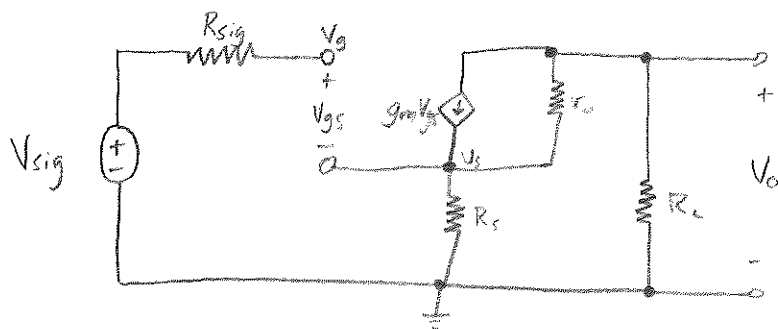


1.



$$\textcircled{1} \quad \frac{V_o - 0}{R_L} = g_m V_{gs} + \frac{V_o - V_s}{r_o}$$

$$\textcircled{2} \quad V_{gs} = V_g - V_s = V_{sig} - V_s$$

$$\textcircled{3} \quad \frac{V_s - 0}{R_s} = - \left(\frac{V_o}{R_L} \right) R_s$$

$$V_s = - \frac{V_o R_s}{R_L}$$

$$\textcircled{2} \rightarrow \textcircled{1}: \quad \frac{V_o}{R_L} + \frac{V_o - V_s}{r_o} + g_m (V_{sig} - V_s) = 0$$

$$\text{Plug into } \textcircled{3} \quad \frac{V_o}{R_L} + \frac{V_o + \frac{V_o R_s}{R_L}}{r_o} + g_m \left(V_{sig} + \frac{V_o R_s}{R_L} \right) = 0$$

$$\frac{V_o}{R_L} + \frac{V_o + \frac{V_o R_s}{R_L}}{r_o} + g_m V_{sig} + g_m \frac{V_o R_s}{R_L} = 0$$

$$V_o \left(\frac{1}{R_L r_o} + \frac{1 + \frac{R_s}{R_L}}{r_o R_L} + \frac{g_m R_s}{R_L r_o} \right) + g_m V_{sig} = 0$$

$$V_o \left(\frac{r_o + R_L + R_s + g_m R_s r_o}{r_o R_L} \right) + g_m V_{sig} = 0$$

$$\frac{V_o \left(\frac{r_o + R_L + R_s + g_m R_s r_o}{r_o R_L} \right)}{V_{sig}} = - \frac{g_m V_{sig}}{V_{sig}}$$

$$\frac{V_o}{V_{sig}} = - \frac{g_m}{\left(\frac{r_o + R_L + R_s + g_m R_s r_o}{r_o R_L} \right)}$$