

$$V_1 \left(\frac{1}{2} + \frac{1}{5} \right) - \frac{1}{5} V_2 = -\frac{2}{5} - 2 \quad | \cdot 10$$

8-20

$$7V_1 - 2V_2 = -24$$

$$6 = 45 - 25$$

$$V_2 \left(\frac{1}{5} + \frac{1}{3} \right) - \frac{1}{5} V_1 - \frac{1}{3} V_3 = \frac{2}{5} + 3 - \frac{5}{3} \quad | \cdot 15$$

$$8V_2 - 3V_1 - 5V_3 = 26$$

$$V_3 \left(1 + \frac{1}{3} \right) - \frac{1}{3} V_2 = \frac{5}{3} + 2 \quad | \cdot 3$$

$$4V_3 - V_2 = 11$$

$$V_1 = \frac{2V_2 - 24}{7} \quad V_3 = \frac{V_2 + 11}{4}$$

$$8V_2 - \frac{3}{7}(2V_2 - 24) - \frac{5}{4}(V_2 + 11) = 26 \quad | \cdot 28$$

$$224V_2 - 24V_2 + 288 - 35V_2 - 385 = 728$$

$$165V_2 = 825 \quad \boxed{V_2 = 5V \quad V_1 = -2V \quad V_3 = 4V}$$

$$P_{2V} = -2W$$

$$P_{2A} = 32W$$

$$P_{2\Omega} = 2W$$

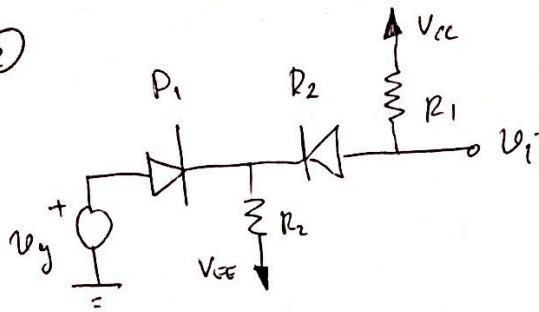
$$\frac{3 \cdot 8}{11}$$

$$P_{5V} = 10W$$

$$P_{3A} = 15W$$

$$R_{AB} = \frac{24}{11} \Omega$$

2)



