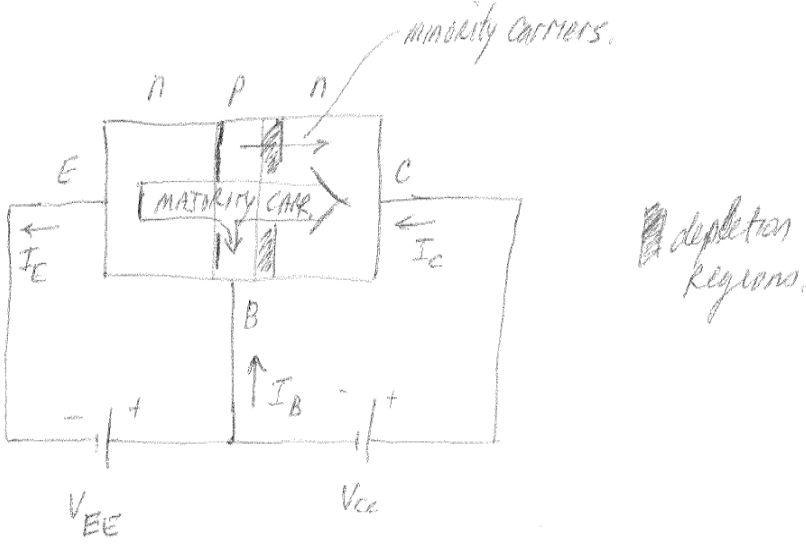
Week #3 Chapter 3 # 4, 7, 8, 9, 15, 18, 19a-c, 35

Note Title 8/9/2018

4) What is the source of leakage current in a transistor?

The leakage current, I_{CO}, is the minority carriers current in the collector.

7) Sketch a figure similar to fig 3.5 for the majority and minority carrier flow in an NPN transistor. Describe the resulting carrier motion.



8) Which of the transistor currents is always the largest? Which is always the smallest? Which two currents are relatively close in magnitude?

I_E always largest

I_B always smallest

I_E & I_C are almost the same.

9) If the emitter current of a transistor is 8 mA and I_B is 1/100 of I_C, determine the levels of I_C & I_B.

$$I_E = 8\text{mA} \qquad \frac{I_C}{I_B} = 100 = \beta$$

$$I_B = \frac{I_E}{\beta + 1} = \frac{8\text{mA}}{101} = 79.21\,\mu\text{A}$$

$$I_C = \beta I_B = (100)(79.21\,\mu\text{A}) = 7.921\,\text{mA}$$

15) a) Given $\alpha_{DC} = 0.998$, determine I_C if $I_E = 4\text{mA}$

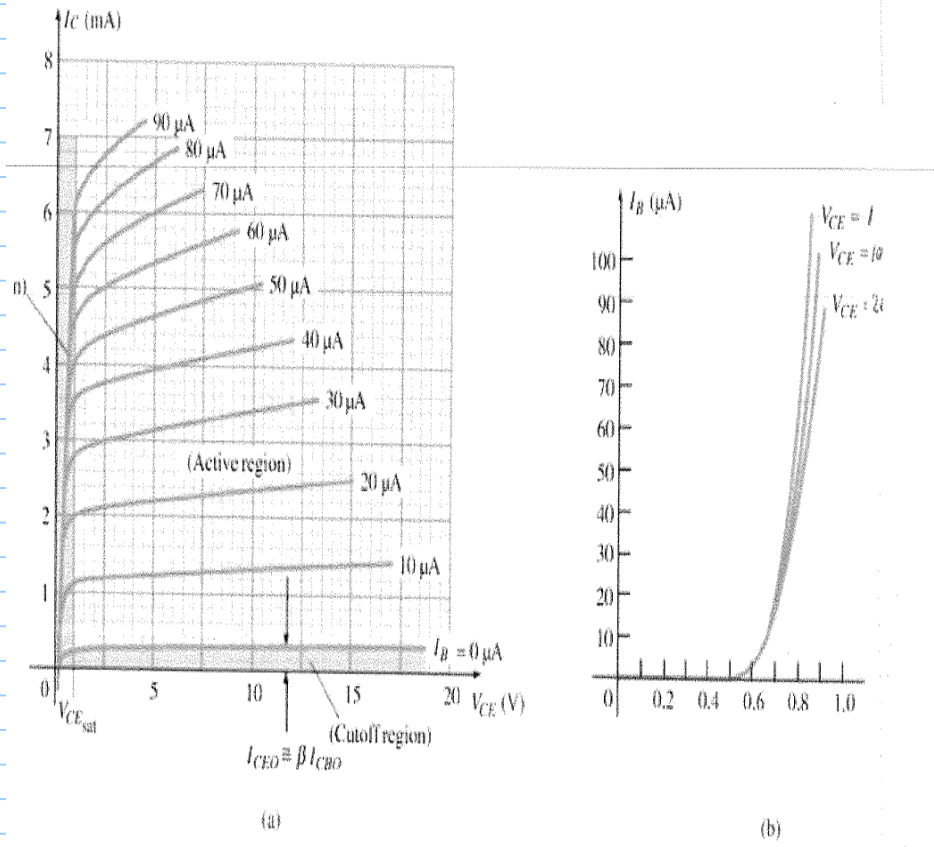
$$I_C = \alpha I_E = 3.992\text{mA}$$

b) Determine α_{DC} if $I_E = 2.8\text{mA}$, $I_C = 2.75\text{mA}$ and $I_{CBO} = 0.1\,\mu\text{A}$

$$I_C = \alpha I_E + I_{CBO}$$

$$2.75\text{mA} = \alpha\, 2.8\text{mA} + 0.1\,\mu\text{A} \qquad \alpha_{DC} = 0.9821$$

18)



a) Find the value of I_C when $V_{BE} = 750mV$ & $V_{CE} = 4V$

Reading graph (b) I_B is roughly 30μA when $V_{BE} = 750mV$.

