Name: ________________________________ **Section: _______**

Signature: _________________ **EEE 313 Fall 2014-2015**

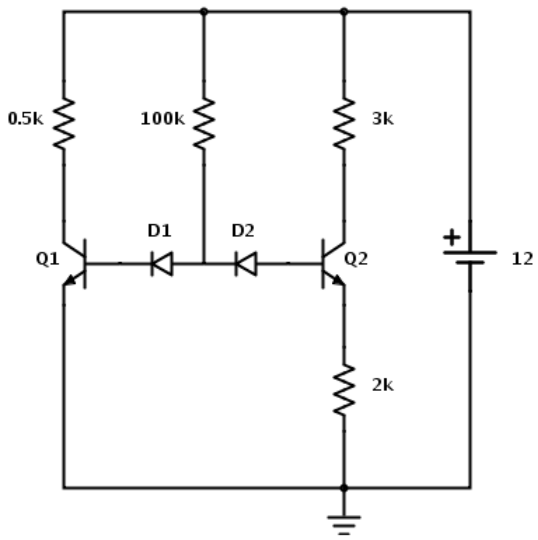
Bilkent University
Department of Electrical and Electronics Engineering
EEE 313 Electronic Circuit Design
Midterm 2
13 December 2014, 10:00
(4 questions, 120 minutes)

- This is a **closed book**, closed notes exam. No cheat sheet allowed.
- All cell-phones should be completely **turned off**.
- Use a calculator for numerical computations. Carry at least **4 significant digits** during calculations. Your final answer should be at least **3 significant digits**.
- Be sure to write the **units** of all numerical results.
- **Show** all work and clearly explain your steps/reasoning to get partial credit.
- Please put your **final answer** for each part inside a box for easy identification. Do not give multiple answers, they will not be graded.
- Do not remove the **staple** from the exam sheets or separate pages of the exam. All extra pages must be stamped to your exam.
- You may leave the exam room when you are done. However, please do not leave during the **last five minutes** of the exam.
- At the end of the exam, please stay seated until **all** exam papers are collected.

Please do not write below this line

1. 25 pts.	
2. 25 pts.	
3. 25 pts.	
4. 25 pts.	
Total 100 pts.	

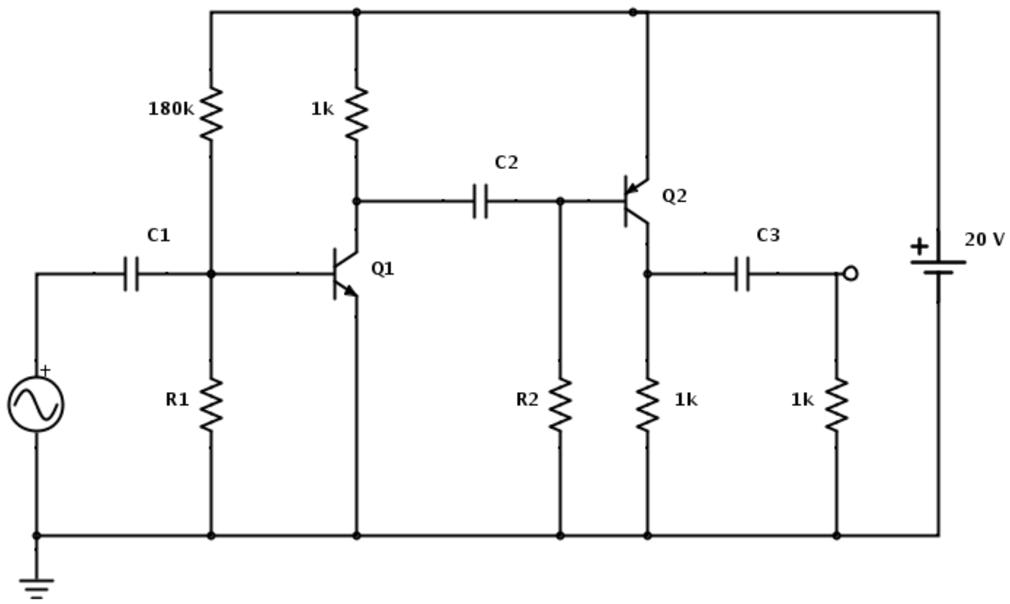
1. (25 points) Consider the circuit shown below. Find the states of the transistors and the diodes. The diodes are ideal. The transistors have parameters $\beta = 100$, $V_{BE(ON)} = 1V$ and $V_{CE(SAT)} = 0.2V$. Assume $n = 1$, $V_T = 26mV$ and $V_A = \infty$. **Justify your answer and show your work**. Provide your answer in the space below.



