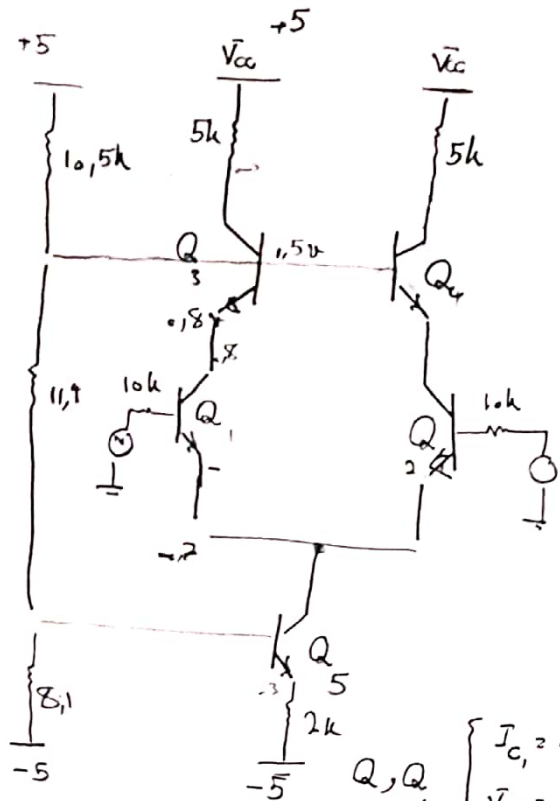


سوال/مسئله

تاریخ: ۹۷۱.۹۹۱۷

محل: ۵  
نام:                     



$$\bar{V}_{B5} = \frac{8.1}{5} \times 10 = -2.3$$

$$\bar{V}_E = -3V$$

$$I_{C5} = \frac{2.2}{2k} = 1mA$$

$$\bar{V}_{CE5} = -0.7 + 3 + 2.3V$$

$$\bar{V}_{B3} = \bar{V}_{B4} = 1.5V$$

$$5 - 0.5 \times 5k = 2.5$$

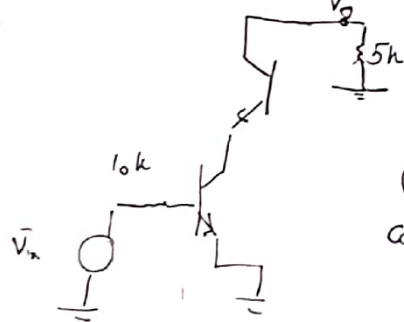
$$\left\{ \begin{array}{l} I_{C1} = 0.5mA \\ \bar{V}_{CE1} = 1.5V \end{array} \right. \quad Q_2, Q_1$$

$$\left\{ \begin{array}{l} I_{C3} = 0.5mA \\ \bar{V}_{CE3} = 1.7V \end{array} \right. \quad Q_3, Q_4$$

$$\left\{ \begin{array}{l} I_{C5} = 1mA \\ \bar{V}_{CE5} = 2.3V \end{array} \right. \quad Q_5$$

$$r_{\pi} = 7.5k$$

رابطه



$$A_{v_{cascode}} = \frac{-5k}{7.5k + 10k} = -42.9$$

$$\left\{ \begin{array}{l} R_{in} = 2 \times r_{\pi} = 15k \\ R_{out} = 2 \times 5k = 10k \end{array} \right.$$

محدود کننده  
محدود کننده

$$5k \times 5 = \bar{V}^+ = 2.5V$$

$$\bar{V}^- = 1.7 - 0.2 = 1.5V$$

$$2 \times (2.5 - 1.5) = 2V$$

$$\rightarrow 4V$$

(2)

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$$\bar{V}_{E, min} = \bar{V}_{EE} + \bar{V}_{CE, min}$$

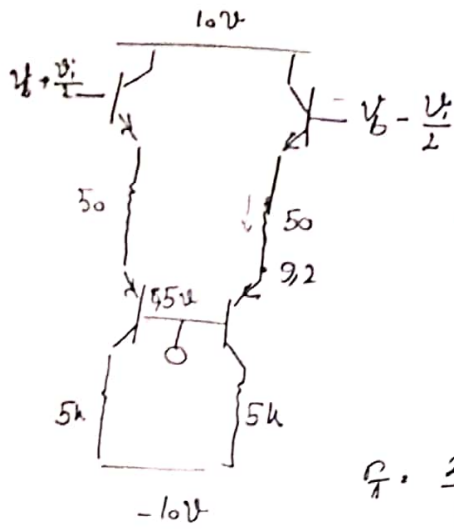
$$\bar{V}_{E, DC} = 3V \rightarrow \bar{V}_E > -2.8V$$

$$-2.1V < \bar{V}_m < 1.3V$$

$$\bar{V}_{E, max} = \bar{V}_{C1} - \bar{V}_{CE, max}$$

$$\rightarrow \bar{V}_{in, out} > -2.1V$$

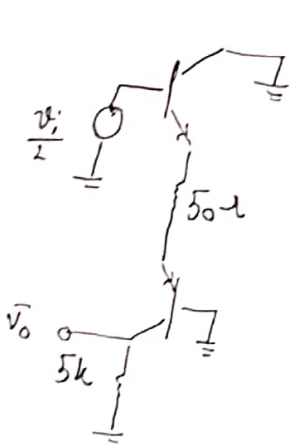
$$\bar{V}_{C, Q, max} = 0.8V \rightarrow \bar{V}_{in, out} < 1.3V$$



$$I_C = \frac{V_b - 9.2}{50} \approx 2mA$$

$$\rightarrow V_b \approx 10V$$

$$I_T = \frac{25mV}{2} \approx 1.25k\Omega$$

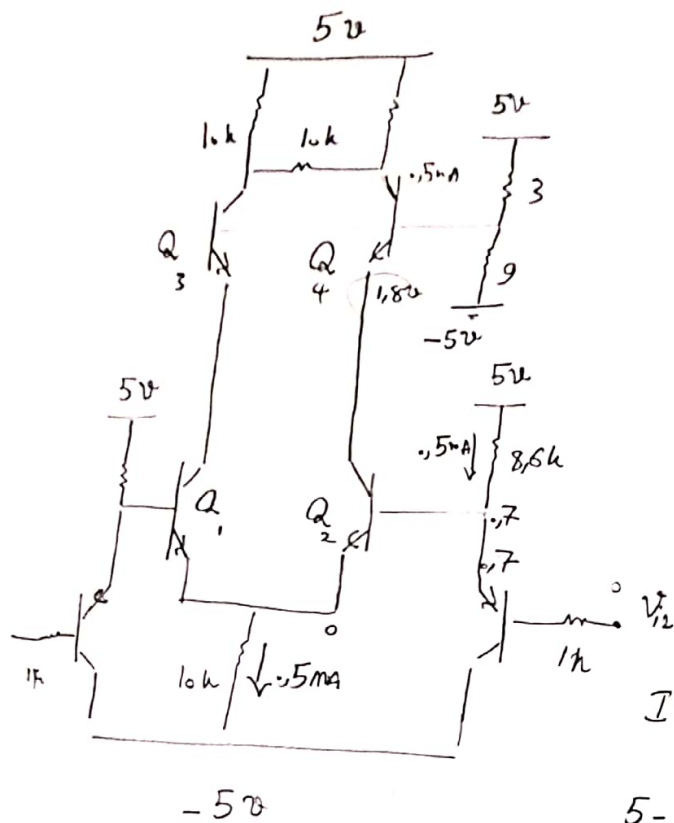


$$\rightarrow CE + \frac{50k}{50 + \frac{1250}{100}} \approx 1.8$$

$$\rightarrow CB + \frac{5k}{\frac{1.25k}{100}} \approx 400$$

$$\rightarrow \frac{V_o}{V_i} \approx 400 \times 1.8 \approx 720 \rightarrow \text{gain}$$

$$R_{in} = \frac{1.25}{1} + 100 \times \left( 50 + \frac{1.25}{100} \right) \approx 7.5k\Omega$$



$$\bar{V}_{B_3} = \bar{V}_{B_4} = \frac{9}{12} \times 10 + (-5) = 2.5V$$

$$\frac{5 - 0.7}{8.6} = 0.5mA$$

$$5 - 0.5 \times 8.6$$

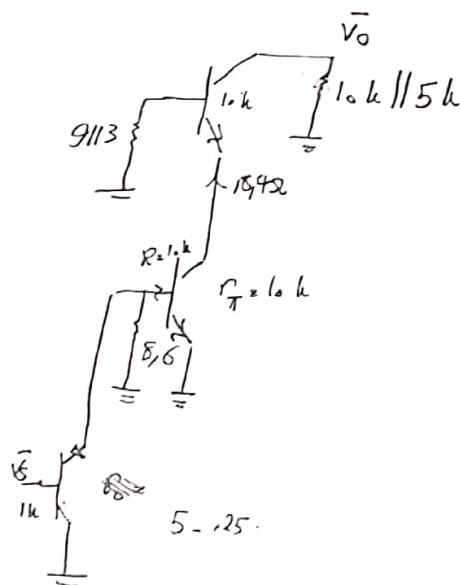
$$I_{C_2} = I_{C_1} = 0.25mA = I_{C_4} = I_{C_3}$$

