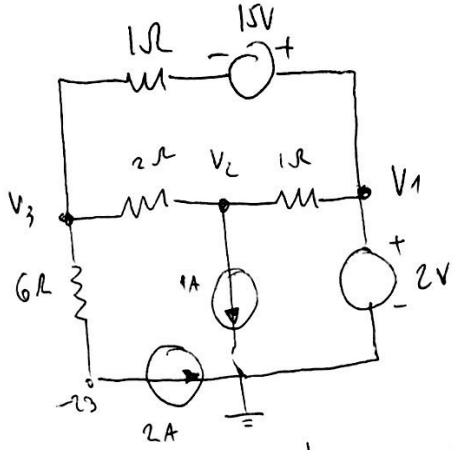


①



$V_1 = 2V$

$$V_2 \left(1 + \frac{1}{2}\right) - V_1 - \frac{1}{2} V_3 = -1$$

$$3V_2 - 2V_1 - V_3 = -2$$

$$\boxed{3V_2 - V_3 = 2}$$

$$V_3 \left(\frac{1}{2} + \frac{1}{6}\right) - \frac{1}{2} V_2 - \frac{1}{6} V_1 = -15 - 2 \quad | \cdot 2$$

~~$$1 \textcircled{1} V_3 - 3V_2 - 6V_1 = -102$$~~

~~$$1 \textcircled{2} V_3 - 3V_2 = -90$$~~

~~$$3V_2 - V_3 = 2$$~~

~~$$3V_3 = -88$$~~

$$3V_3 - V_2 = -30$$

$$9V_2 - 3V_3 = 6$$

$$8V_2 = -24$$

$$\boxed{V_2 = -3V}$$

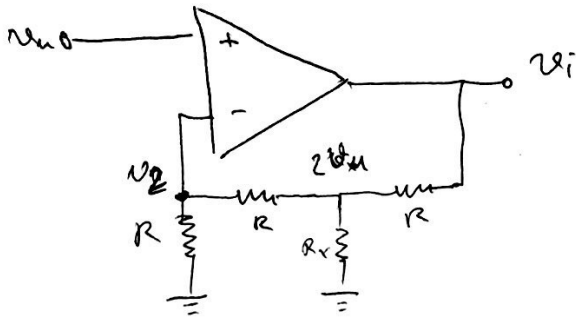
$$\boxed{V_3 = -11V}$$

- $I_B = -4A$
- $I_D = -3A$
- $I_C = 5A$
- $I_A = -2A$
- $P_{1A} = 3W$
- $P_{2V} = 6W$
- $P_{15V} = 30W$
- $P_{2A} = 46W$

