ECE-255
Exam 3
November 14, 2013

Name: _____

Student ID: _____

INSTRUCTIONS

- This is a closed book, closed notes exam.

- Clearly mark your multiple choice answers in the test booklet.

- When the exam ends, all writing is to stop. This is not negotiable. No writing while turning in the exam/scantron or risk an F in the exam.

- All students are expected to abide by the customary ethical standards of the university, i.e., your answers must reflect only your own knowledge and reasoning ability. As a reminder, at the very minimum, cheating will result in a zero on the exam and possibly an F in the course.

- Communicating with any of your classmates, in any language, by any means, for any reason, at any time between the official start of the exam and the official end of the exam is grounds for immediate ejection from the exam site and loss of all credit for this exercise.

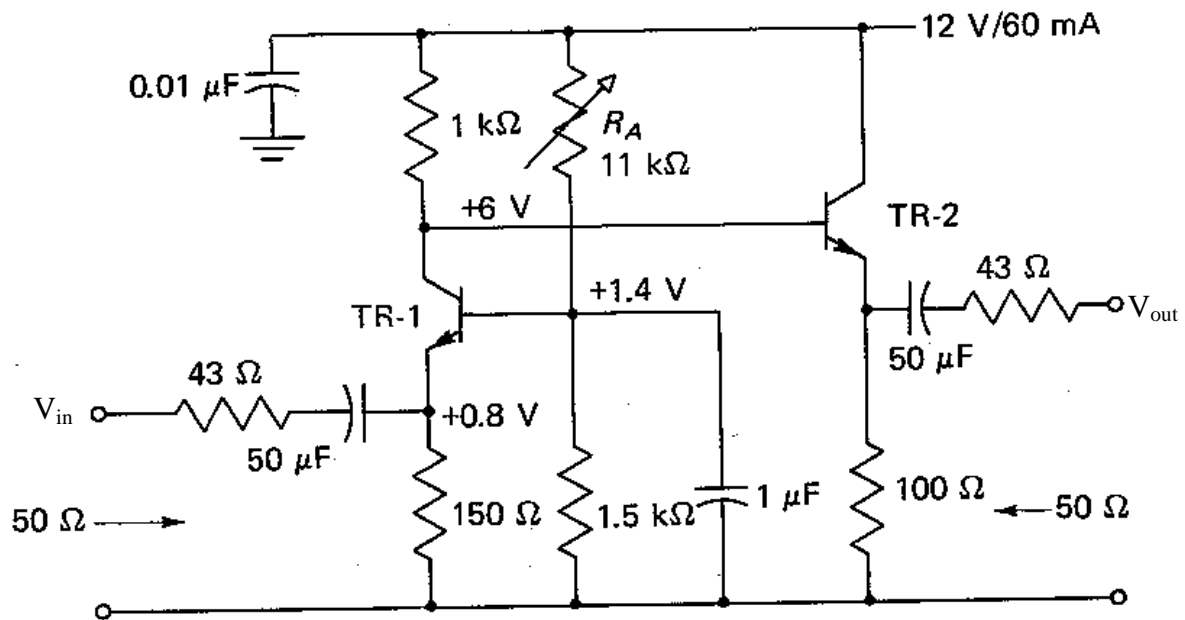1) What is the configuration of the multi-stage amplifier shown below?
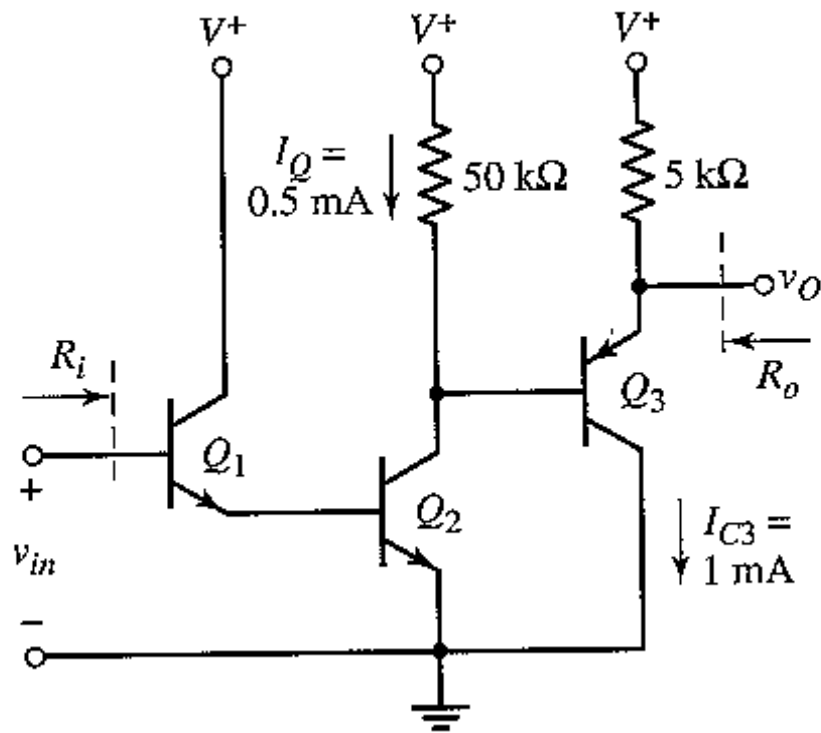
(1) CC-CE-CE   (2) CE-CE-CC   (3) CC-CE-CC
(4) CE-CE-CE   (5) CB-CE-CC   (6) None of the above

2. What is the configuration of the multi-stage amplifier shown below?

(1) CB-CC   (2) CE-CC   (3) CE-CB   (4) CC-CC
(5) CE-CE   (6) None of the above
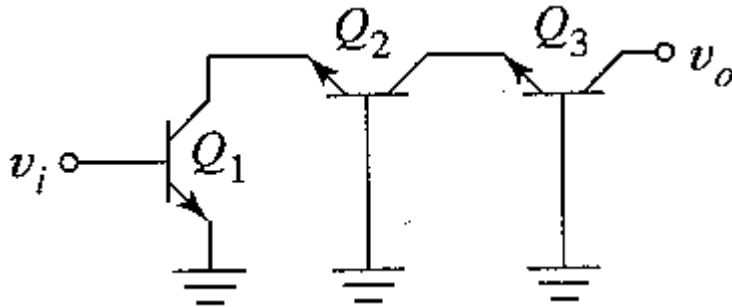
3. For the amplifier shown below known as double cascade, what is the gain |Av|? All transistors are identical.

   Note since $I_{c1}=I_{c2}=I_{c3}$, therefore $g_{m1}=g_{m2}=g_{m3}$, $r_{o1}=r_{o2}=r_{o3}$, $r_{\pi1}=r_{\pi1}=r_{\pi1}$
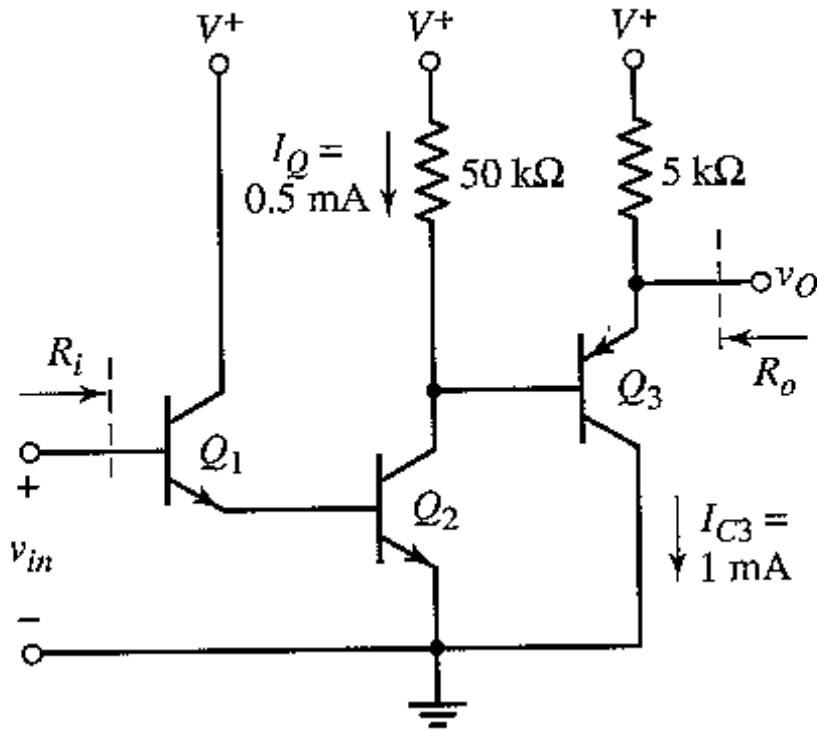
   Assume $r_o \gg r_\pi$

