Solutions for Homework #6

1.

4.1

Case	Mode
1	active
2	saturation
3	active
4	saturation
5	inverted active mode
6	active
7	cut-off
8	cut-off

2.

4.7

$i_c = \beta i_B$

$400 = \beta \times 7.5$

$\beta = \dfrac{400}{7.5} = \underline{\underline{53.3}}$

$\alpha = \dfrac{\beta}{\beta+1} = \dfrac{53.3}{54.3} = \underline{\underline{0.982}}$

3

4.9

$i_C = I_s e^{v_{BE}/V_T}$

$i_B = \dfrac{i_C}{\beta}$

$i_E = \dfrac{\beta+1}{\beta} i_C$

$i_C = (5 \times 10^{-15})e^{0.650/0.025} = 977\ \mu A$

i_C is constant and independent of β

i_B ranges from $\dfrac{i_C}{\beta} = \dfrac{977 \times 10^{-6}}{50} = 19.6\ \mu A$

to $\dfrac{i_C}{\beta} = \dfrac{977 \times 10^{-6}}{200} = 4.89\ \mu A$

i_E ranges from

$\dfrac{\beta+1}{\beta} i_C = \dfrac{51}{50} 977 \times 10^{-6} = 998\ \mu A$

to $\dfrac{\beta+1}{\beta} i_C = \dfrac{201}{200} 977 \times 10^{-6} = 983\ \mu A$

4.

4.10

$i_E = 1\ mA$

Case I: $i_B = 50\ \mu A$

$i_C = i_E - i_B = 1 \times 10^{-3} - 50 \times 10^{-6} = 950\ \mu A$

$\beta = \dfrac{i_C}{i_B} = \dfrac{950 \times 10^{-6}}{50 \times 10^{-6}} = 19$

$\alpha = \dfrac{\beta}{\beta+1} = \dfrac{19}{20} = 0.95$

Case II: $i_B = 10\ \mu A$

$i_C = i_E - i_B = 1 \times 10^{-3} - 10 \times 10^{-6}\ A$

$= 990\ \mu A$

$\beta = \dfrac{i_C}{i_B} = \dfrac{990 \times 10^{-6}}{10 \times 10^{-6}} = 99$

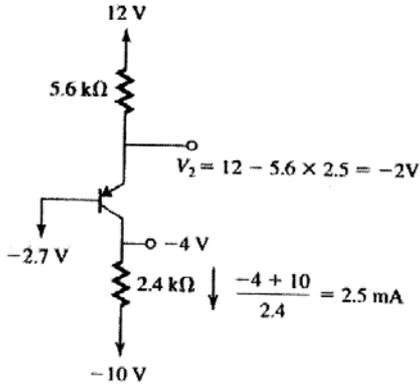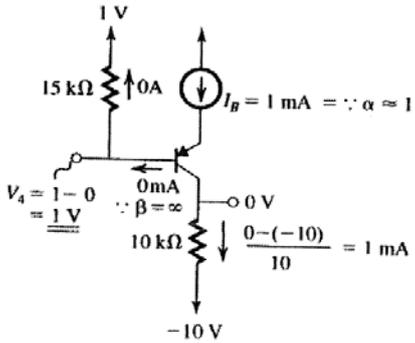$\alpha = \dfrac{\beta}{\beta+1} = \dfrac{99}{100} = 0.99$
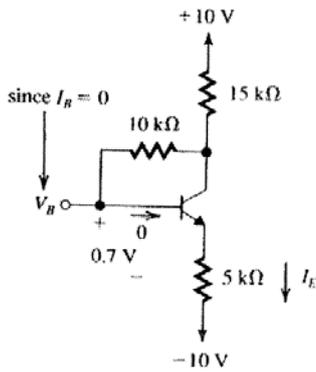
4.19

(a) $I_1 = \dfrac{10.7 - 0.7}{10} = 1$ mA

(b)

$V_2 = 12 - 5.6 \times 2.5 = -2V$

-2.7 V

-4 V

$\dfrac{-4 + 10}{2.4} = 2.5$ mA

(c)

$V_4 = 1 - 0 = 1$ V

$I_B = 1$ mA $= \because \alpha \approx 1$

0 mA

$\because \beta = \infty$

$\dfrac{0-(-10)}{10} = 1$ mA

(d)

since $I_B = 0$

$I_E = I_C$

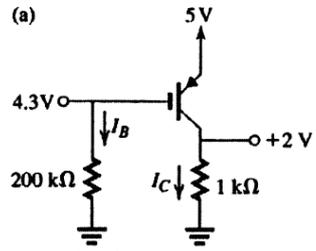$\dfrac{V_B - 0.7 + 10}{5} = \dfrac{10 - V_E}{15}$

$15V_6 + 139.5 = 50 - 5V_6$
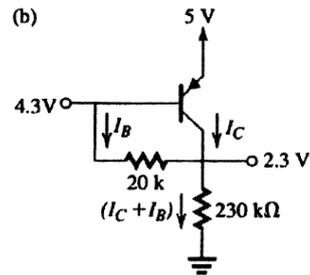
$V_6 = -4.475$ V

$I_5 = \dfrac{V_6 - 0.7 + 10}{5}$
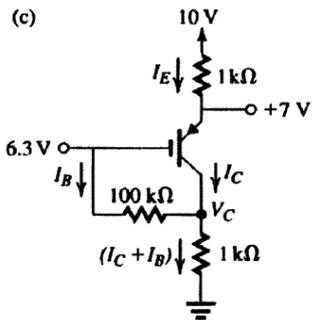
$= \dfrac{-4.475 - 0.7 + 10}{5} = 0.965$ mA

4.20

(a)

$\dfrac{I_c}{I_B} = \beta = \dfrac{\left(\dfrac{2}{1\,K}\right)}{\left(\dfrac{4.3}{200\,K}\right)} = \dfrac{2\,m}{0.0215\,m} = 93$

(b)

$(I_c + I_B) = \dfrac{2.3}{230} = 10$ mA

$I_B = \left(\dfrac{4.3 - 2.3}{20\,K}\right) = 0.1$ mA

$\dfrac{I_c}{I_B} = \left(\dfrac{10\,m - 0.1\,m}{0.1\,m}\right) = \beta = 99$

(c)

$I_E = \left(\dfrac{10 - 7}{1\,K}\right) = 3$ mA

$I_E = I_c + I_B = 3$ mA

$V_c = 3\,m(1\,K) = 3$ V

$I_B = \dfrac{6.3 - 3}{100\,K} = 33\ \mu$A

$\dfrac{I_E}{I_B} = \beta + 1 = \dfrac{3\,m}{33\,\mu} = 90.9$

$\beta = 89.9$

7.&8.略