A common source (CS) amplifier w/ NMOS transistor:

$k'_n = 0.2 \frac{mA}{V^2}$ $\quad \frac{W}{L} = 40$ $\quad V_t = 0.5V$

$V_A = 50V$

$R_D = 20k\Omega$

$R_L = 20k\Omega$

$R_{sig} = 100k\Omega$

a) If $I_{DQ} = 0.25mA$

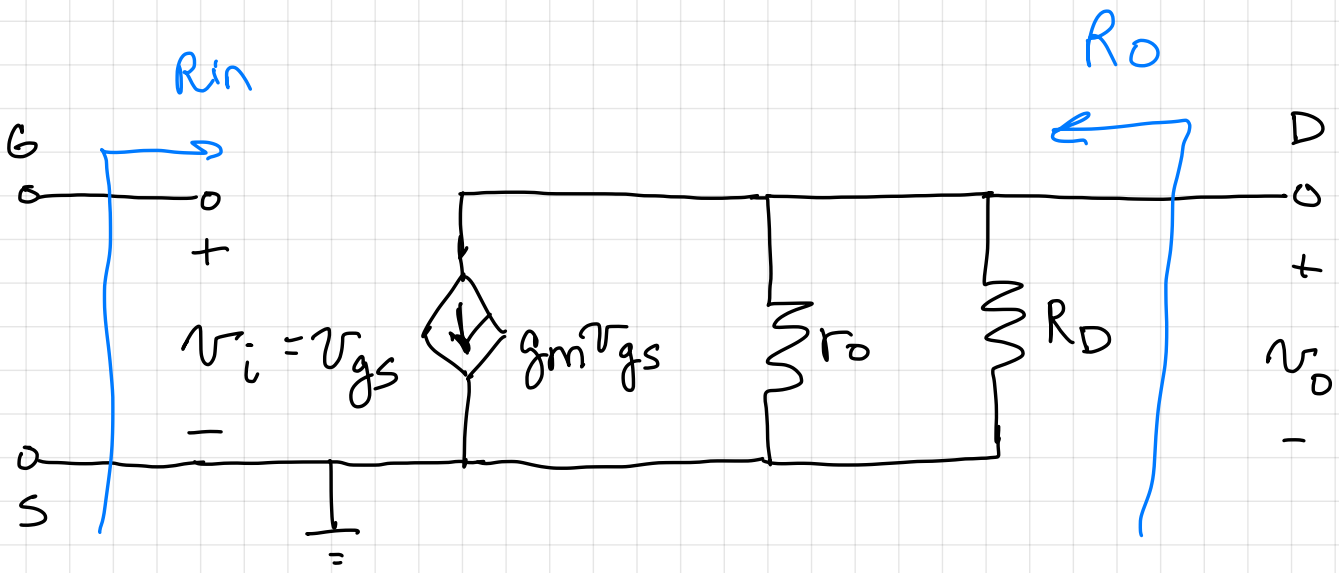
$V_{GSQ} = ?$

$$I_{DQ} = \frac{1}{2} k'_n \frac{W}{L} (V_{GSQ} - V_t)^2$$

$$0.25mA = \frac{1}{2}(.2)(40)(V_{GSQ} - 0.5)^2$$

$$\boxed{V_{GSQ} = 0.75V}$$

b) R_{in}, g_m, R_o, A_{vo}, r_o



$R_{in} = \infty$

$g_m = k'_n \frac{W}{L}(V_{GSQ} - V_t) = 2\,mA/V^2$

$= 0.2(40)(.25) = 2\,mA/V^2$

