PART 2: $V_{th} = 550mV$

$$I_{TAIL} = \frac{\beta}{2}\frac{W}{L}(V_{G_1} - V_{th})^2$$

$$\boxed{I_{TAIL} = 4\mu A}$$

$$g_{m_1} = g_{m_2} = \sqrt{2\left(\frac{I_{TAIL}}{2}\right)\beta\frac{W}{L}}$$

$$\boxed{g_{m_1} = g_{m_2} = 80\mu S}$$

* WITH JUST A 50mV INCREASE IN V_{th}, WE SEE THE TRANSCONDUCTANCE (AND HENCE THE GAIN) DROP BY A FACTOR OF TWO.

PART 3: (FIG. 2)

$I_{REF} = 16\mu A$

$$\left(\frac{W}{L}\right)_{M_0} = \left(\frac{W}{L}\right)_{M_1} \Rightarrow \boxed{I_{TAIL} = 16\mu A}$$

$$(g_m r_o)_{M_0} = (g_m r_o)_{M_1} = 10 \qquad V_{D_1} = 550mV$$

$$\Delta V_{DS} = -50mV = g_m r_{o_1} \Delta V_{GS} \Rightarrow \Delta V_{GS} = -0.005V$$

$$I'_{TAIL} = \frac{\beta}{2}\frac{W}{L}(V_{GS_1} + \Delta V_{GS_1} - V_{th})^2$$

$$\boxed{I'_{TAIL} = 14.44\mu A}$$

$$I_{REF} = \frac{\beta}{2}\frac{W}{L}(V_{GS} - V_{th})^2$$

$$V_{GS_0} = 0.6V = V_{GS_1}$$

PART 4:

$$V_{D_1} \geq V_{OV_1} \Rightarrow V_{BIAS_2} - \underbrace{(V_{OV_2} + V_{th})}_{V_{GS2}} - V_{OV_1} = 0$$

$$\boxed{V_{BIAS_2} \geq 50\sqrt{I_{REF}} + V_{th}}$$

$$V_{OV_1} = V_{G_1} - V_{th}$$

$$I_{REF} = \frac{\beta}{2}\left(\frac{W}{L}\right)_1 (V_{G_1} - V_{th})^2$$

$$\sqrt{\frac{2 I_{REF}}{\beta\frac{W}{L}}} = V_{G_1} - V_{th} = V_{OV_1} = 25\sqrt{I_{REF}}$$

$$\frac{I_{REF}}{2} = \frac{\beta}{2}\left(\frac{W}{L}\right)_2 V_{OV}^2$$

$$V_{OV_2} = \sqrt{625 I_{REF}}$$

$$V_{OV_2} = 25\sqrt{I_{REF}}$$