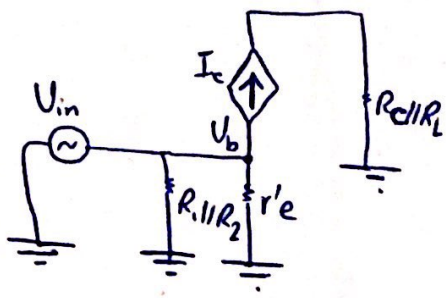
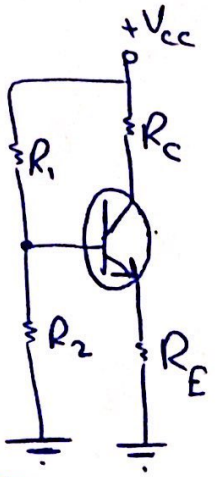
$V_{cc} = 5V$ $I_E = 80mA$

$R_L = 8\Omega$

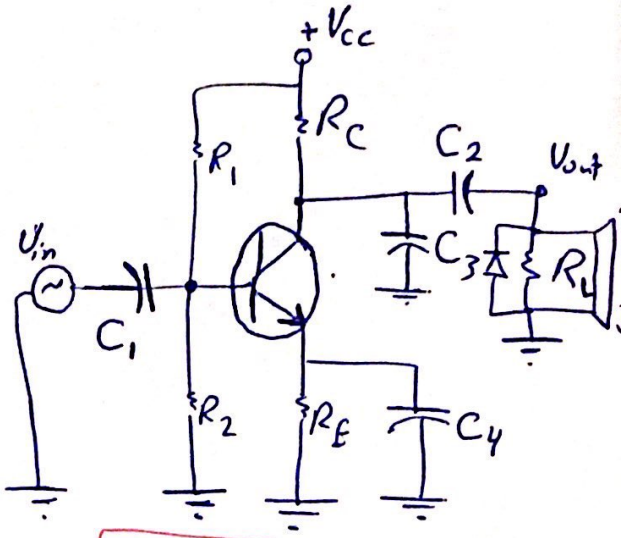
$V_{CE} = 2.5V$



ac digram



dc diagram



Total digram

1 DC analysis

$$R_C + R_E = \frac{V_{cc} - V_{CE}}{I_E} = \frac{5 - 2.5}{80 \times 10^{-3}} = 31.25$$

$\because V_{R_E} = 10\%$ of V_{cc} $\quad \therefore V_{R_E} = 0.5 = \frac{R_E}{R_C + R_E} \times 2.5 \Rightarrow R_E = 6.25\Omega$

$R_C = 31.25 - 6.25 = 25 \Rightarrow 27\Omega$ $\quad \therefore I_E = \frac{2.5}{35} = 71mA \approx 57mA$

$V_B = V_{BE} + V_{R_E} = 0.7 + 80 \times 10^{-3} \times 5 = 1.1V$

$R_{IN(Base)} = \frac{\beta_{DC} V_B}{I_E} = \frac{368 \times 1.1}{0.08} = 5.7K\Omega$ $\quad \therefore I_B = \frac{V_B}{R_{IN(Base)}} = \frac{1.1}{5.7K}$

$\therefore R_2 = \frac{R_{IN(Base)}}{10} = \frac{5.7K}{10} = 570\Omega \Rightarrow 470+51$ $\quad \therefore I_2 = 10 I_B = 2mA$

$R_1 = \frac{V_{cc} - V_B}{I_2} = \frac{5 - 1.1}{2m} = 1.95K\Omega$ practically $2.2K\Omega$

2 AC analysis

$r'_e = \frac{25mV}{I_E} = \frac{25mV}{80mA} = 0.3125$ $\quad R_c = R_C \| R_L = \frac{8 \times 27}{8 + 27} = 6.17$

$\therefore A_V = \frac{R_c}{r'_e} = \frac{6.17}{0.3125} = 19.7$ $\quad I_c = \frac{V_c}{R_c} = \frac{A_V V_b}{R_c}$