$$V_{CC} - i_D(R_1 + R_2) - V_D - V_{EE} = 0$$

$$i_D = \frac{V_{CC} - V_{EE} - V_D}{R_1 + R_2} = 620 \mu A$$

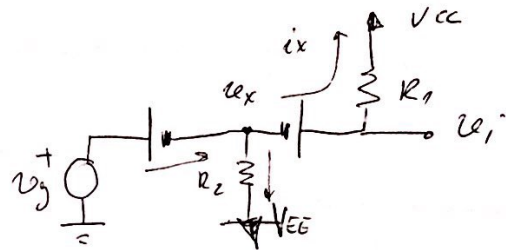
3a $V_g = -6V$ $D_1: OFF, D_2: ON$

$$V_i = V_{CC} - R_1 \cdot i_D = 1,9V \quad 1^\circ$$

$$V_D = V_g - (V_{EE} + i_D R_2) = V_g - 1,2V$$

3a $V_g = 1,9V$ $D_1 \rightarrow ON$

$$V_i = V_g \quad 2^\circ$$



$$V_g = V_D$$

$$i_{R2} = \frac{V_g - V_{EE}}{R_2}$$

$$i_{R2} = \frac{V_g - V_D - V_{EE}}{R_2} = \frac{V_g + 4,3}{R_2}$$

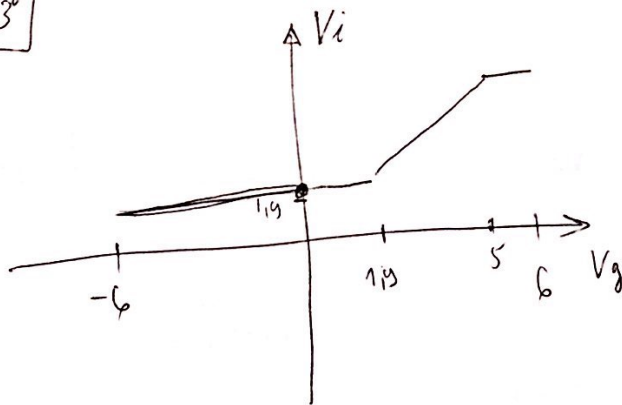
$$i_x = \frac{V_g - V_{CC}}{R_1}$$

$$i_{D2} = \frac{V_{CC} - V_g}{R_1} \quad 3a \quad V_g = 5V \quad D_2 \rightarrow OFF$$

$$i_D = i_x + i_{R2} = \frac{V_g + 4,3}{2R_1} + \frac{2(V_{CC} - V_g)}{2R_1} = \frac{V_g + 4,3 + 2V_{CC} - 2V_g}{2R_1}$$

$$i_D = \frac{-V_g + 14,3}{10k\Omega} > 0 \quad D_1 \text{ outside ON} \quad 3a \quad V_g = 14,3V \quad D_1 \rightarrow OFF$$

$$V_i = V_{CC} \quad 3^\circ$$



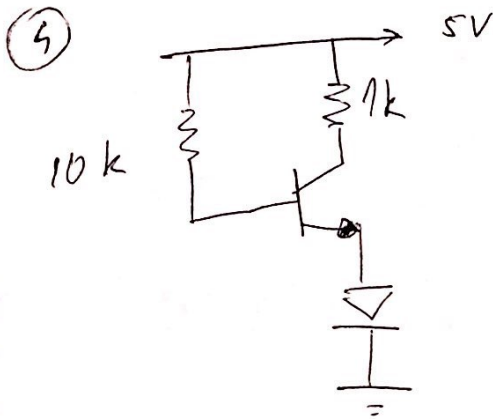
$$i_D = \frac{V_g - V_D}{R_2}$$

3) a) DC:
$$V_i = \frac{R_3}{R_1 + R_2} (V_2 - V_1) = 50(V_2 - V_1)$$

AC:
$$V_i = 100(V_2 - V_1)$$

$$V_2 - V_1 = 5\text{mV} - 35\text{mV}\sin\omega t$$

$$V_i = 0,25 - 3,5\text{V}\sin\omega t$$



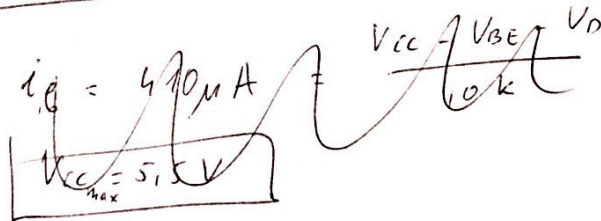
$$I_B = \frac{V_{CC} - V_{BE} - V_D}{10k} = 360\mu A$$

$$I_C = 36\text{mA} \Rightarrow V_C = -31\text{V}$$
 Q je y 3ac

$$V_C = 0,9\text{V}, I_C = 4,1\text{mA}$$

$$I_E = 4,46\text{mA}$$

$$V_{CC\text{min}} = 1,4\text{V}$$



$$\frac{V_{CC} - V_{BE} - V_D}{100} = \frac{V_{CC} - V_{CES} - V_D}{1000}$$

$$I_C = \frac{V_{CC} - 0,9}{1k} \cdot \beta$$

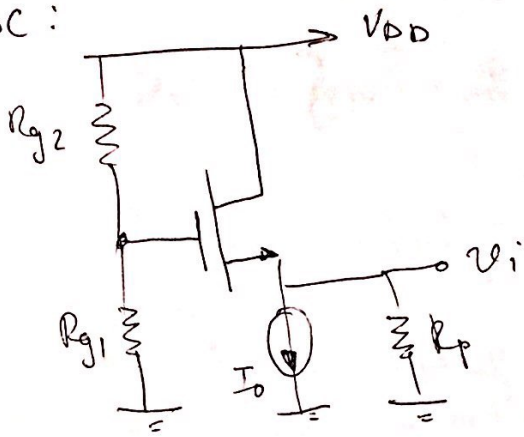
$$10V_{CC} - 10V_B - 10V_D = V_{CC} - V_{CES} - V_D$$

