一、多選擇題(20%，每題 4%，不倒扣，答案卷上需按題號答題)

1. A p-n junction can be formed by intimately contacting two uniformly doped silicon semiconductors. Under equilibrium condition, which of the following phenomena can be observed?
(A)The majority carriers flowing across the junction; (B) The depletion region formed near the junction; (C) The minority conversion layer formed near the junction; (D) The built-in potential formed across the junction.

2. The operational amplifier is one of the major electronic components in this era.   Which of the following description is not true of the operational amplifier?
(A) In ideal Op Amp, the input impedance is infinite and the output impedance is zero; (B) In ideal Op Amp, the common-mode rejection is infinite and closed-loop gain is infinite; (C) In real situation, the open-loop gain is finite and increase with frequency; (D) Op amps are prone to DC problems such as DC offset and input bias.

3. Which one of the followings is NOT TRUE if the doping concentrations of a pn junction increase?
(A) the saturation current I_S increases; (B) the built-in voltage decreases; (C) the depletion region decreases; (D) the junction capacitance increases.

4. Which one is correct for a p-channel enhancement-type MOSFET?
(A) body effect makes the threshold voltage more positive; (B) only holes contribute to the current conduction; (C) the threshold voltage is positive; (D) drain current results from carrier drift in the channel.

5. Compared to MOS transistors, bipolar transistors have
(A) higher transconductance; (B) higher input impedance; (C) current dominated by drift current; (D)higher input impedance

二、非選擇題(80%)

1. The CMOS digital logic inverter is the fundamental unit in digital circuit in VLSI.   As the consequence, it is important to understand the CMOS digital logic inverter operation principle.
(a) Please draw the COMS inverter. (5%);
(b) Please draw the voltage transfer characteristics of the CMOS inverter and explain the operation. (10%)

2. Utilizing the node voltage method to obtain the power consumption of every resistor in Fig. 1 (15%)
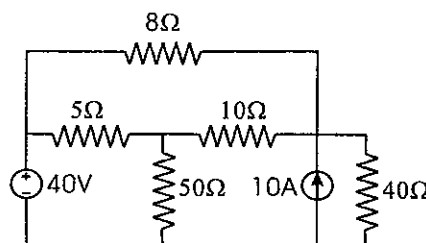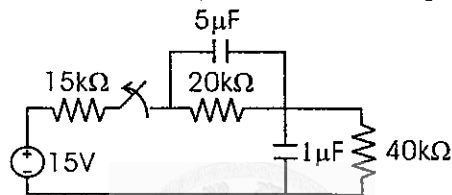

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3. The instrument amplifier is widely used in various scenarios.　Assume R1/R2 = R3/R4, please obtain the transfer function of the instrument shown as Fig. 2. (15%)
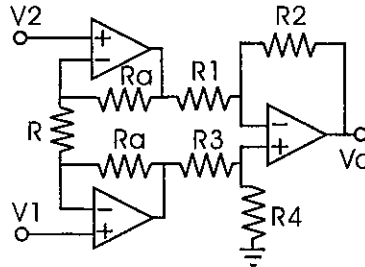
4. Assuming the switch of Fig.3 is closed for long time, the switch is opened at t = 0.

   (a) Please identify $V_O(t)$ as t $\geqq$ 0. (8%)

   (b) After the switch is opened for 60ms, how many percentage of the originally stored energy is dissipated? (5%)

5. The Op-amp is not perfect as we assume before.　As shown in Fig. 4, the op-amp is made by MOSFET technology and connected.　Because of the limitation in fabrication, it gives an output of 0.5V.
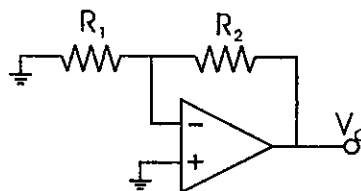
   (a) What is the input offset voltage? (8%)

   (b) R_1 is changed to 50kΩ, R_2 is replaced by a 1nF capacitor, please find the V_O as a function of time. Assume $V_O(t = 0) = 0$, and $V_{O(sat)} = \pm 13V$. (14%)