(1) $g_m r_o$ (2) $g_m^3 r_o^3$ (3) 1   (4) $g_m^2 r_o^2$
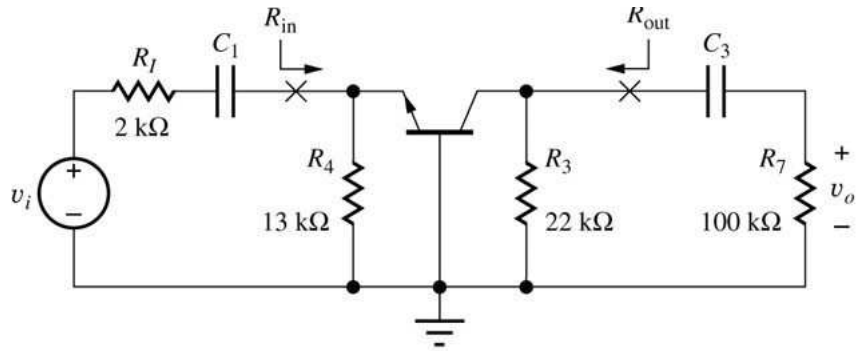
(5) $g_m r_o / r_\pi$ (6) None of the above

4) For the circuit shown below R_i=? (Bias currents for Q_2 and Q_3 are indicated on the Figure)

Assume β=100, V_A=∞, V_{BE} (on)=0.7V, V_T=25mA, V+=5V. (Assume α≈1).

(1) ≈ 500kΩ   (2) ≈ 5kΩ   (3) ≈ 250kΩ   (4) ≈ 1.5MΩ

(5) ≈ 1MΩ   (6) None of the above

5) What are <u>the values of R_{in}</u> (see the signs in the following circuits) for the following common-base (CB) and common-gate (CG) circuits?
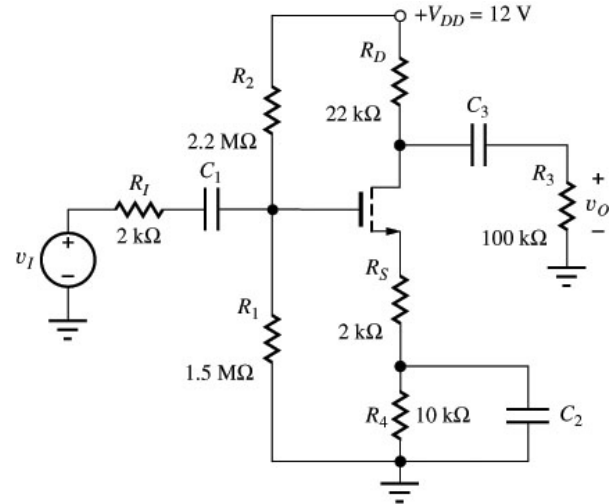

(a)
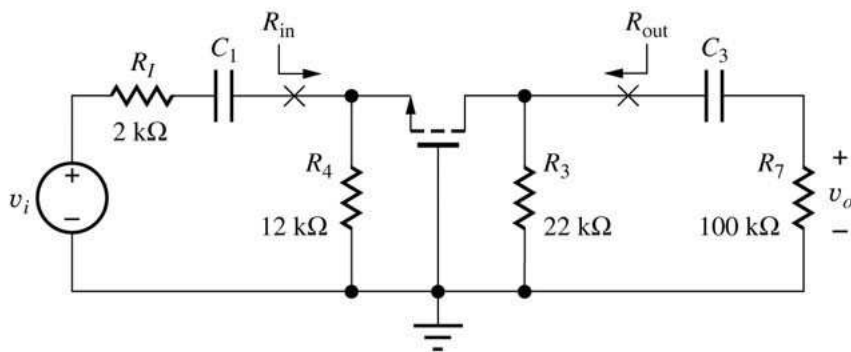
(b)

We know g_m of both transistors is 0.5 mS and $\beta_0=100$.

(1) About 13 kΩ for (a) and 12 kΩ for (b)
(2) About 1.98 kΩ for (a) and 2 kΩ for (b)
(3) About 2 kΩ for (a) and 1.98 kΩ for (b)
(4) About 1.73 kΩ for (a) and 1.72 kΩ for (b)
(5) About 1.72 Ω for (a) and 1.73 Ω for (b)
(6) None of the above

6) For the amplifier below. Choose value of C_1 so that it can be neglected at a frequency of 10 kHz.

We use $C_1 \geq 10 \dfrac{1}{2\pi f R}$ as the design rule.

