

Write your name at the top right corner of every page (including this cover page).

Copy everything you want counted towards your grade onto the pages that I provided.

Write with a pen that cannot be erased!

No books or calculators are allowed!

Write down all the steps that lead to your result.

Identify new variables that you may introduce in the circuit diagrams that I provided.

Read all the problems before you start so that you can begin with those that seem easiest to you.

Problem 1 (10 pts):

Mark the *correct* correspondence with an X in the appropriate row / column combination:

a.) Which equation applies for which kind of transistor?

equation	BJT	FET
$i_C = I_S(e^{v_{EB}/V_T} - 1)$		
$i_D = I_{DSS}(1 - v_{GS}/V_p)^2$		

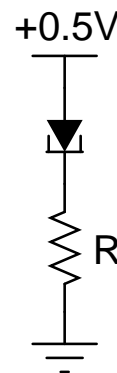
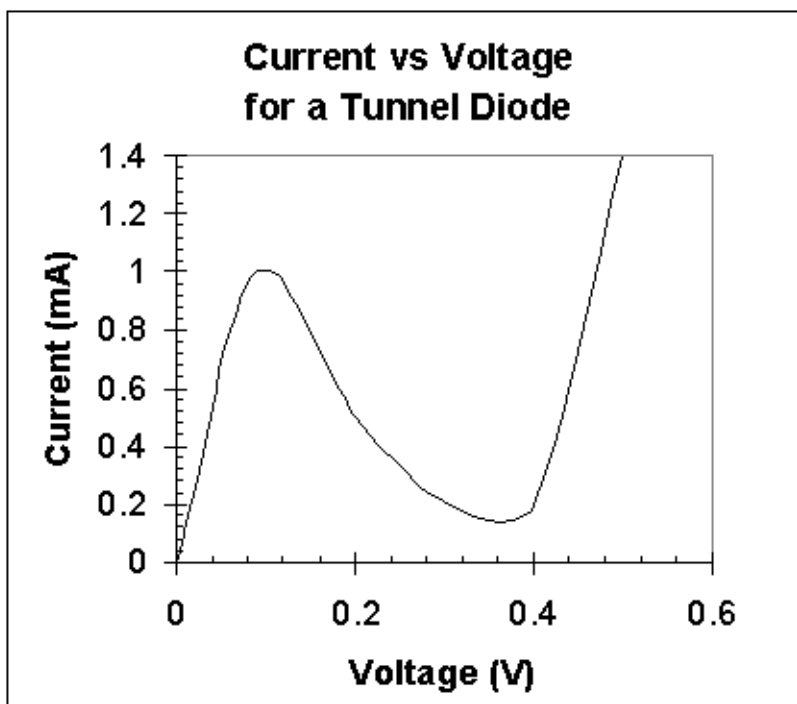
(continuation of problem 1)

b.) Some of the symbols used in the equations above stand for parameters and others for variables. Parameters are determined by the manufacturing process and physical design of the transistor, while the values of (dependent as well as independent) variables are determined by your circuit design. Given this distinction the parameters are the ones that have to be looked up in data sheets or be derived from nature's fundamental constants, while the variables are what you solve for when analyzing your circuits. Which of the following symbols represent parameters?

parameter?	Yes	No
i_C		
I_S		
v_{BE}		
V_T		
i_D		
I_{DSS}		
v_{GS}		
V_p		

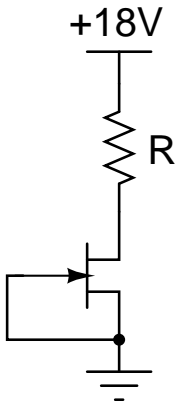
Problem 2 (4 pts):

Below you see one quadrant of the I-V characteristics of a tunnel diode. (It does not matter for the problem that we did not discuss this particular device in the lectures! The modified diode symbol in the circuit is the usual symbol for this kind of diode.) Use load line analysis to find the voltage drop across the tunnel diode if the resistor has the value $R = 1/3k\Omega$



Problem 3 (6 pts):

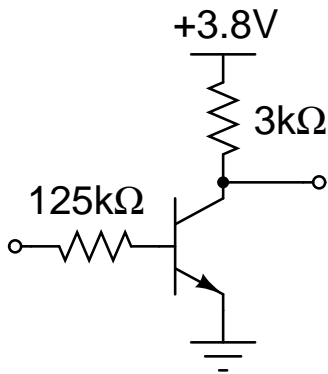
The JFET in the following circuit has parameters $I_{DSS} = 8\text{mA}$ and $V_p = -4\text{V}$. Find the current through the resistor $R = 500\Omega$. After your calculation verify that the transistor indeed is in the active region.



(continuation of problem 3)

Problem 4 (6 pts):

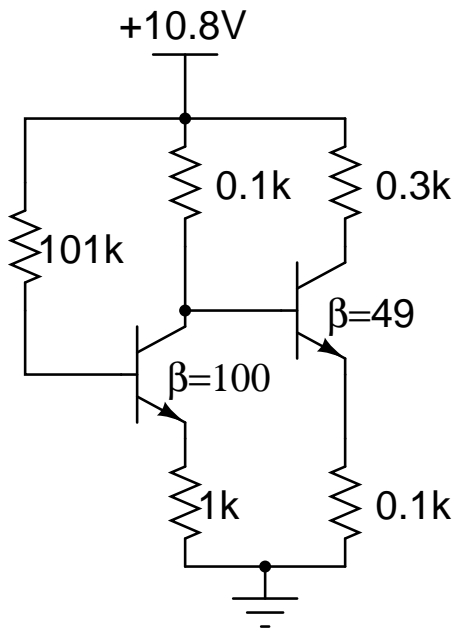
Below you find a simple logical inverter. So when its input goes high (3.8V), the transistor should saturate as to have the minimum possible output voltage. What is the minimal β the transistor must have to saturate at an input voltage of 3.8V given the resistors as shown?



(continuation of problem 4)

Problem 5 (6 pts):

Calculate the base current into the $\beta = 49$ transistor under the active region assumption for both transistors and show that it is in saturation.



(continuation of problem 5)