$$5 - 10 \times 0.25 = 2.5$$

$$Q_2, Q_1 \begin{cases} I_{C_1} = 0.25mA \\ \bar{V}_{CE} = 1.8V \end{cases}$$

$$Q_3, Q_4 \begin{cases} I_{C_3} = 0.25mA \\ \bar{V}_{CE} = 2.5 - 1.8 = 0.7V \end{cases}$$

$$Q_5, Q_6 \begin{cases} I_{C_5} = 0.5mA \\ \bar{V}_{CE} = -5 - 0.7 = -5.7V \end{cases}$$



$$C_E = \frac{8.6 \parallel 10}{8.6 \parallel 10 + \frac{5k \parallel 1k}{100}} = 0.987$$

$$C_E = - \frac{18.42}{\frac{10k}{100}} = -0.184$$

$$C_B = + \frac{10 \parallel 5}{1.84 \parallel 9.13 \parallel 10} = +181.16$$

$$\rightarrow A_V = 32.9 \angle -33^\circ$$


$$\frac{\bar{V}_r}{1.0k \parallel 15k} = 2.125$$

$$\rightarrow \bar{V}_r = 2.183$$

$$\bar{V}_{DC} = 2.5V$$

$$\bar{V} = -0.5V$$

$$\rightarrow P_{D_1} = 0.3 \times 2 = 1V \rightarrow 1 \times 2 = 2V \rightarrow 2V$$

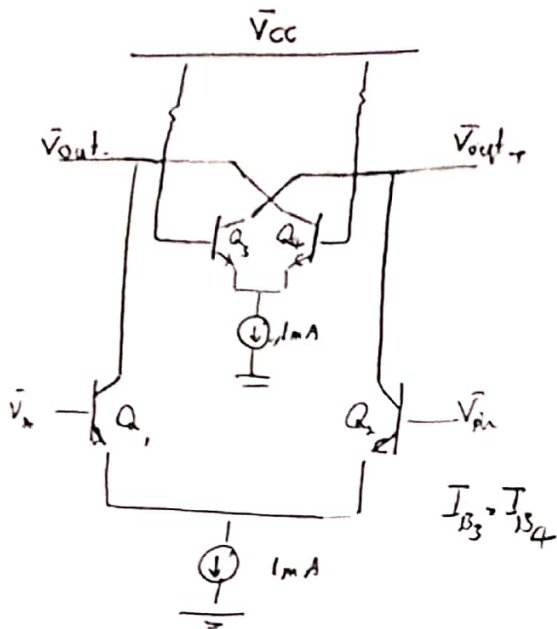
$$\bar{V}^+ = 0,83 \text{ V}$$


$$\bar{V}^- \rightarrow -0,88 \rightarrow \bar{V}_{CE} = 0,88 \cdot 2 = 1,76$$

$$\bar{V}_E = 1,5 \text{ V} \rightarrow \bar{V} = 1,5 + 7 = \underline{2,2 \text{ V}}$$

$$\frac{1}{1 + \eta} \left( \frac{R_6}{R_6 + R_5} \right)_{10} - 5 = 2,2$$

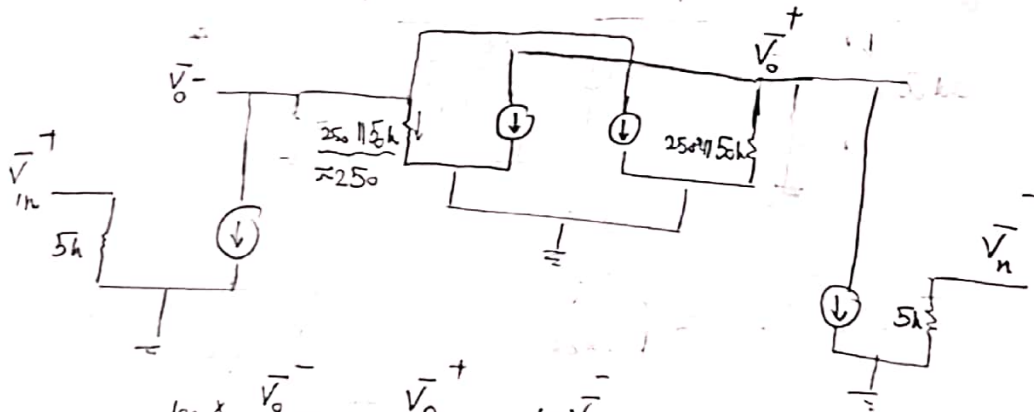
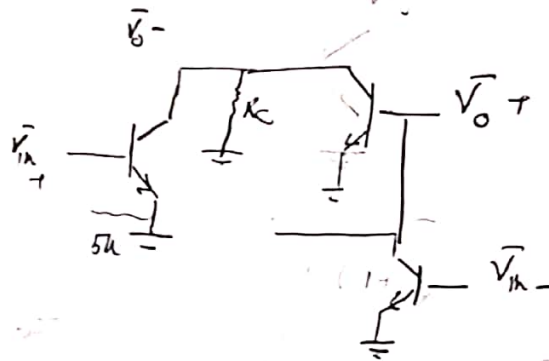
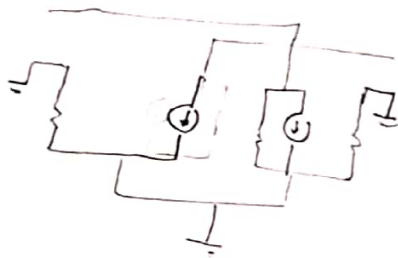
$$\frac{R_5}{R_6} = \frac{7}{18}$$



