

# ECE 320 - Homework #5

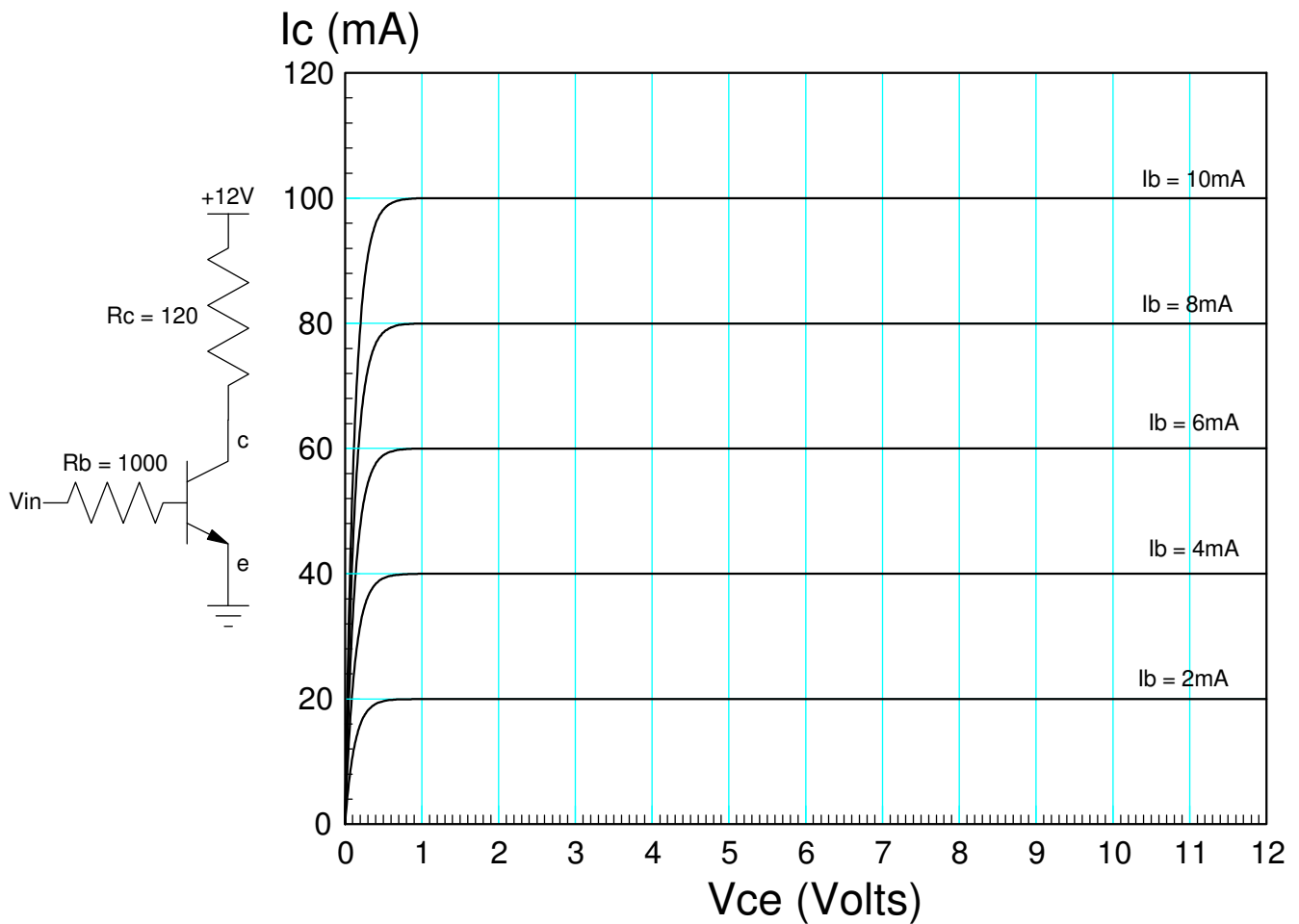
Transistor Theory, Transistors used as a Switch Due Monday, September 30th

1) The VI characteristics for a transistor are shown below:

- What is the current gain,  $\beta$ ?
- Label the Off / Saturated / Active regions.

2) Draw the load line for the following circuit. Mark on the load line the operating point (termed Q-point) when

- $V_{in} = 0V$
- $V_{in} = 5V$
- $V_{in} = 10V$
- $V_{in} = 15V$



Problem 3-6: Assume a TIP112 transistor (NPN) (\$0.41 each)

- $\beta = 1000$
- $|V_{ce:sat}| = 0.9V$
- $\max(I_c) = 4A$
- $V_{be} = 1.4V$

3) Design a circuit to meet the following requirements (i.e. a transistor used as a switch)

- Input: 0V / 5V binary signal capable of 20mA
- Output: DC Motor which draws 200mA @ 10V
- Relationship:
  - When  $V_{in} = 0V$ , 0V is applied to the motor
  - When  $V_{in} = 5V$ , 10V is applied to the motor +/- 1V

4) Check your design in PartSim

note:

- Use a 50 Ohm resistor to model the motor ( 200mA @ 10V )
- Use a 3904 transistor ( Vendor Parts - Fairchild - NPN - 3904 )

5) Check your design in lab.

note:

- Use a TIP112 transistor in lab. They'll survive the in-rush current you get from starting the motor.
- Check  $V_{ce}$  and  $V_{be}$  for the transistor to see if it matches your calculations and simulation results for  $V_{in} = 0V$  and  $V_{in} = 5V$