$r_o = \frac{V_A}{I_{DQ}} = \frac{50}{.25} = 200\,k\Omega$

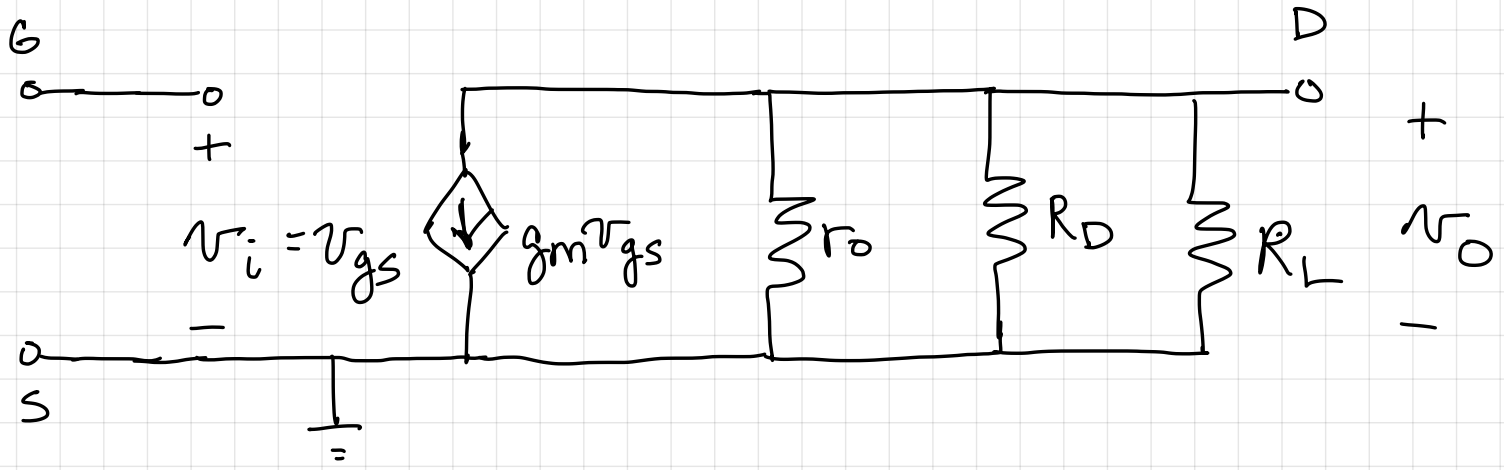
$R_o = r_o \| R_D = (200 \| 20)\,k\Omega = 18.2\,k\Omega$

$A_{vo} = \left.\frac{v_o}{v_i}\right|_{R_L \to \infty} = -g_m(r_o \| R_D)$

$= -2(200 \| 20)$

$A_{vo} = -36.4\ V/V$

c) $A_v = \frac{v_o}{v_i}$



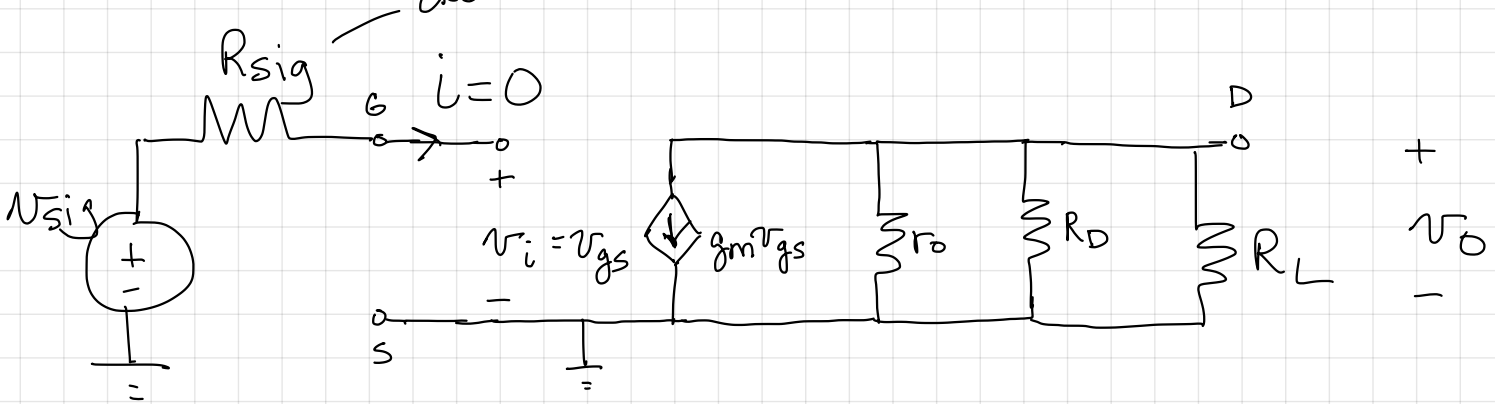
$$A_v = -g_m (r_o \| R_D \| R_L)$$

$$= -2 (200 \| 20 \| 20)$$

$$\simeq -19.05 \text{ V/V}$$

d) G_v

does not affect G_v



$$G_V \equiv A_V = -g_m(r_o \| R_D \| R_L)$$

$$= -19.05 \text{ V/V}$$