$$Q_1, Q_2 \quad I_{C2} = 5 \text{ mA}$$

$$C_E = \frac{-R_C}{\frac{r_T}{100}}$$

$$I_{B3} = I_{B4}$$



$$100 \times \frac{V_o^-}{50k} + \frac{V_o^+}{250} + \frac{100 V_{in}^-}{5k} = 0$$

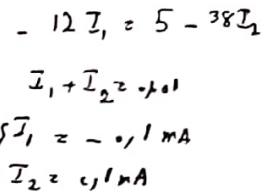
$$100 \times \frac{V_o^+}{50k} + \frac{V_o^-}{250} + \frac{100 V_{in}^+}{5k} = 0$$

$$\left( \frac{100}{50k} - \frac{1}{250} \right) (V_o^+ - V_o^-) + \frac{(V_{in}^+ - V_{in}^-) 100}{5k} = 0$$

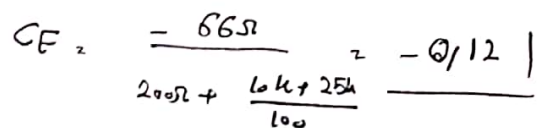
$$\rightarrow +2(V_o^+ - V_o^-) = 20(V_{in}^+ - V_{in}^-)$$

$$\rightarrow A_v = 10$$

سوال 15



$$Q_6 \begin{cases} I = .2 \text{ mA} \\ \bar{V} = 2.1 \text{ V} \end{cases} \quad Q_7 \begin{cases} I = .4 \text{ mA} \\ \bar{V} = 5 - 2.7 = 2.3 \text{ V} \end{cases}$$

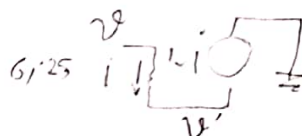


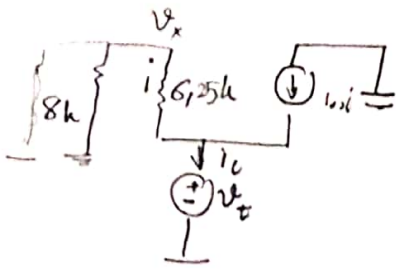
$$CB_2 + \frac{8,8h}{121,38425} = \frac{133,69}{100}$$

$$CE_z = \frac{8k \parallel 12.5k}{\frac{12.5k}{100}} = 64$$

$$- A_v = \frac{\bar{V}_o}{\frac{\bar{V}_d}{2}} = \frac{2V_o}{V_d} = 102,7$$

→ Ave  $\approx 513$





$$\left( \frac{v_t}{8 + 6.25} \right) (101) = i_o$$

$$\rightarrow r_{out} = \frac{8 + 6.25}{101} = 141 \Omega$$

(ج) چون طبقه آخر  $A_v$  نزدیک 1 می باشد باید برای سربس به طبقه اول قبلی سر درواز

$$Q_7 \rightarrow v_o^+ < 2.1$$

$$Q_6 \rightarrow \bar{V}_{CE_6} = 2.1V$$

$$\rightarrow \bar{V}_2 = (2.1 - 2) = 1.9V$$

$$V^+ = 8k \times 0.2mA = 1.6V$$

$$\rightarrow \text{swing P-P} = 2 \times 1.6 = 3.2V$$

$$\bar{V}_E = -1.71 + \bar{V}_{in}$$

$$\bar{V}_{CE_1} = 1.21 + \bar{V}_{in} > 0.2 \rightarrow \underline{|\bar{V}_1| > \bar{V}_{in}}$$

$$\bar{V}_{CE_1}, \bar{V}_E = -1.7 + \bar{V}_{in}$$

$$-1.7 + \bar{V}_{in} + 5 = 4.7 + \bar{V}_{in} > 0.31$$

$$1 > \bar{V}_{in} > -4$$

$$\rightarrow 1V > \bar{V}_{in} > -4V$$

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