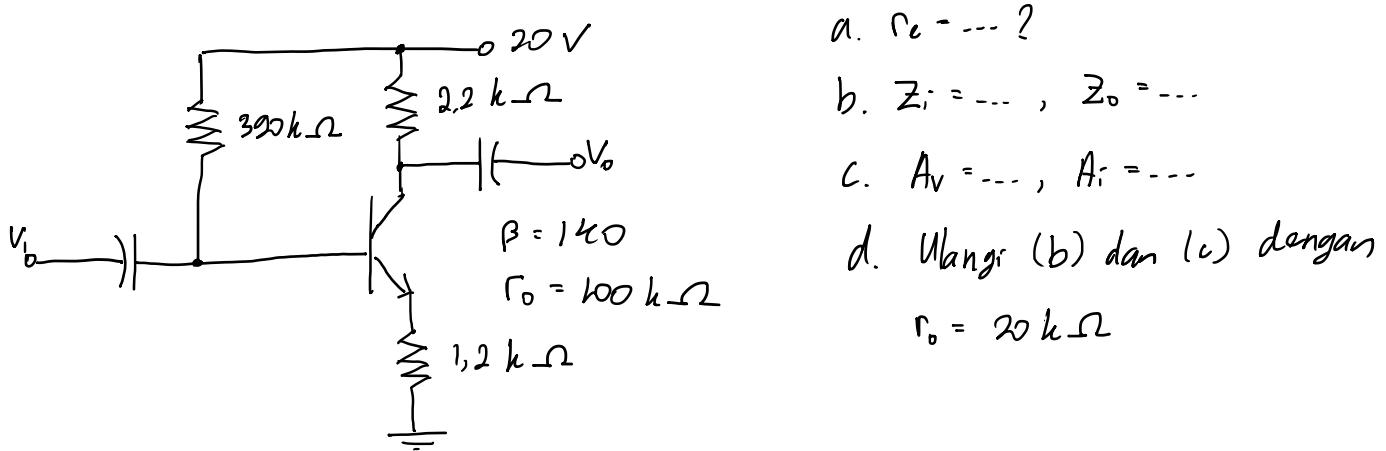
$$= - 359,22$$

$$Z_i = R_B \parallel h_{ie}$$

$$= 44637,60 \parallel 3407,4$$

$$= 3165,75 \Omega$$

\approx



$$a. r_e = \dots ?$$

$$b. Z_i = \dots, Z_o = \dots$$

$$c. A_v = \dots, A_i = \dots$$

d. Ulangi (b) dan (c) dengan
 $r_o = 20 \text{ k}\Omega$

a.

$$I_B = \frac{V_{cc} - V_{BE}}{R_B + (\beta + 1) R_E}$$

$$I_B = \frac{20 - 0,7}{390k + (141) 1,2k}$$

$$I_B = \frac{19,3}{550,200}$$

$$I_B = 34,51 \mu\text{A}$$

$$I_E = (\beta + 1) I_B$$

$$I_E = 141 \cdot 34,51 \mu\text{A}$$

$$I_E = 4,87 \text{ mA}$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$r_e = \frac{26 \text{ mV}}{4,87 \text{ mA}}$$

$$r_e = 5,34 \Omega$$

$$b. Z_i = R_B \parallel h_{ie}$$

$$Z_i = R_B \parallel \beta r_e$$

$$Z_i = 390k \parallel 140,5,34$$

$$Z_i = 746,17 \Omega$$

$$Z_o = R_c \parallel r_o$$

$$Z_o = 2,2k \parallel 100k$$

$$Z_o = 2152,64 \Omega$$

$$A_v = - \frac{R_c}{r_e}$$

$$A_v = - \frac{2,2k}{5,34}$$

$$A_v = - 412$$

$$A_i = \frac{R_B \parallel h_{ie}}{r_e}$$

$$A_i = \frac{796,17}{5,34}$$

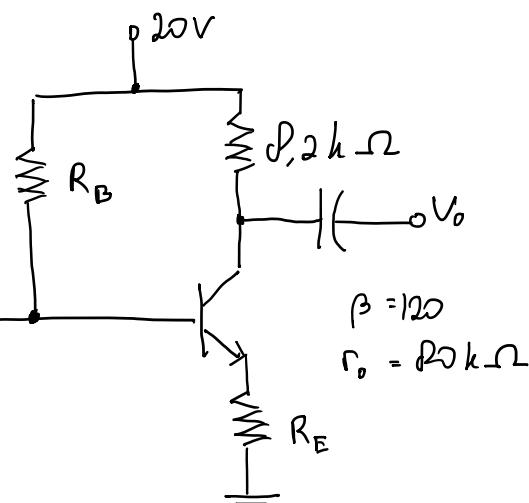
$$A_i = 139,7$$

d. Nilai r_o hanya berpengaruh terhadap Z_o , sehingga nilai Z_o ketika $Z_o = 20k\Omega$:

$$Z_o = R_c \parallel r_o$$

$$Z_o = 2,2k \parallel 20k$$

$$Z_o = 1901,99 \Omega$$



$$r_e = 3,8 \Omega$$

$$A_v = -10$$

$$Z_o = \beta R_E$$

$$R_o = \dots ?$$

$$R_B = \dots ?$$

$$10R_c = 2,2k\Omega$$

$$r_o < 10R_c$$

$$Z_o = \beta R_E$$

$$R_E \gg r_e$$

$$A_v = - \frac{R_c}{R_B}$$

$$-10 = - \frac{2,2k}{R_E}$$

$$R_E = 220 \Omega$$

$$r_e = \frac{26mV}{I_E}$$

$$3,8 = \frac{26mV}{I_E}$$

$$I_E = 6,84 mA$$

$$I_E = (\beta + 1) I_B$$

$$I_B = \frac{6,84 mA}{120 + 1}$$

$$I_B = 56,55 \mu A$$

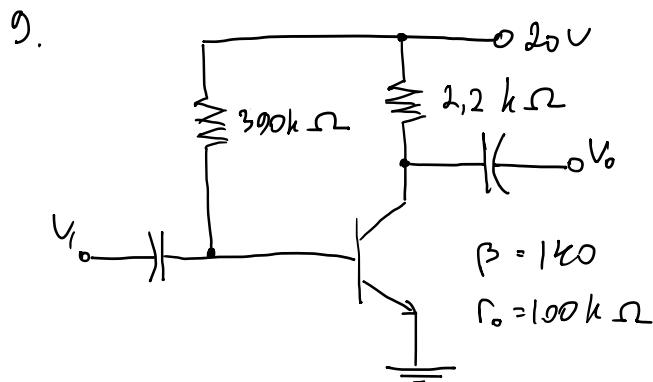
$$I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta + 1) R_E}$$

$$56,55 \mu A = \frac{20 - 0,7}{R_B + (120) 220}$$

$$R_B = 242.070,79 \Omega$$

Pakai nilai R_B yang mendekati standar:

$$R_B = 240k \Omega$$



a. $r_e = \dots ?$

b. $Z_i = \dots, Z_o = \dots$

c. $A_v = \dots, A_i = \dots$

d. ulang (b) dan (c) dengan $r_o = 20 k\Omega$

a. $I_B = \frac{V_{cc} - V_{BE}}{R_B}$

$$I_B = \frac{20 - 0,7}{390 \text{ k}}$$

$$I_B = 49,49 \mu\text{A}$$

$$I_E = (\beta + 1) I_B$$

$$I_E = (141) 49,49 \mu\text{A}$$

$$I_E = 6,90 \text{ mA}$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$r_e = \frac{26 \text{ mV}}{6,90 \text{ mA}}$$

$$r_e = 3,72 \text{ }\Omega$$

c. $A_v = - \frac{R_c}{r_e}$

$$A_i = \frac{R_b \parallel \beta r_e}{r_e}$$

$$A_v = - \frac{2,2 \text{ k}}{3,72}$$

$$A_i = \frac{520,1}{3,72}$$

$$A_v = -591,4$$

$$A_i = 139,0 \simeq 140$$

d. Nilai r_o berpengaruh terhadap Z_o , sehingga:

$$Z_o = R_c \parallel r_o$$

$$Z_o = 2,2 \text{ k} \parallel 20 \text{ k}$$

$$Z_o = 1901,90 \text{ }\Omega$$

b. $Z_i = R_b \parallel \beta r_e$

$$Z_i = 390 \text{ k} \parallel 140 \cdot 3,72$$

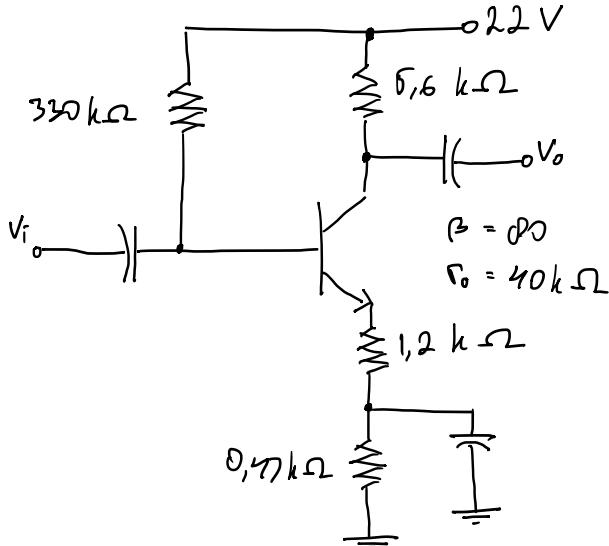
$$Z_i = 520,1 \text{ }\Omega$$

$$Z_o = R_c \parallel r_o$$

$$Z_o = 2,2 \text{ k} \parallel 100 \text{ k}$$

$$Z_o = 2152,64 \text{ }\Omega$$

10.



a. $R_E = \dots ?$

b. $Z_i = \dots , A_v = \dots$

c. $A_i = \dots ?$

a. $R_E = 1.2 \text{ k}\Omega + 0.47 \text{ k}\Omega$

$$R_E = 1.67 \text{ k}\Omega$$

$$I_B = \frac{V_{CE} - V_{BE}}{R_B + (\beta + 1)R_E}$$

$$I_B = \frac{22 - 0.7}{330k + (\beta + 1) \cdot 1.67k}$$

$$I_B = 45.7 \mu\text{A}$$

$$I_E = (\beta + 1) I_B$$

$$I_E = \beta I_B = 45.7 \mu\text{A}$$

$$I_E = 3.71 \text{ mA}$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$r_e = \frac{26 \text{ mV}}{3.71 \text{ mA}}$$

$$r_e = 7 \Omega$$

$$A_v = - \frac{R_L}{r_e + R_E}$$

$$A_v = - \frac{5.6k}{7 + 1.67k}$$

$$\cancel{A_v = -3.34}$$

$$c. A_i = \frac{\beta R_E}{R_B + Z_b}$$

$$A_i = \frac{\beta \cdot 330k}{330k + \beta R_E}$$

$$A_i = \frac{\beta \cdot 330k}{330k + \beta \cdot 1.67k}$$

$$\cancel{A_i = 56.94 \approx 57}$$

b. $Z_i = R_B \parallel \beta R_E$

$$= 330k \parallel 50 \cdot 1.67k \Omega$$

$$= 0.5099,22 \Omega$$