(1) $C_1 < 0.178$ nF
(2) $C_1 < 1.78$ nF
(3) $C_1 < 17.8$ nF
(4) $C_1 > 0.0178$ nF
(5) $C_1 > 0.178$ nF
(6) $C_1 > 1.78$ nF

7) What is the common-mode gain ($|Av_c|$) for the circuit shown below? Assuming $\beta_0 >> 1$ and $r_o >> 1$. What is the differential mode gain ($|Av_d|$) for the circuit shown below?
[Answers: first common-mode gain; second differential mode gain]

Note: pay attention to how output is taken
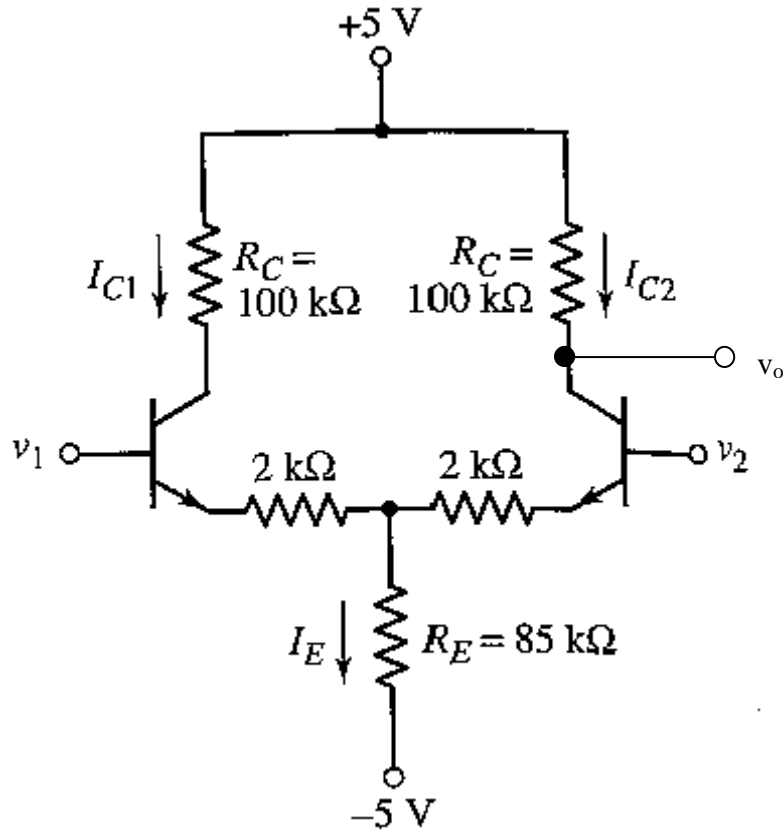
(1) ≈0.58; ≈50   (2) ≈0.02; ≈50   (3) ≈0.58; ≈100   (4) ≈25; ≈1.15
(5) ≈50; ≈0.58   (6) ≈1.18; ≈50

