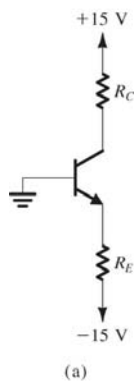
β=100, and v_{BE} = 0.7 V at i_c = 1 mA
Design the circuit to have i_c=2 mA and collector voltage = 5 V

$$V_{BE1} = V_{BE2} + V_T \ln\left(\frac{i_{C1}}{i_{C2}}\right)$$



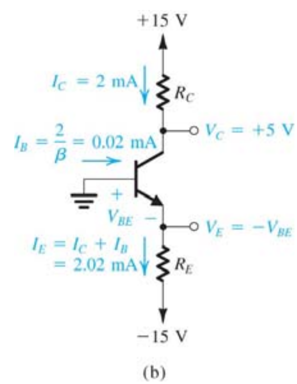


Figure 6.15 Circuit for Example 6.2.

V_E=-0.7 V, β =50
Find I_E,I_B,I_C,V_C

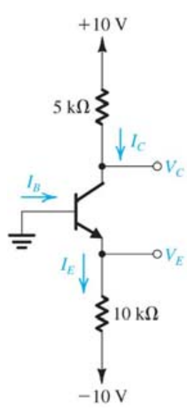


Figure E6.13

Measurements: V_B=1.0V, V_E=1.7V find α, β and V_C

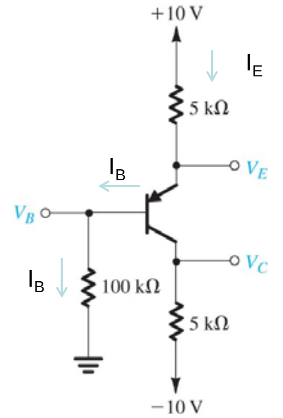
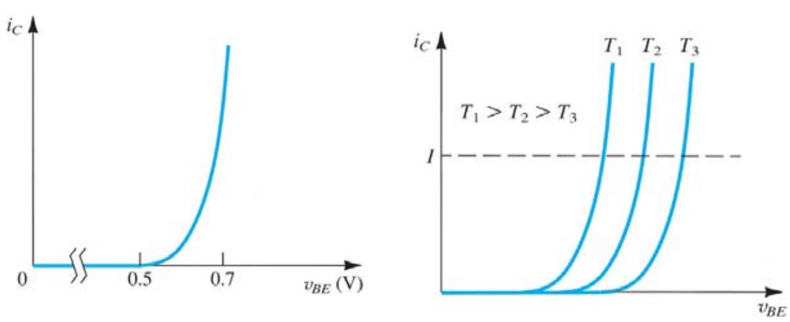


Figure E6.14

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



The Early Effect

- In our analysis, we assume v_{BE} will be the only factor to determine i_C and i_B.
- Practical BJT s show some dependence of the collector current on the collector voltage (J. M. Early)
- The real i-v characteristics as shown on the next slide

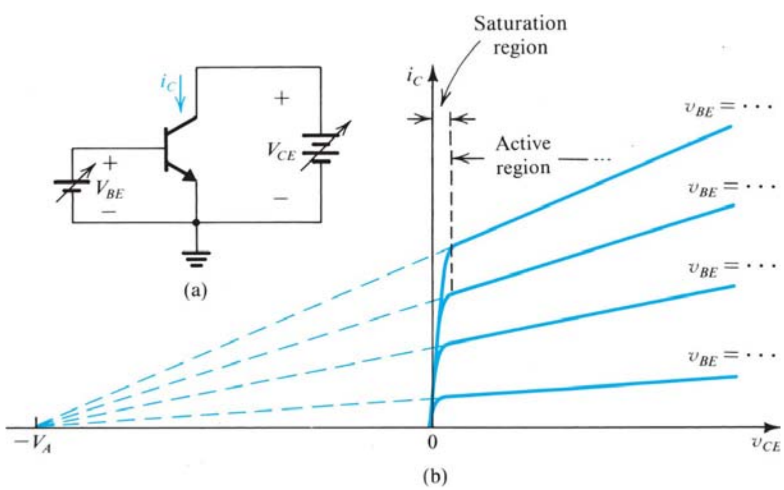


Figure 6.18 (**a**) Conceptual circuit for measuring the i_C–v_{CE} characteristics of the BJT. (**b**) The i_C–v_{CE} characteristics of a practical BJT.

Large signal model including r_o

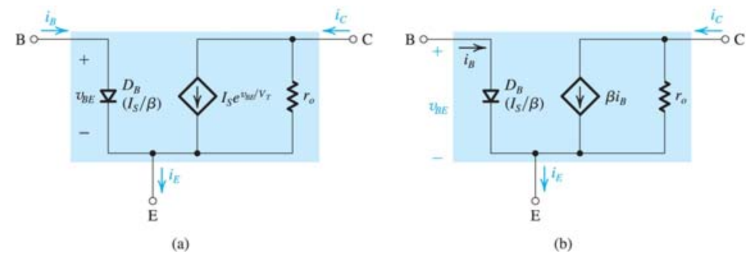
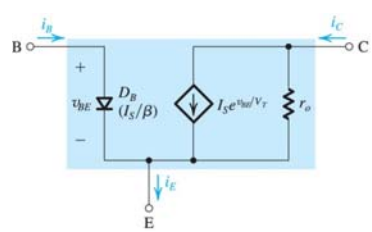


Figure 6.19 Large-signal, equivalent-circuit models of an *npn* BJT operating in the active mode in the common-emitter configuration with the output resistance r_o included.

