Ans. to the Q. No. 1.a

a) we know,

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

$$= \frac{8 - 0.7}{390 + (120+1) \times 5.6}$$

$$= 6.837 \times 10^{-3} A$$

$$= 6.84 \mu A$$

Given,

$V_{CC} = 8$

$V_{BE} = 0.7$

$R_B = 390$

$R_E = 5.6$

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

$$= (120+1) \times (6.84) \mu A$$

$$= 0.828 \ mA$$

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

$$= \frac{26}{0.828} = 31.4 \Omega$$

Since, $r_e < 10 R_E$

So,

$$Z_b = \beta r_e + \frac{(\beta+1) R_E}{1 + \frac{R_E}{r_o}}$$

$$= (120) \times (31.4) + \frac{(120+1) * 5.6}{1 + \frac{5.6}{40}}$$

$$= 598.16 k\Omega$$

$$Z_i = R_B \parallel Z_b$$

$$= 390 \parallel 598.16 k\Omega = \left(\frac{1}{390} + \frac{1}{598.16}\right)^{-1}$$

$$= 236.1 k\Omega$$

$$Z_o = R_E \parallel r_e$$

$$= 5.6 \parallel 31.4 \Omega = \left(\frac{1}{5.6k} + \frac{1}{31.4}\right)^{-1}$$

$$= 31.22 \Omega$$

Ans.

b) We know,

$$A_v = \frac{(\beta+1)\, R_E/z_b}{1 + R_E/r_o}$$

$$= \frac{(120+1) \times \frac{5.6\,k\Omega}{598.16\,k\Omega}}{1.5.6\,k\Omega / 40\,k\Omega}$$

$$= 0.994$$

c) $$A_v = \frac{v_o}{v_i}$$

Given,

$v_i = 1\,mV$

$\therefore v_o = A_v \times v_i$

$= 0.994 \times 1$

$= 0.993\ mV$

Ans.

Ans. to the Q. No. 1, b

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

$$= \frac{20 - 0.7}{390 + (140+1)\, 1.2\,k\Omega}$$

$$= \frac{19.3}{559.2} = 34.51\ \mu A$$

Given,

$V_{CC} = 20V$

$V_{BE} = 0.7V$

$R_B = 390\,k\Omega$

$R_E = 1.2\,k\Omega$

$\beta = 140$

$r_o = 100\,k\Omega$

$R_C = 2.2\,k\Omega$

$I_E = (\beta + 1) I_B$

$= (140+1) \times (34.51)$

$= 4.866\ mA$

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

$$= \frac{26}{4.866} = 5.34\ \Omega$$

Ans.

b) $Z_b = \beta r_e + (\beta+1)R_E$

$= 140 \times 5.34 + (140+1)\ 1.2\ k\Omega$

$= (747.6\Omega + 169.9)\ k\Omega$

$= 169.95\ k\Omega$

So,

$Z_i = R_B \parallel Z_b$

$= \left(\frac{1}{390} + \frac{1}{169.95}\right)^{-1}$

$= 118.37\ k\Omega$

$Z_o = R_C$

$= 2.2\ k\Omega$

c) $A_v = -\frac{\beta R_C}{Z_b}$

$= -\left(\frac{140 \times 2.2}{169.95}\right)$

$= -1.81$

d) $Z_b = \beta r_e + \left[\frac{(\beta+1) + \frac{R_C}{r_o}}{1 + (R_C + R_E)\ r_o}\right] R_E$

$= 747.6\ \Omega + \left[\frac{141 + 2.2/20}{1 + 3.4/20}\right] \times 1.2\ k\Omega$

$= (747.6\ \Omega + 144.72)\ k\Omega$

$= 145.47\ k\Omega$

$Z_i = R_B \parallel Z_b$

$= \left(\frac{1}{390} + \frac{1}{145.47}\right)^{-1} = 10\cancel{9}.95\ k\Omega$

$Z_o = R_C$

$= 2.2\ k\Omega$

$$A_v = \frac{v_o}{v_i} = \frac{\frac{-\beta R_e}{Z_b}\left[1+\frac{r_e}{r_o}\right] + \frac{R_C}{r_o}}{1+\frac{R_C}{r_o}}$$

$$= \frac{\frac{-140\times 2.2}{1+5.47}\left[1+\frac{5.34}{20}\right] + \frac{2.2}{20}\,k\Omega}{1+\frac{2.2}{20}\,k\Omega}$$

$$= \frac{-2.117+0.11}{1.11}$$

$$= -1.81$$

c) DC analysis remains the same.

So, $r_e = 5.34\,\Omega$

$Z_i = R_B \parallel \beta r_e$

$\cancel{= \left(\frac{1}{390}+\frac{1}{140\times 5.34}\right)^{-1}}$

$= 390\,k\Omega \parallel (140)\times(5.34\,\Omega)$

$= 746.17\,\Omega$

$Z_o = R_C$

$= 2.2\,k\Omega$

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

$= \frac{-2.2\,k\Omega}{5.34\,\Omega} = -411.99$ vs $-1.81$ in unbypassed.

For (d),

$Z_i = 746.17\,\Omega$ vs $105.95\,k\Omega$

$Z_o = R_C \parallel r_o = \left(\frac{1}{2.2}+\frac{1}{20}\right)^{-1} = 1.98\,k\Omega$ vs $2.2\,k\Omega$

$A_v = -\frac{R_C \parallel r_o}{r_e} = \frac{1.98\,k\Omega}{5.34\,\Omega} = -370.79$ vs $-1.81$ in unbypassed

So, significance difference in the results. Ans.

## Ans to the Q. No. Q. 2, A

we know,

$$A_V = -\frac{Re}{re}$$

$$\therefore re = -\frac{Re}{AV}$$

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

$$= 23.5 \Omega$$

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

$$= \frac{26}{23.5} = 1.106 mA$$

$$I_B = \frac{I_E}{\beta+1}$$

$$= \frac{1.106}{91}$$

$$= 12.15 mA$$

here,

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

$$\therefore V_{CC} = I_B R_B + V_{BE}$$

$$= (12.15) \times 1 + 0.7$$

$$= 12.85 V$$

Ans.

## Ans. to the Q. No. 2, B

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

$$= \frac{18 - 0.7}{680 k\Omega} = 25.44 \mu A$$

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

$$= (100+1) \times (25.44) \mu A$$

$$= 2.5 mA$$

$$re = \frac{26 mV}{2.57}$$

$$= 10.116 \Omega$$

$$A_{VNL} = \frac{-R_C}{r_e}$$

$$= \frac{3.3\ k\Omega}{10.11\ \Omega} = -326.22$$

Now,

$$A_{VL} = \frac{R_L}{R_L + R_o} \times A_{VNL}$$

For,

$R_L = 4.7\ k\Omega$, $A_{VL} = \frac{(4.7)\ k\Omega}{(4.7+3.3)\ k\Omega} \times (-326.22)$

$= -191.65$

$R_L = 2\ k\Omega$, $A_{VL} = \frac{2\ k\Omega}{(2+3.3)\ k\Omega} \times (-326.22)$

$= -123.101$

$R_L = 1\ k\Omega$, $A_{VL} = \frac{1\ k\Omega}{(1+3.3)\ k\Omega} \times (-326.22)$

$= -75.865$

So, $A_{VL}$ is decreasing as the value of $R_L$ is also decreasing.

$R_L \downarrow\ A_{VL} \downarrow$

b) There will be no change for $Z_i$, $Z_o$ and $A_{VNL}$.

Ans: