

國立臺灣科技大學  
九十學年度碩士班招生考試試題

系所組別：電機工程系乙二組  
科 目：電子學

In the following, compute to three significant digits.

1. (20 points) Consider a circuit with a resistor of  $R = 2.2K\Omega$  in series with a diode whose breakdown voltage is essentially constant with  $V_x = 5.2\text{volts}$  over a wide range of currents and temperatures. If a power supply of  $V_s = 10\text{volts}$  is applied to the circuit with the  $n$ -side of the diode connected to the positive end of  $V_s$ , what is the supply current  $I_s$  in mA?
2. For the circuit shown in Fig.P2, let  $V_{BE(on)} = 0.7\text{volts}$ ,  $\beta = 100$ , and  $V_{CE(sat)} = 0.2\text{volts}$ .
  - a) (15 points) Determine the Q-point of the circuit.
  - b) (10 points) Plot the load line and indicate the Q-point on the collector current-voltage characteristic plot. Indicate important data and the associated units on the plot.

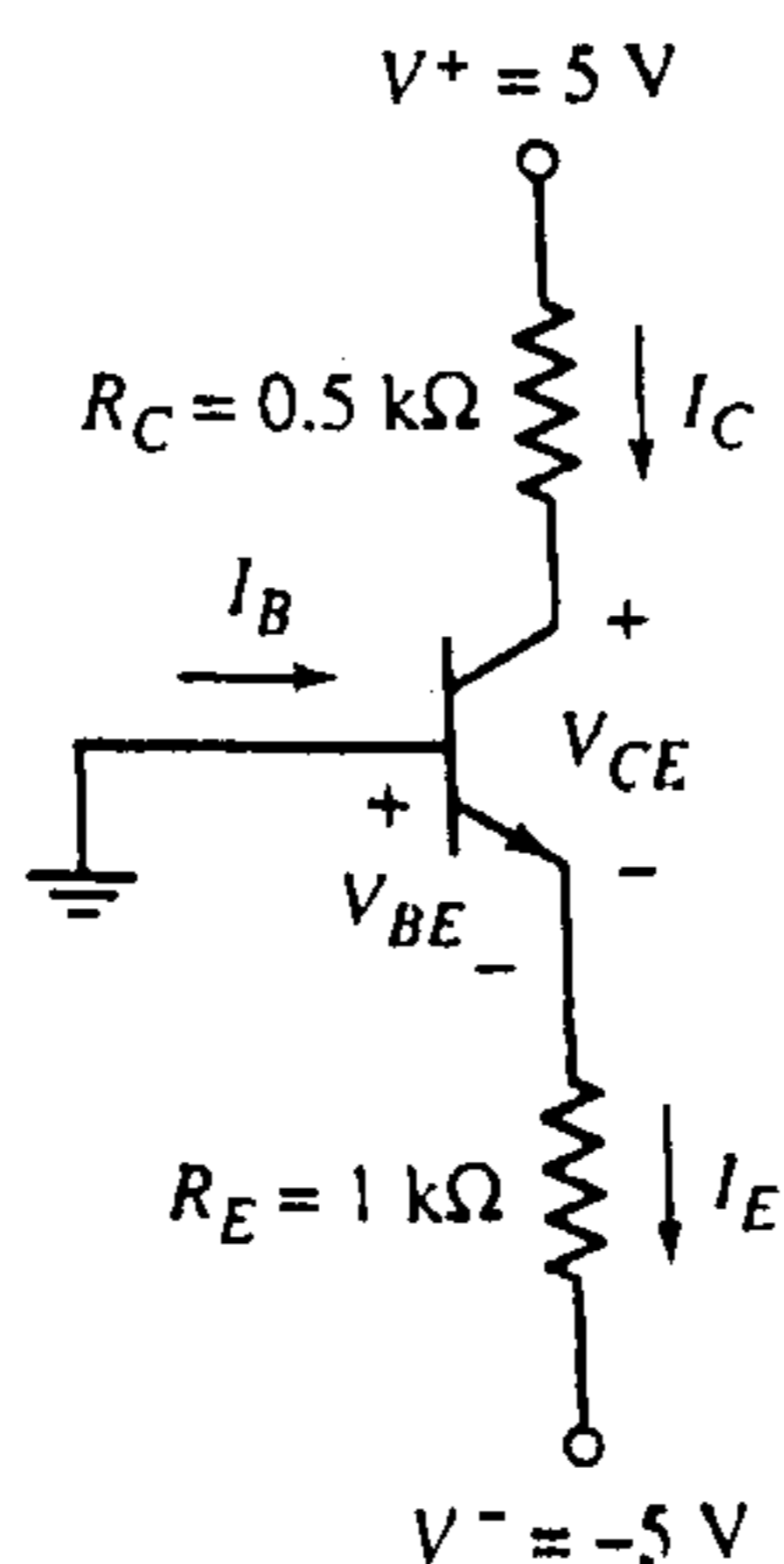


Fig.P2

3. Consider the typical common source MOSFET circuit shown in Fig.P3, where  $R_{S1} = 2.2K\Omega$ ,  $R_1 = 56K\Omega$ ,  $R_2 = 33K\Omega$ ,  $R_D = 4.7K\Omega$ ; the transistor parameters  $g_m = 2\text{mA/V}$ ,  $r_o = 100K\Omega$ , and  $V_{DD} = 10\text{volts}$ . Assuming the impedance of the capacitance  $C_{C1}$  is small enough for the ac signal of concern.
  - a) (15 points) Determine the ac voltage gain of the circuit.
  - b) (10 points) Determine the input and output resistances of the circuit.
  - c) (10 points) Why is it usually important to calculate the input and/or output impedance(s) of a circuit?