$$9V_{CC} = 10V_B + 9V_D - V_{CES}$$

$$V_{CC} = \frac{10V_B + 9V_D - V_{CES}}{9} = 1,4\text{V}$$

$$\frac{V_{CC} - V_{BE} - V_D}{10k}$$

DC :



$$V_s = I_x \cdot R_p$$

$$I_D = I_0 + I_x$$

$$V_G = 7V$$

$$I_0 + I_x = \frac{\beta}{2} (7V - I_x R_p + V_t)^2$$

$$I_0 + I_x = \frac{\beta}{2} (5 - 4000 I_x)^2$$

$$250 I_0 + 250 I_x = 4000^2 I_x^2 - 40000 I_x + 25$$

$$4000^2 I_x^2 - 40250 I_x + 24125 = 0$$

$$I_{x \frac{1}{2}} = \frac{40250 \pm 8250}{2 \cdot 4000^2} \Rightarrow \bar{I}_{x1} = \cancel{1515625} \text{ mA}$$

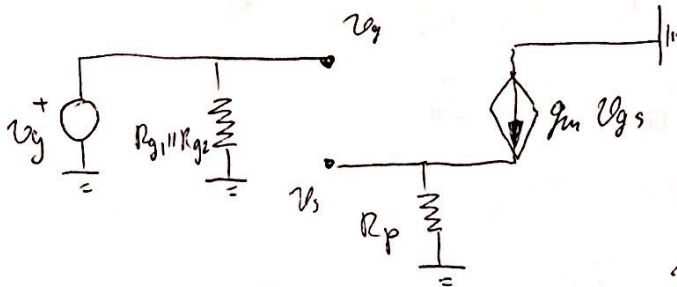
$$\boxed{I_{x2} = 1 \text{ mA}}$$

$$\boxed{V_{s2} = 4V}$$

$$\cancel{V_{s1} = 60625V}$$

$$\boxed{V_i = 4V}$$

$$g_m = 8 \text{ mS}$$



$$V_s = g_m V_g R_p - g_m V_s R_p$$

$$V_s (1 + g_m R_p) = g_m R_p \cdot V_g$$

$$V_s = \frac{g_m R_p}{1 + g_m R_p} \cdot V_g = V_i \quad V_{gs} = \frac{1}{1 + g_m R_p} V_g$$

$$V_i = \frac{0,97}{u} V_{gs}$$

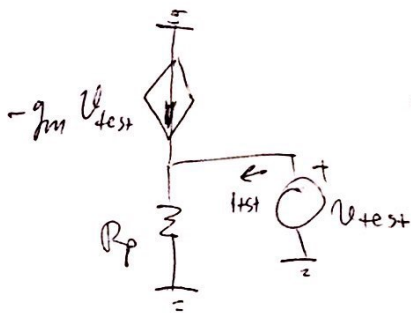
$$i_u = \frac{V_{gs}}{R_{g1} \parallel R_{g2}}$$

$$i_p = \frac{g_m}{1 + g_m R_p} \cdot V_g$$

$$\frac{i_p}{i_u} = \frac{\frac{g_m}{1 + g_m R_p}}{\frac{1}{R_{g1} \parallel R_{g2}}} = \frac{g_m \cdot \overbrace{R_{g1} \parallel R_{g2}}^{21 \text{ k}\Omega}}{1 + g_m R_p}$$

$$\boxed{-\alpha_i = 5,091}$$

$$R_{iZL} =$$



$$i_{test} = \frac{V_{test}}{R_p} + g_m V_{test} = V_{test} \left(g_m + \frac{1}{R_p} \right)$$

$$R_{iZL} = \left(g_m + \frac{1}{R_p} \right)^{-1} = 121,21 \Omega$$