$V_{GS(th)} = 2V$

$V_{GS(on)} = 4.5V$

$I_{D(on)} = 75mA$

$R_{DS(on)} = 6\Omega$

$I_{D(max)} = 200mA$

$P_{D(max)} = 350mW$

$V_{DS} = I_D \cdot R_{DS} = 75mA \cdot 6\Omega = 0.45V$

$V_{DSmax} = I_{Dmax}R_{DS} = 200mA \cdot 6\Omega = 1.2V$

$V_{GS} > V_{TH}$; $V_{DS} < V_{GS} - V_{TH}$ ← ∴ Región lineal

$I_{D(on)} = K(V_{GS(on)} - V_{GS(th)})^2$

$K = \dfrac{I_{D(on)}}{(V_{GS(on)} - V_{GS(th)})^2}$

$g_m = 2K(V_{GS(on)} - V_{GS(th)})$

$g_m = 2 \cdot 0.012(4.5V - 2V)$

$g_m = 0.06\ S$

$K = \dfrac{75mA}{(4.5V - 2V)^2} = 0.012$

Ganancia $A_v = -g_m \cdot Z_o$ $rd \gg 10R_D$

$Z_o = rd \| R_D$

$Z_o = R_D$

$A_v = -0.06 \cdot 150\Omega$

$A_v = -9$ $\Rightarrow V_{out} = V_{in} \cdot A_v$

$V_{out} = 5mV \cdot -9$

$V_{out} = -45mV$

Si $R_D = 15$ la ganancia baja ya que A_v esta relacionada directamente con R_D

$$Z_i = R_G = 3,3 M\Omega$$

$$A_V = -g_m \cdot R_D \| Z_{i2}$$

$$Z_o = rd \| R_D \| Z_{i2}$$

$$V_{GS} = -I_D \cdot R_S$$

$$g_{mo} = \frac{2 I_{DSS}}{|V_P|} = \frac{2 \cdot 6mA}{|-4|} = 3\,mS$$

$$I_D \approx \frac{I_{DSS}}{2} \simeq 3mA$$

$$V_{GS} = -3mA \cdot 680\Omega$$

$$V_{GS} = -2,04 \,V$$

$$g_m = g_{mo} \cdot \left(1 - \frac{V_{GS_Q}}{V_P}\right)$$

$$g_m = 3mS \cdot \left(1 - \frac{-2,04}{-4}\right)$$

$$g_m = 1,47 mS$$

Z_{i2} Segunda etapa.

$$Z_{i2} = R_1 \| R_2 \| \beta re$$

$$Z_{i2} = 900,34$$

$$\Rightarrow A_V = (-1,47mS)(900,34 \| 2,4k)$$

$$\underline{A_{V_1} = -962 mS}$$

Segunda Etapa.

$$V_B = \frac{V_{CC} \cdot R_2}{R_1 + R_2} = \frac{12V \cdot 4.7k\Omega}{4.7k\Omega + 15k\Omega} = 2.86\ V$$

$$V_{BE} = V_B - V_E \rightarrow V_E = V_B - V_{BE}$$
$$V_E = 2.86 - 0.7 = \underline{2.16\ V}$$

$$I_C = \frac{V_E}{R_E} = \frac{2.16V}{1k\Omega} = \underline{2.16mA}$$

$$V_C = V_{CC} - V_{RC} = 12 - (2.16mA)(2.2k\Omega)$$
$$V_C = 7.24\ V$$

$$re = \frac{V_t}{I_E} = \frac{26mV}{2.16mA} = 12.03\ \Omega$$

$$Z_{i2} = R_1 \| R_2 \| \beta re$$
$$= 15k \| 4.7k \| 12.03$$
$$= 12.02\ \Omega$$

Ganancia 2 $$A_{v_2} = -\frac{R_C}{re} = -\frac{2.2k\Omega}{12.03} = -182.87\ S$$

Ganancia total $= A_{v_1} \cdot V_{v_2} = -962 ms \cdot -182.87 s$
$$= \underline{175.92}$$

$\therefore V_{salida} = 20mV \cdot 175.92$
$$= \underline{3.51\ V}$$