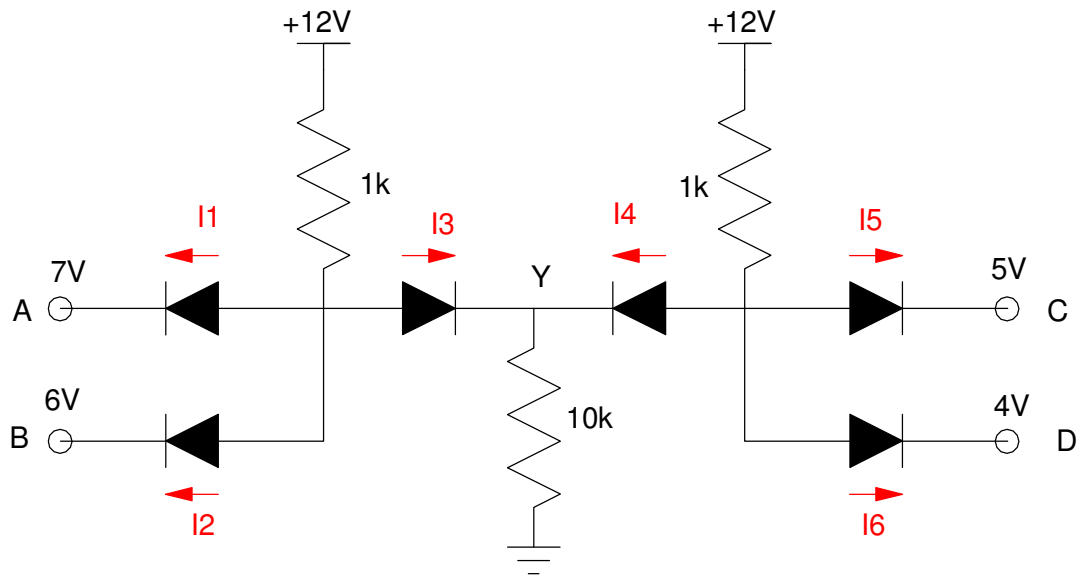# ECE 320 - Homework #4

Max/Min Circuits, Clipper Circuits, Transistor Theory. Due Monday, February 8th

Max/Min:

1) Determine the voltages and currents for the following max/min circuit. What function does this circuit implement?   Y = f(A, B, C, D)
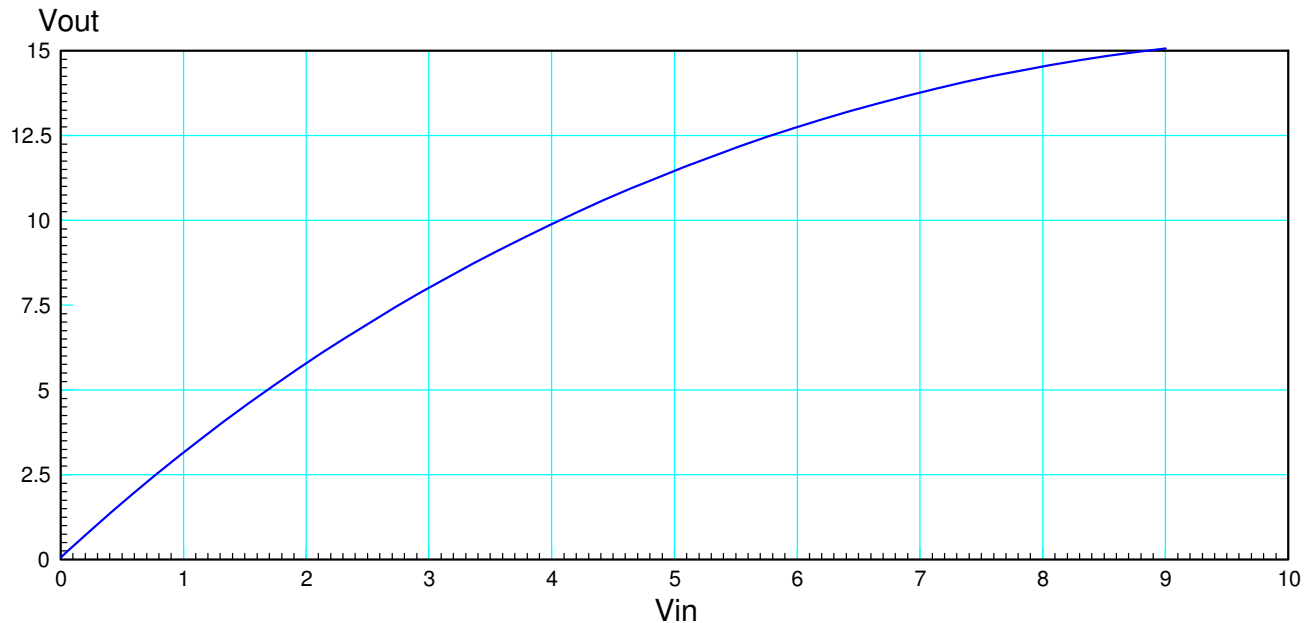
2) Check your results in CircuitLab (or similar program)

Problem 1-2.

