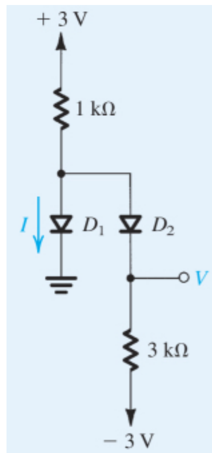
Assignment #2, Total: 10 pts

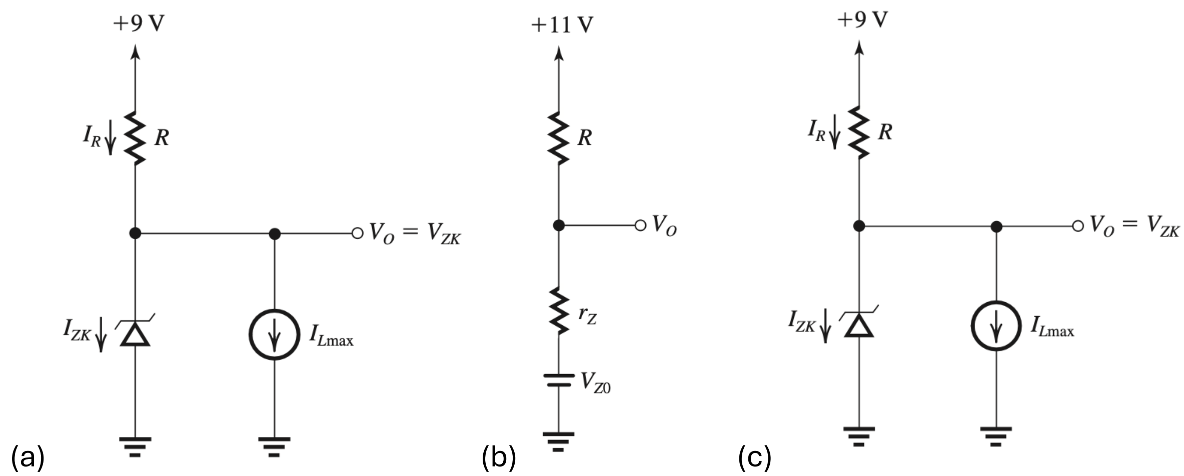
Name: **NetID:**

Chapter 4. Diodes

1. (0.5 pts) Assuming that the diodes in the circuits are ***ideal***, find the values of the labeled voltage and current.

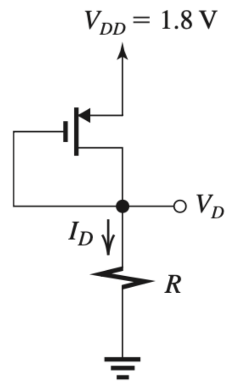


2. (2 pts) Design a zener regulator circuit using a 7.5-V zener specified at 10 mA.
   The zener has an incremental resistance r_z = 30 Ω and a knee current of 0.5 mA. The regulator operates from a 10-V supply and delivers a nominal current of 5 mA to the load.
   (a) What is the value of R you have chosen?
   (b) What is the output voltage when both the supply is 10% high and the load is removed?
   (c) What is the largest load current that can be delivered while the zener operates at a current no lower than the knee current while the supply is 10% low?



Chapter 5. MOS Field-Effect Transistors (MOSFETs)

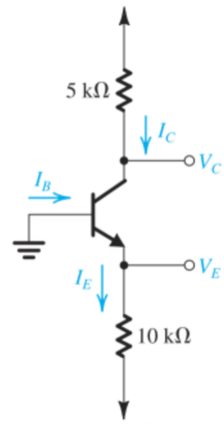
3. (1 pt) The PMOS transistor in the circuit has $V_t = -0.5$ V, $\mu_p C_{ox} = 100\ \mu A/V^2$, $L = 0.18\ \mu m$, and $\lambda = 0$. Find the values required for W and R in order to establish a drain current of 160 μA and a voltage V_D of 0.8 V.



4. (1 pt) For a particular MOSFET operating in the saturation region at a constant v_{GS}, i_D is found to be 200 μA for $v_{DS} = 1$ V and 205 μA for $v_{DS} = 1.5$ V. Find the values of r_o, V_A, and λ.

Chapter 6. Bipolar Junction Transistors (BJTs)

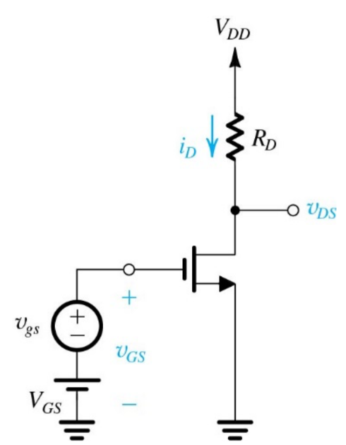
5. (1 pt) In the circuit shown in the figure, the power supplies are ±3 V and the voltage at the emitter was measured and found to be –0.7 V. If β = 50, find I_E, I_B, I_C, and V_C.



Chapter 7. Transistor Amplifiers

6. (1 pt) A designer wants to create a BJT amplifier with a gm of 20 mA/V and a base input resistance of 4000 Ω or more. What collector-bias current should she choose? What is the minimum β she can tolerate for the transistor used?

7. (1.5 pt) Consider the amplifier of the following circuit: V_{DD} = 5 V, R_D = 24 kΩ, (W/L) = 1 mA/V^2, and V_t = 1 V.
   (a) Find the coordinates of the two end points of the saturation-region segment of the amplifier transfer characteristic, that is, points A and B.
   (b) If the amplifier is biased to operate with an overdrive voltage V_{OV} of 0.5 V, find the coordinates of the bias point Q on the transfer characteristic. Also, find the value of I_D and of the incremental gain A_v at the bias point.



8. (2 pts) The following figure shows a discrete-circuit amplifier. The input signal v_{sig} is coupled to the gate through a very large capacitor (shown as infinite). The transistor source is connected to ground at signal frequencies via a very large capacitor (shown as infinite). The output voltage signal that develops at the drain is coupled to a load resistance via a very large capacitor (shown as infinite). All capacitors behave as short circuits for signals and as open circuits for dc.

   (a) If the transistor has V_t = 1 V, and k_n = 4 mA/V^2, verify that the bias circuit establishes V_{GS} = 1.5 V, I_D = 0.5 mA, and V_D = +7.0 V. That is, assume these values, and verify that they are consistent with the values of the circuit components and the device parameters.

   (b) Find gm and r_o if V_A = 100 V.

   (c) Find R_{in}, v_{gs}/v_{sig}, v_o/v_{gs}, and v_o/v_{sig}.