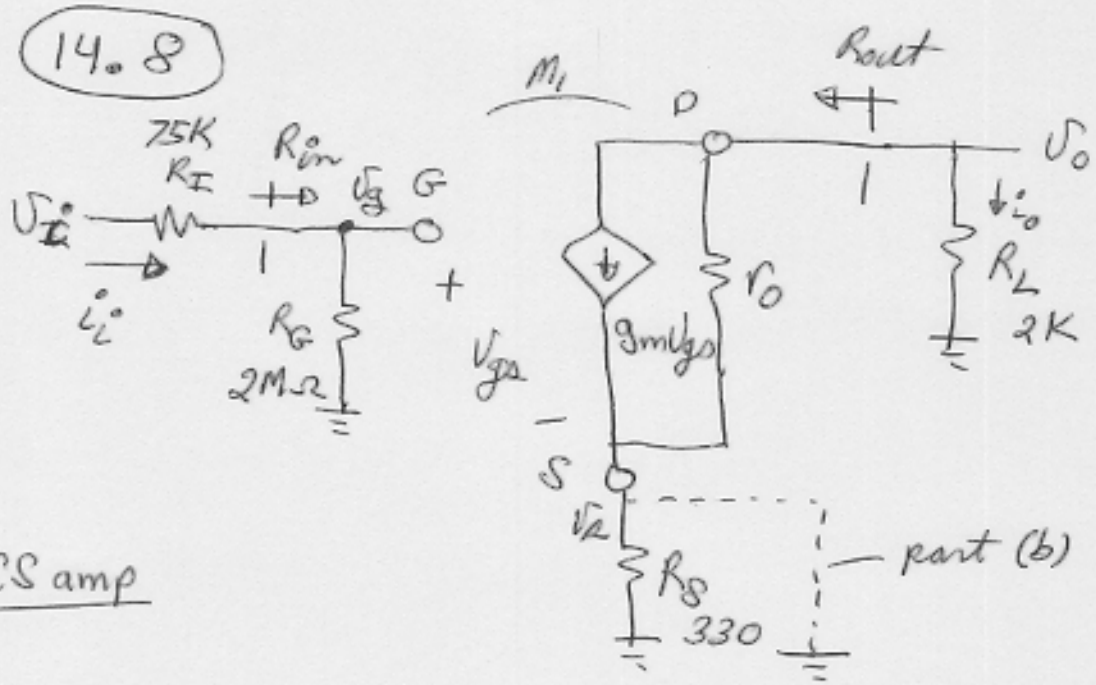
Jaeger 3rd ed

(14.8)



m_1

$g_m = 5\,mS$

$r_o = 10K$

$\mu = g_m r_o = 50$

CS amp

$$v_o = v_{gs}\,\frac{(-g_m r_o)\,R_L}{R_S + R_L + r_o}$$

$$\left(\cong -v_{gs} g_m (r_o \| R_L)\right)$$

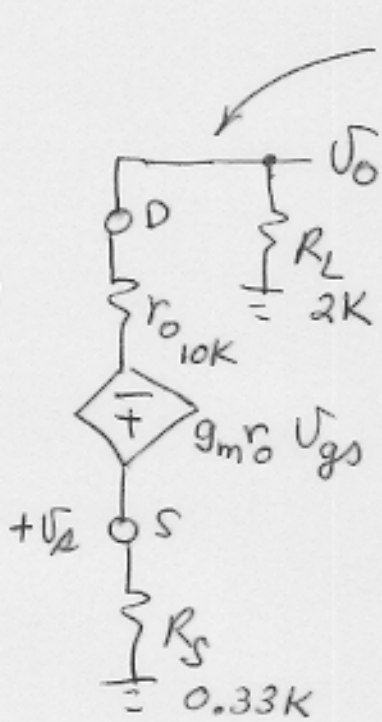
$$v_s = v_{gs}\,\frac{(+g_m r_o)\,R_S}{R_S + R_L + r_o}$$

$v_{gs} = v_g - v_s$ so

$$v_{gs} = v_g \mp v_{gs}\,\frac{(g_m r_o)\,R_S}{R_S + R_L + r_o}$$

$$\Rightarrow v_{gs} = v_g\,\frac{R_S + R_L + r_o}{R_S + R_L + r_o + g_m r_o R_S} \cong v_g\,\frac{1}{1 + g_m R_S}$$

Ther. equivalent



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14.8 cont

$$\therefore \frac{v_o}{v_g} = \frac{-g_m r_o R_L}{R_s + R_L + r_o + g_m r_o R_S} \cong \frac{-g_m (R_L \parallel r_o)}{1 + g_m R_S}$$

$$\therefore A_v \equiv \frac{v_o}{v_i} = \frac{v_g}{v_i}\frac{v_o}{v_g} = \frac{R_G}{R_I + R_G} \frac{-g_m r_o R_L}{R_s + R_L + r_o + g_m r_o R_S}$$

$$\therefore A_v = -3.34 \text{ (exact)}, \text{ OR } -3.03 \text{ (approx)}$$

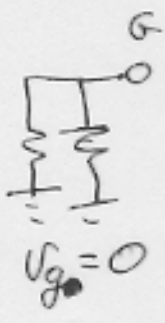
(a) $R_{in} = R_G = 2\,M\Omega$

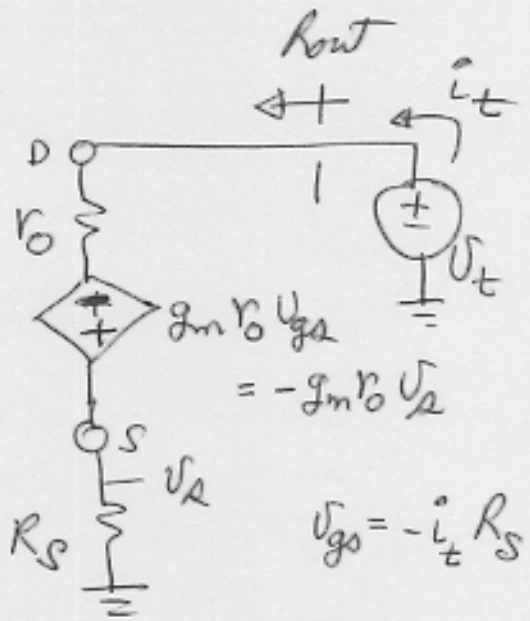
$$A_i = \frac{i_o}{i_i} = \frac{v_o}{v_i}\frac{R_I + R_G}{R_L} = -3465$$

$$R_{out} = \frac{v_t}{i_t} = R_S + (1 + g_m R_S) r_o$$

$$\cong (1 + g_m R_S) r_o$$

$R_{out} = 26.8\,K\Omega$





(b) let $R_S \to 0$

$A_v = -8.03$

$R_{in} = 2\,M\Omega$

$A_i = -8333$

— finding R_{out} —

$R_{out} = r_o = 10K\Omega$