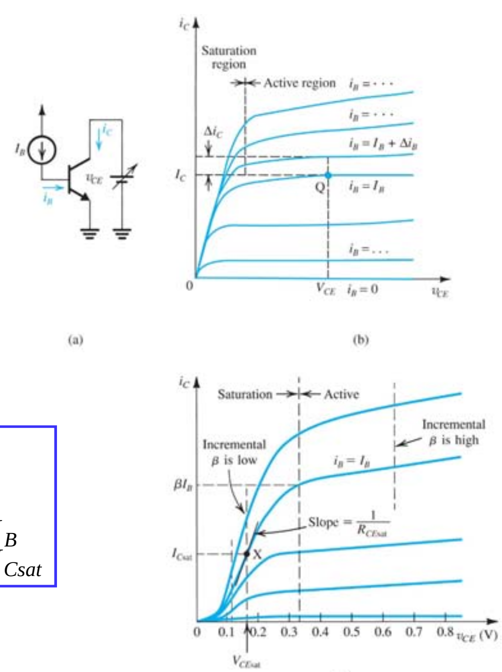
Example

- Use this model to express i_C in terms of v_{BE} and v_{CE}



Common Emitter C/C (alt. form)

- i_B is used as a parameter
- Common Emitter Current Gain β: Another way to measure β (incremental β)
- $\Delta i_c / \Delta i_b$
- Saturation voltage and saturation resistance($\beta_{forced} < \beta$)



$$R_{CEsat} \equiv \left. \frac{\partial v_{CE}}{\partial i_C} \right|_{\substack{i_B = I_B \\ i_C = I_{Csat}}}$$

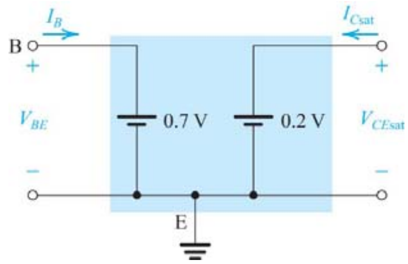


Figure 6.21 A simplified equivalent-circuit model of the saturated transistor.

R_C=10KΩ, what should be V_{BB} for
- Active V_{CE}=5V, β=50
- Edge of saturation
- Deep sat with β=10

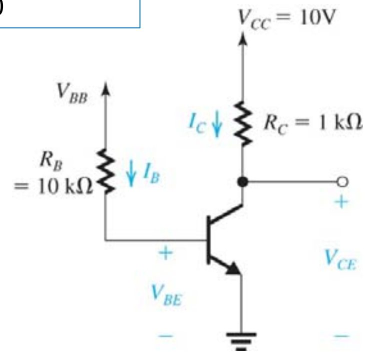


Figure 6.22 Circuit for Example 6.3.

Find V_{CE} for V_{BB} =0V

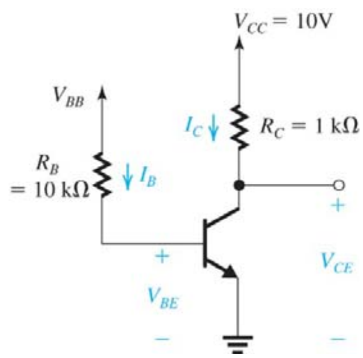
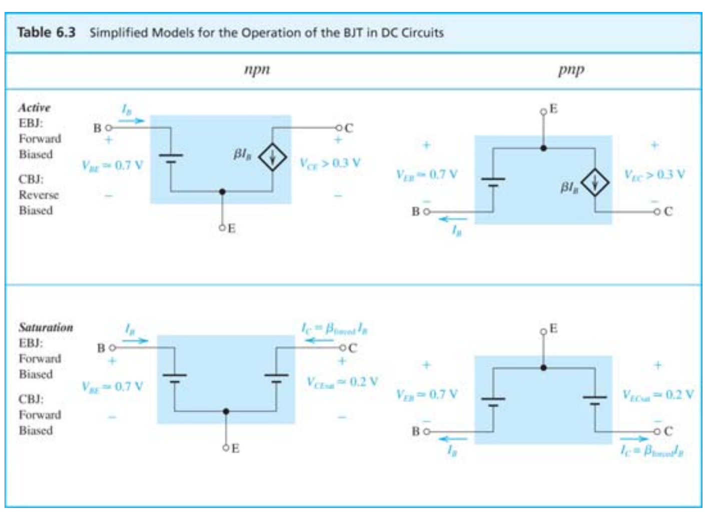


Figure 6.22 Circuit for Example 6.3.



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