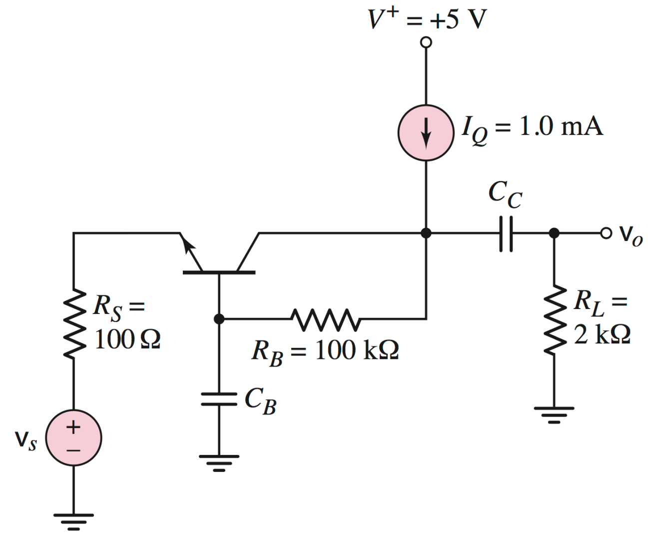
Q1 state	
Q2 state	
D1 state	
D2 state	

2. (25 points) Gilbert's boss asked him to design a two-stage BJT amplifier as shown below. Please help Gilbert choose resistor values R_1 and R_2 such that the DC base current for both transistors are $I_{B1} = I_{B2} = 100\mu A$. Draw the small signal ac equivalent circuit. Also, determine the small signal voltage gain of the amplifier, $A_v = v_o/v_s$. Assume that all capacitors are very large. The transistors have the following parameters.

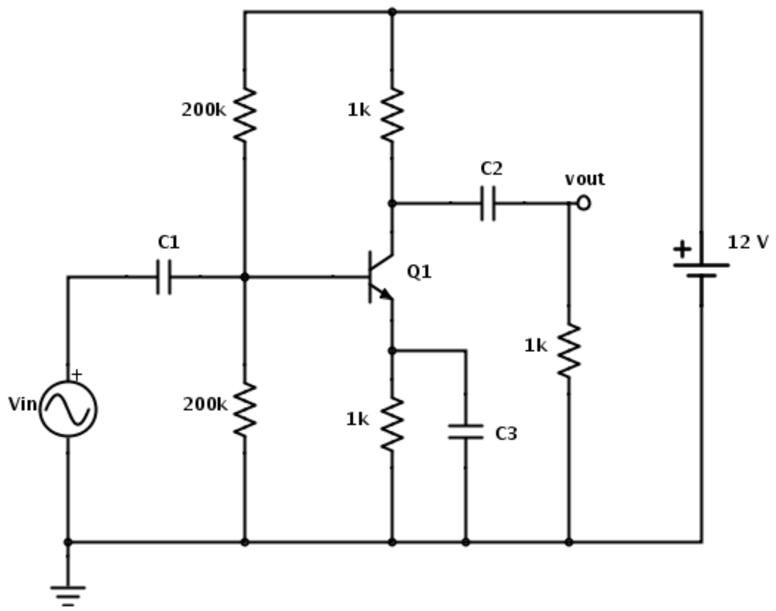
	β_F	β_R	n	V_A	$V_{BE(ON)}$	$V_{EB(ON)}$	$V_{CE(SAT)}$	$V_{EC(SAT)}$
npn	100	10	1	∞	1.0 V	-	0.2 V	-
pnp	100	10	1	∞	-	1.0 V	-	0.2V



3. (25 points) Consider the circuit shown below. The transistor has parameters $\beta = 50$, $V_{BE(on)} = 0.7$ V and $V_A = \infty$. Assume that C_C and C_B are very large. (a) Determine the quiescent values of I_{CQ} and V_{CEQ}. (b) Draw the small-signal AC equivalent circuit. (c) Determine the small-signal voltage gain $A_v = v_o/v_s$.



4. (25 points) For the circuit shown below, the transistor has parameters $\beta = 99$, $V_{BE(ON)} = 0.8V$ and $V_{CE(SAT)} = 0.2V$. Assume $n = 1$, $V_T = 26mV$ and $V_A = \infty$. Assume that all capacitors are very large. The DC solution yields $I_{BQ} = 26\mu A$. (a) Draw the small-signal AC equivalent circuit. (b) Determine the small-signal voltage gain $A_v = v_o/v_s$. (c) Find the maximum symmetric undistorted peak-to-peak output voltage swing.



Gain	
Swing	