Reading graph (a) I_C is roughly 3.1mA when $V_{CE} = 4V$ and $I_B = 30\mu A$.

If you said I_B was 35μA instead, as you might because the graph is hard to read, I_C would be found by interpolating between the I_B 30μA & 40μA curves when $V_{CE} = 4V$. $I_C \cong 3.5mA$

b) Find the value of V_{CE} & V_{BE} when $I_C = 3.5mA$ & $I_B = 30\mu A$.

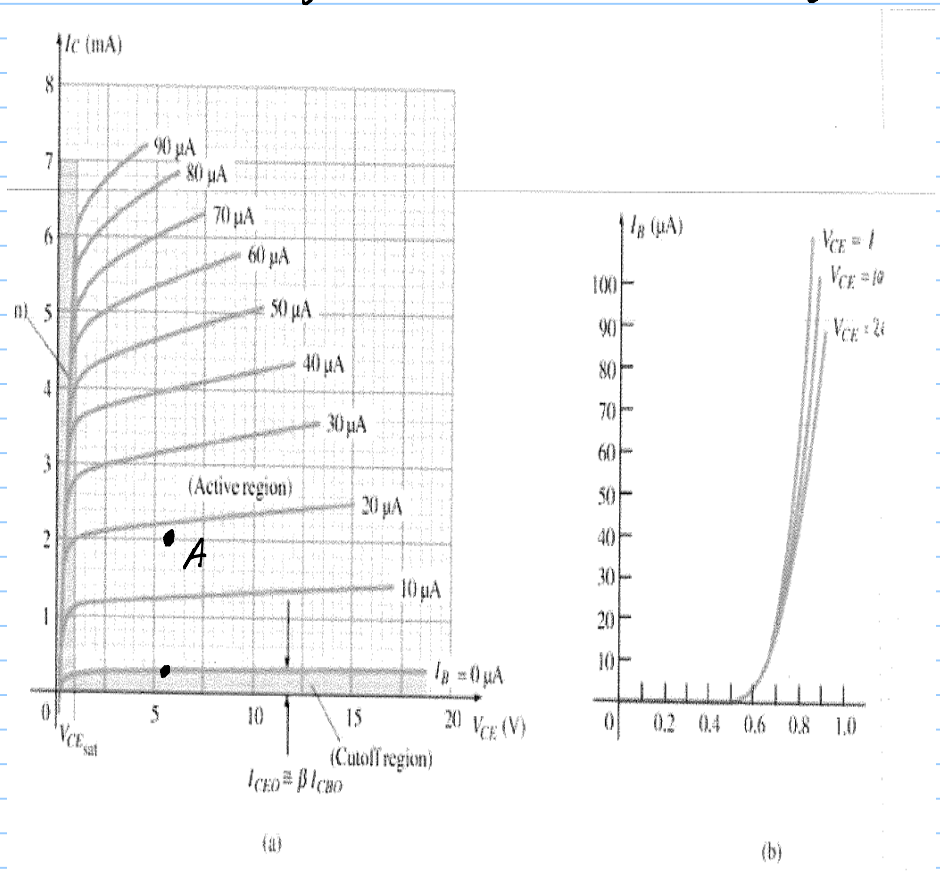
V_{CE} is around 12.5V when $I_C = 3.5mA$ on the $I_B = 30\mu A$ curve (a)

V_{BE} is around 0.75V when $I_B = 30\mu A$ using curve (b)

19) a) For the common-emitter characteristics below, find the dc beta at the operating point $V_{CE} = 6V$ and $I_C = 2mA$.

b) find the α corresponding to the operating point.

c) at $V_{CE} = 6V$, find the corresponding value of I_{CEO}.



a) $I_B \cong 18\mu A$ at $V_{CE} = 6V$ and $I_C = 2mA$

$$\beta = \frac{I_C}{I_B} = \frac{2mA}{18\mu A} = 111$$

b) $$\alpha = \frac{\beta}{\beta+1} = \frac{111}{112} = 0.9911$$

c) $I_{CEO} \cong 0.25\ mA$

35) Using the characteristic curve of figure 3.23b, determine how much the level of h_{fe} has changed from its level at 1mA to its value a 10mA. Notes the vertical scale is a log scale and may require reference to 11.2. Is this change one that should be considered in a design situation?

$h_{fe} = 120$ @ 1mA

$h_{fe} = 160$ @ 10mA

β tends to change as I_C increases. This should be considered.