Small Signal Parameters:

$g_m = \frac{2I_D}{V_{OV}} = 1mS$

$r_o = V_A/I_D = 200k\Omega$

$g_m r_o = 200$

} All Transistors

1) Minimum V_{OUT}:

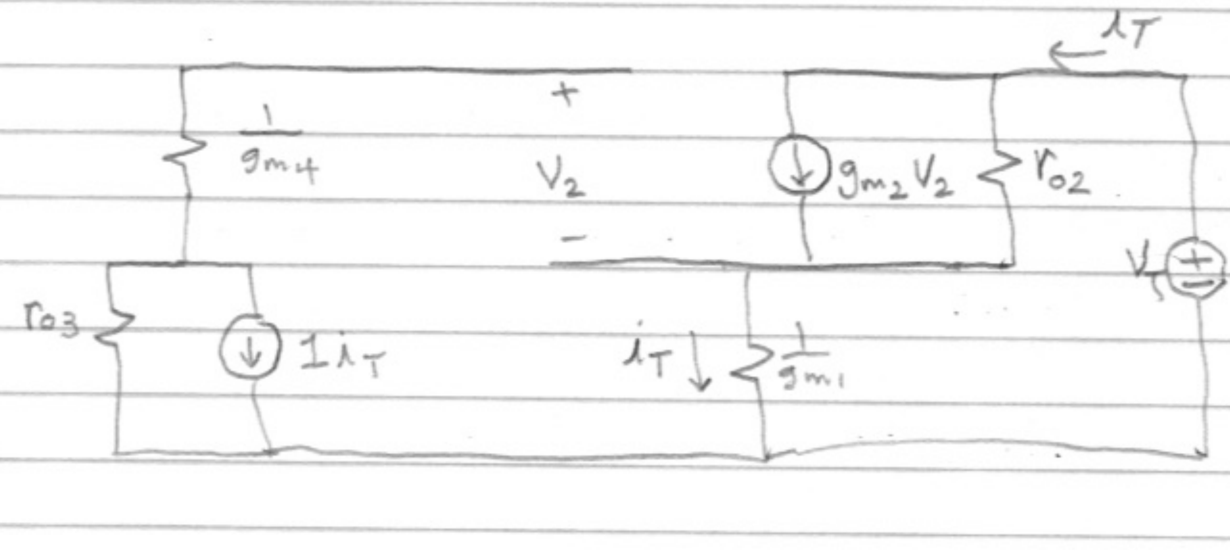
$$V_{OUT_{min}} = V_t + V_{OV_1} + V_{OV_2} = 0.3+0.1+0.1 = 0.5V$$

2) R_{OUT}:

Ignore r_{o4} and r_{o1}

$V_{gs1} = V_{gs3} \rightarrow$ M3 mirrors M1

These assumptions let us draw the following schematic:



$$i_T = g_{m2} v_2 + \frac{v_T - i_T/g_{m1}}{r_{o2}}$$

$$v_2 = -i_T r_{o3} - i_T/g_{m1}$$

This gives

$$R_{OUT} = \frac{v_T}{i_T} = r_{o2}\left(1 + \frac{1}{g_{m1} r_{o2}} + r_{o3} g_{m2} + \frac{g_{m2}}{g_{m1}}\right)$$

$$= r_{o2} + \frac{1}{g_{m1}} + r_{o2} g_{m2}\left(1 + \frac{1}{g_{m2} r_{o3}}\right) r_{o3}$$

(Exact Answer)

$$R_{OUT} = 2\times10^5 + 1000 + 200\left(1 + \frac{1}{200}\right) 2\times10^5$$
$$= 4.04\times10^7\,\Omega$$

often approximated as:

$$R_{OUT} \cong r_{o2}(1 + g_{m2} r_{o3}) = 4.02\times10^7\,\Omega$$