$I_b = \frac{V_b}{R_{in(tot)}}$

$R_{in(tot)} = R_{in(base)} \| R_1 \| R_2$

$R_{in(base)} = \beta_{ac}(r'_e)$

to remove noise

$C_1 > \frac{1}{1000\pi f}$ $\quad C_3 < \frac{1}{2\pi R_c f_{max}}$

$C_4 > \frac{10}{2\pi R_E f}$ min freq. $\quad C_2 > \frac{1}{2000\pi f}$

$R_L = 8\,\Omega$

$\because A_v = \frac{R_c}{r'_e} = \frac{R_C // R_L}{r'_e} = 20$

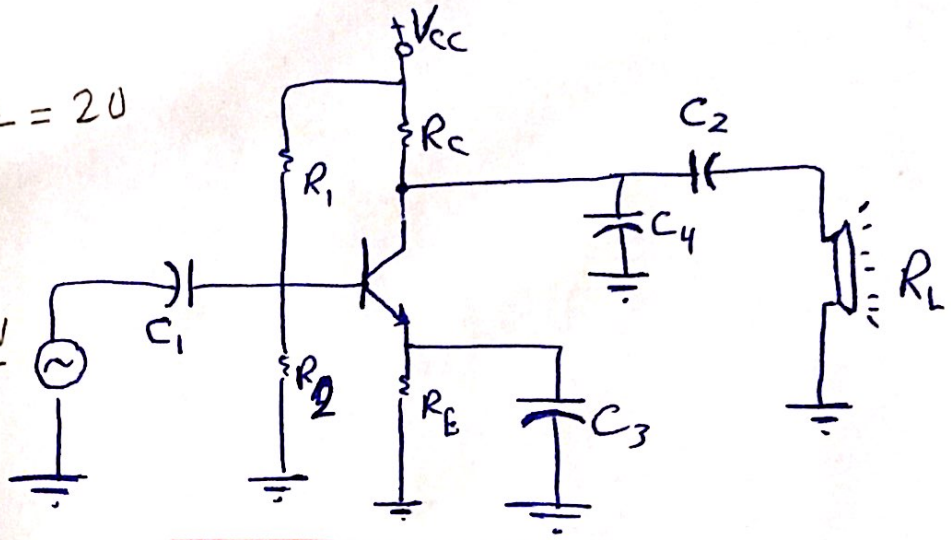
$\because R_L << R_C$

$\therefore A_v = \frac{R_L}{r'_e}$

$\therefore r'_e = \frac{R_L}{A_v} = \frac{8}{20} = \frac{25mV}{I_E}$

$\therefore I_E = 62.5\,mA$

let $I_E = 80mA$



Circuit diagram

1- DC analysis

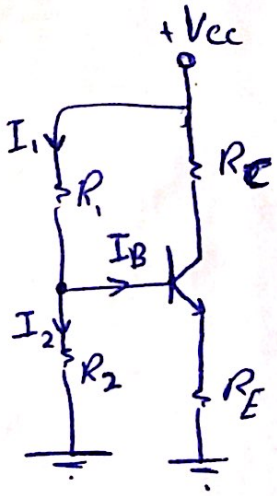
We need $I_C = 80mA$ $\quad \because V_{CE} = 2.5\,V$

$\therefore (R_C + R_E) = \frac{V_{cc} - V_{CE}}{I_C} = \frac{5 - 2.5}{80mA} = 31.25$

$\because V_{R_E} = 0.1\,V_{cc} = 0.1 * 5 = 0.5\,V$

$= \frac{R_E}{R_E + R_C} * (V_{cc} - V_{CE}) = \frac{R_E}{31.25} * (5 - 2.5) = 0.5$

$\therefore R_E = 6.25\,\Omega$ $\quad \therefore R_C = 31.25 - 6.25 = 25\,\Omega$



$\because V_B = V_{BE} + V_{R_E} = 0.7 + I_C R_E = 0.7 + 80 * 10^{-3} * 6.25 = 1.2\,V$

$\because R_{IN(Base)} = \frac{\beta_{DC}\, V_B}{I_C} = \frac{350 * 1.2}{0.08} = 5.25\,K\Omega$

$\because I_B = \frac{V_B}{R_{IN(Base)}} = \frac{I_C}{\beta_{DC}} = \frac{1.2}{5.25K} = 228\,\mu A$

$\because R_2 = \frac{R_{IN(Base)}}{10} = 525\,\Omega$

$\because I_2 = 10 I_B = 2.28\,mA$

$\because R_1 = \frac{V_{cc} - V_B}{I_B + I_2} = 1.5\,K\Omega$ practically $220\,\Omega$

$C_1 > \frac{1}{1000\pi f}$ $\quad C_3 > \frac{10}{2\pi R_E f}$

min freq

$C_2 > \frac{1}{2000\pi f}$

Sound from $20 \rightarrow 20KH_z$

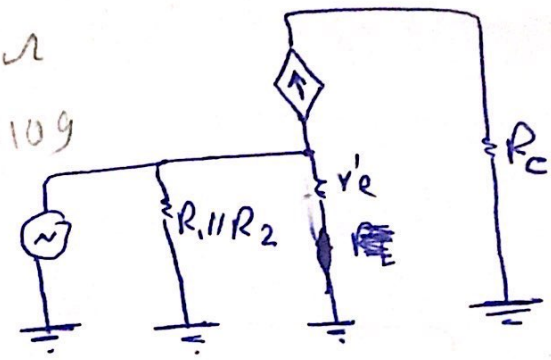
$C_4 < \frac{1}{2\pi R_C f}$ max freq

↳ to remove noise

2] AC analysis

$\because R_1 // R_2 = \frac{R_1 * R_2}{R_1 + R_2} = \frac{525 * 220}{525 + 220} = 155\ \Omega$

$\because R_{in(base)} = r'_e * \beta_{AC} = R_E = 350 * \frac{25}{80} = 109$



$\therefore R_{in(tot)} = R_{in(base)} // R_1 // R_2$

$= \frac{109 * 155}{109 + 155} = 64\ \Omega$

$\because I_b = \frac{V_{in}}{R_{in(tot)}} = \frac{50\ mV}{64} = 781\ \mu A$

$\because A_i = \frac{I_C}{I_b}$ $\quad \because I_c = \frac{V_e}{R_c}$ $\quad \because V_e = A_v \cdot V_{in}$

$\therefore V_e = 20 * 50 * 10^{-3} = 1\ V$ $\quad \therefore I_c = \frac{1}{6} = .167\ mA$

$\therefore A_i = \frac{0.167}{781 * 10^{-6}} = 213$