69



國立臺灣科技大學  
九十學年度碩士班招生考試試題

系所組別：電機工程系乙二組  
科 目：電子學

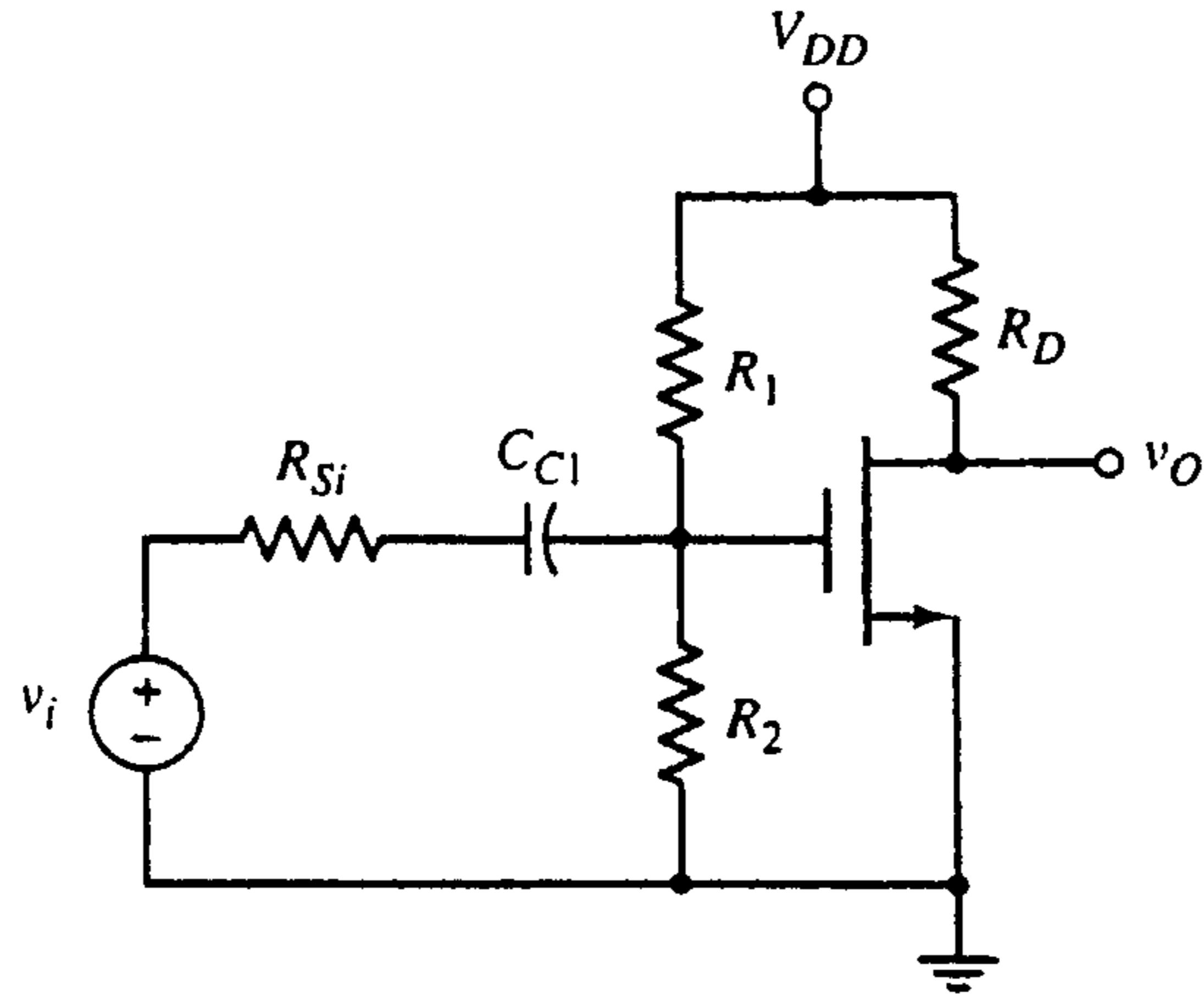


Fig.P3

4. (20 points) The closed-loop voltage gain of an inverting amplifier with ideal op-amp is well known to be  $A_1 = \frac{-R_2}{R_1}$  where  $R_2$  is the feedback resistance and  $R_1$  is the resistance between the input voltage  $V_i$  and the inverting terminal of the op-amp. Derive the closed-loop voltage gain  $A_1$  if the open-loop voltage gain  $A_o$  of the op-amp is finite. Show all steps that lead to your conclusion.



70