Clipper Circuits:

3) Design a circuit to approximate the following function subject to the following requirements:
   - Input: 0 .. 10V, capable of 100mA
   - Output: 100k resistor
   - Relationship: Graph below, +/- 200mV

4) Check your design in CircuitLab

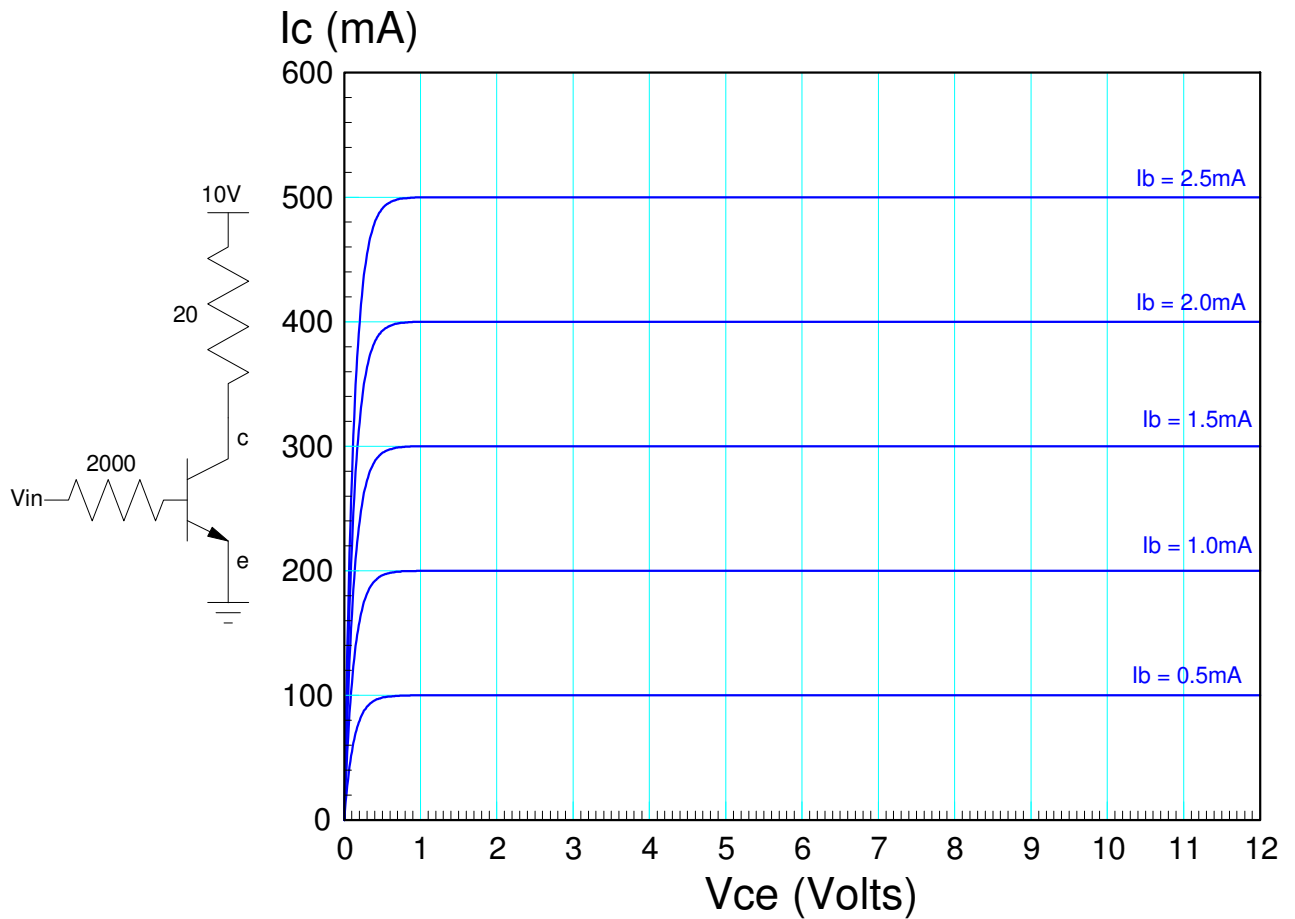Vout

Problem 3 - 4

5) Design a circuit which meets the following requirements:
   - Input: -10 .. +10V, capable of 100mA
   - Output: 1k resistor
   - Relationship:

$$V_{out} = \begin{cases} +5V & V_{in} > +5V \\ V_{in} & -5V < V_{in} < +5V \\ -5V & V_{in} < -5V \end{cases}$$

Transistors

6) Determine the current gain, β, for the transistor show below. Also label the off, active, and saturated regions.

7) Draw the load-line and determine the Q-point for
   - Vin = 0V
   - Vin = 3V
   - Vin = 6V

Ic (mA)

600

500   Ib = 2.5mA

10V

400   Ib = 2.0mA

20

300   Ib = 1.5mA

c

2000

Vin

200   Ib = 1.0mA

e

100   Ib = 0.5mA

0
 0   1   2   3   4   5   6   7   8   9   10   11   12
Vce (Volts)

Problem 6 - 7

Lab (over)

Lab: Please include a photo of your circuit to receive credit for problems 8-10

8-10) Build the following circuit with your electronics kit.

- Measure Vce and Ic for 1k < Rb < infinity.
- Determine the operating point for each conidition and the current gain for your 3904 transistor
- Draw the load line on the graph below and mark each point you measured

Rb	Ib	Vce	Ic	Current Gain (Ic/Ib)	Operating Region (off / active / saturated)
1k br - bl - re					
10k br - bl - or					
100k br - bl - ye					
1M br - bl - gr					
infinity					

Ic (mA) vs Vce (Volts)