8) For the differential amplifier shown below, what is <u>output resistance (R_{out}) for ac small signals</u> <u>between v_{O1} and v_{O2}?</u> Assume $R_{C1}=R_{C2}=R_1=20k\Omega$, $\beta=\infty$, $V_{BE}(ON)=0.7V$, and $V_T=25mV$. The output resistance r_o for Q_1 and Q_2 is infinite. $V+=5V$ and $V-=-5V$.
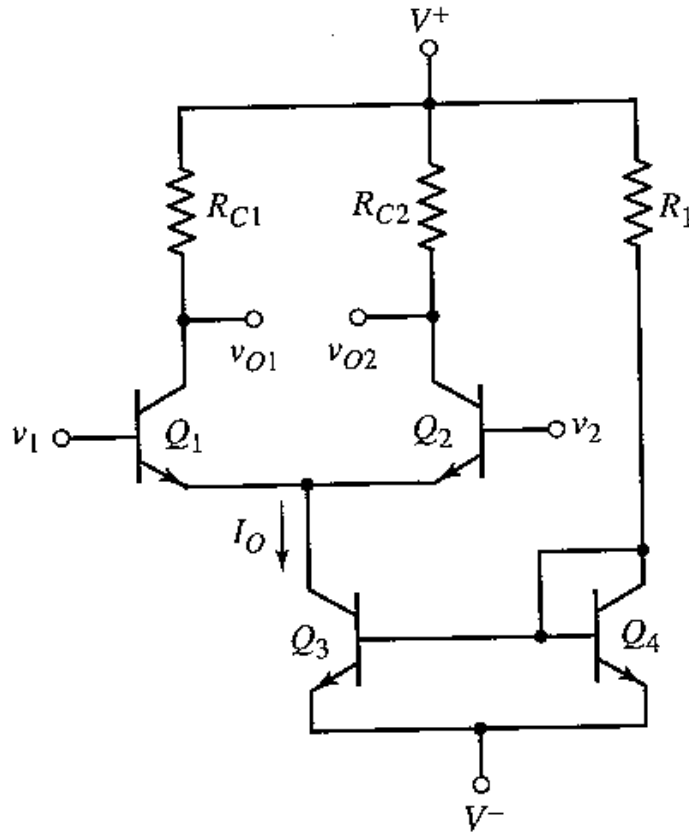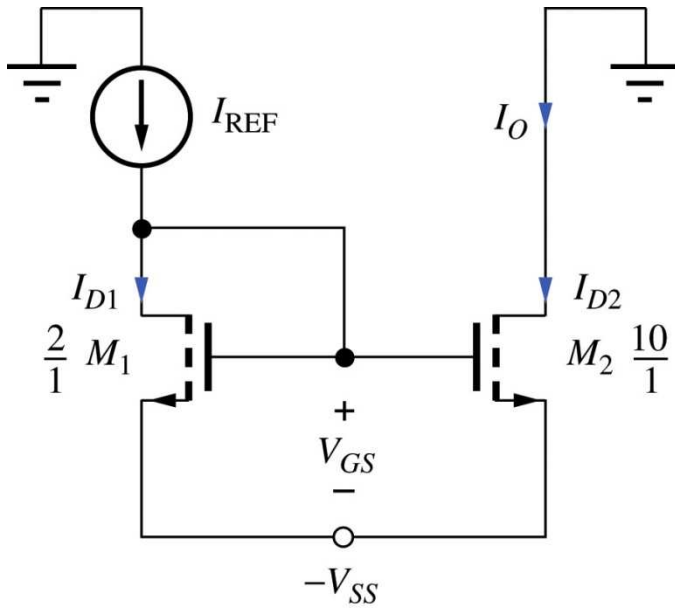

(1) 10 kΩ   (2) 20 kΩ   (3) 30 kΩ   (4) 40 kΩ
(5) ∞   (6) None of the above

9) What is the value of output impedance (R_o) for the current mirror shown below? Assume $\beta=\infty$, $V_{BE}(ON)=0.7V$, $V_A=100V$

(1) ∞ (2) 232kΩ (3) 107kΩ (4) 0   (5) 116kΩ
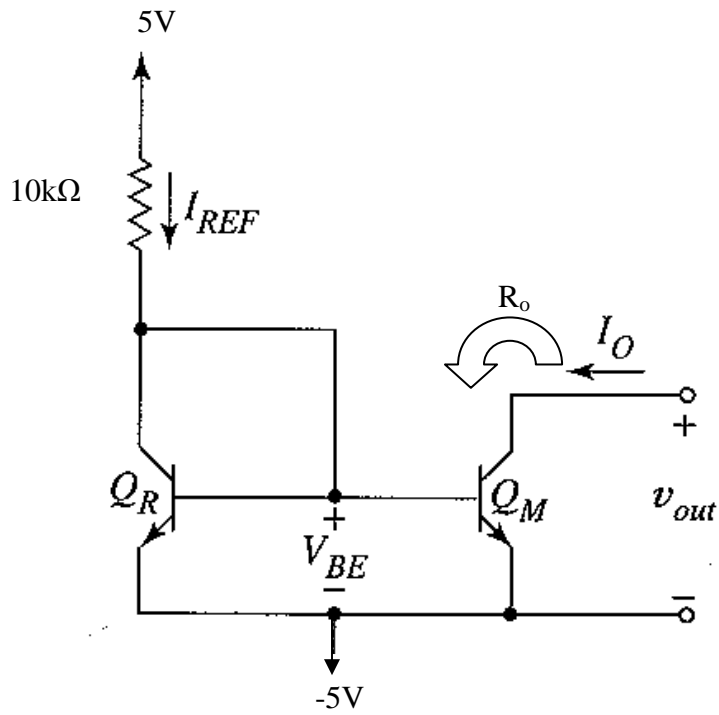
(6) None of the above

10. What is the output current Io for the current source in the following circuit if I_{REF}=50 µA, K_n'=25 µA/V^2, V_{TN}=0.75 V, V_{SS}=5V, and λ=0.0015 V^{-1}?

(1) ≈ 50 µA
(2) ≈ 100 µA
(3) ≈ 150 µA
(4) ≈ 200 µA
(5) ≈ 250 µA
(6) ≈ 300 µA