九十二學年度台灣大學電資學院電機系電子學(一)第一次小考

一、(a) For the circuit in Fig. 1, taking the finite open-loop gain A of the op amp into account, show that

$$\frac{V_o}{V_I}=\frac{-G_o}{1+[1+G_o+(R_4/R_3)]/A}$$

where G_o is the nominal magnitude of the closed-loop gain (See Example 2.2),

$$G_o=\frac{R_2}{R_1}\left[1+\frac{R_4}{R_2}+\frac{R_4}{R_3}\right]$$

(b) Apply this result to the case G_o=100, A=1000, and R_4=R_2=R_1. Find. V_o/V_I.

(c) Repeat (b) for the same G_o and A values but with R_4=R_2=10R_1.

(d) For comparison, find V_o/V_I for the inverting configuration with the same G_o and A values.

Note: The expression for V_o/V_I above suggests that the effect of finite A can be made approximately equal to that of the inverting configuration by selecting $R_4 \ll R_3$. This component selection, however, defeats the purpose of using the T network in the feedback. Why? (You need to study the design process in Example 2.2 to be able to answer this question.)

二、Figure 2 shows a modified version of the difference amplifier studied in Example 2.6. The modified circuit includes a resistor R_G, which can be used to vary the gain. Show that the differential voltage gain is given by

$$\frac{V_o}{V_d}=-2\frac{R_2}{R_1}\left[1+\frac{R_2}{R_G}\right]$$

Hint: The virtual short circuit at the op amp input causes the current through the R_1 resistors to be $V_d/2R_1$.

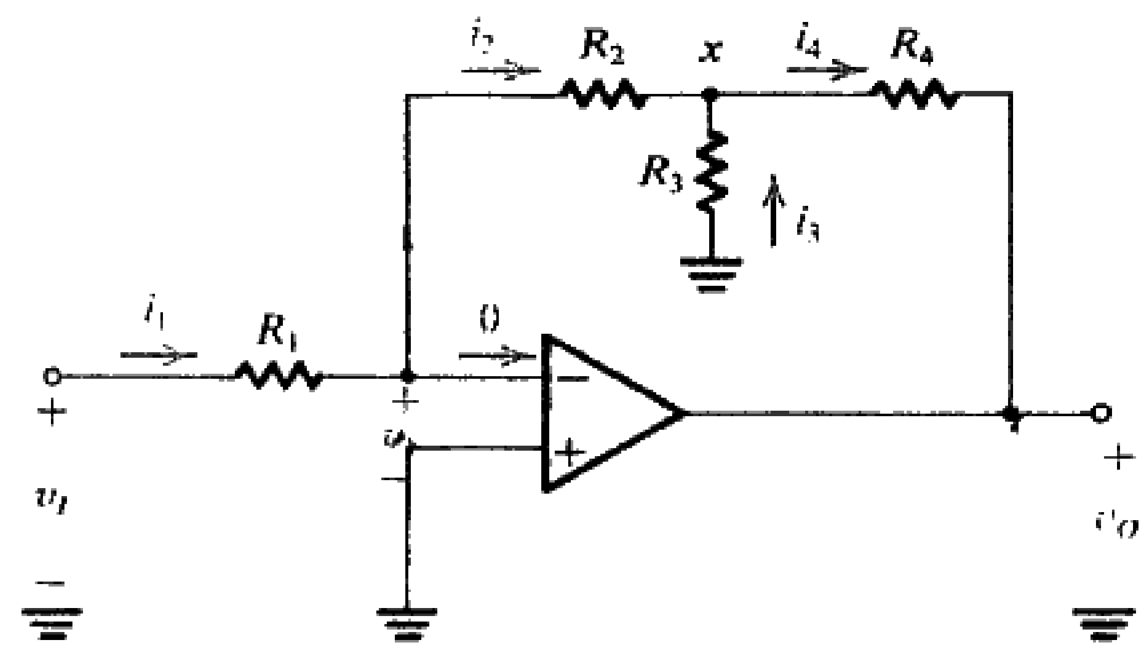

Figure 1

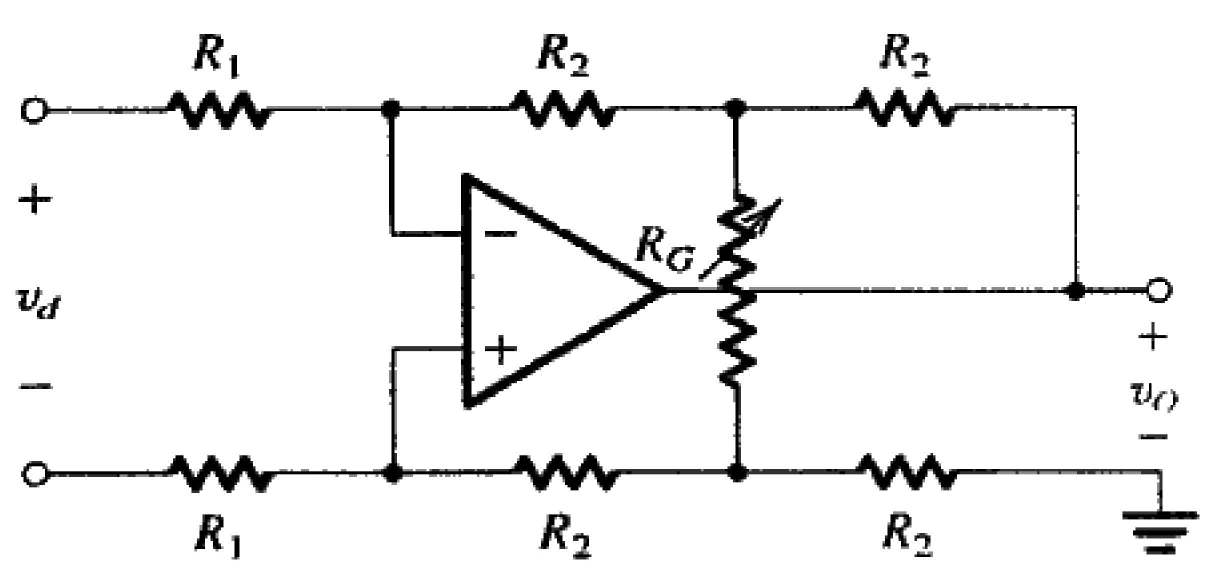

Figure 2