$V_T = 8V$
 $R_T = 2\Omega$

$I_N = 4A$
 $R_N = 2\Omega$

③



$$\frac{v_i - 2v_u}{R} = \frac{2v_u}{R} + \frac{v_u}{R}$$

$$v_i = 5v_u$$

$$v_r = 5$$

$$\frac{v_i - 2v_u}{R} = \frac{2v_u}{R_x} + \frac{v_u}{R}$$

$$v_i = 3v_u + \frac{2R}{R_x} v_u = v_u \left(3 + \frac{2R}{R_x} \right)$$

$$3(v_u - v_2) = v_i$$

$$\frac{v_i - 2v_2}{R} = \frac{v_2 + v_2}{R}$$

$$v_u - \frac{v_i}{3} = v_2$$

$$v_i = 5v_2$$

$$v_i = 5 \cdot v_u - \frac{5}{3} v_i$$

$$v_i \cdot \frac{8}{3} = 5 \cdot v_u$$

$$v_i = \frac{15}{8} v_u$$

$$A_v = \frac{15}{8}$$

$$\beta = \frac{1}{5}$$

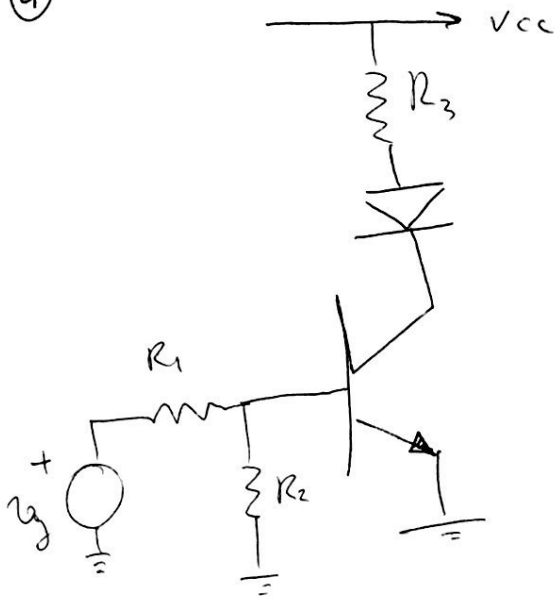
$$v_i = \frac{3}{1 + \frac{3}{5}} v_u$$

$$3 + \frac{2 \cdot R}{R_x} = 6$$

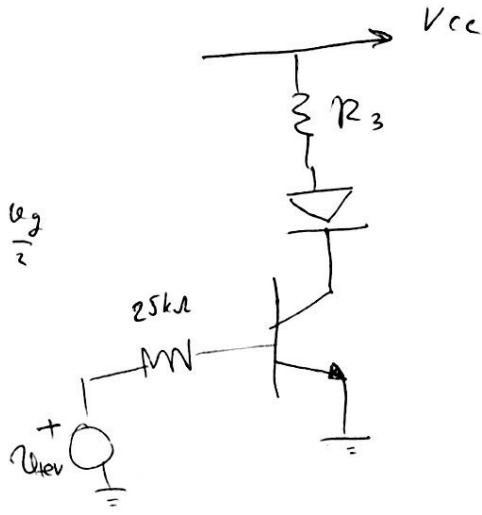
$$\frac{2R}{R_x} = 3$$

$$R_x = 2k\Omega$$

4



$$V_{tev} = \frac{V_g}{2}$$



$\bar{m}_j = 39$ $V_{tev} \in (0, 0.16)$ $Q: 300$, $D: OFF$
 $\bar{m}_j = 39$ $V_g \in (0, 1.2)$

$$\frac{V_g}{2} - i_B \cdot 25k\Omega - V_{BE} = 0$$

$$i_B = 56 \mu A$$

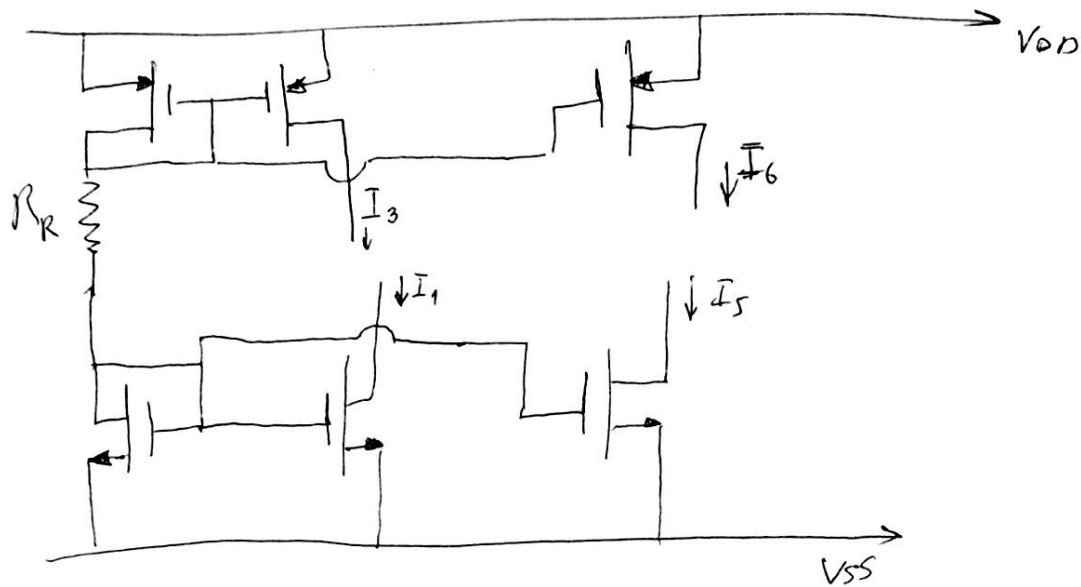
$$V_B = 0.16 V$$

$\bar{m}_i : Q: 300 \quad D: ON$

$$V_C = 0.12 V$$

$$\frac{V_{CC} - 0.19}{R_3} = i_C = 4.1 mA$$

$$I_4 = I_2 \quad I_3 = 4I_2 \quad I_1 = 2I_2 \quad I_5 = 5I_2 = I_6$$



$$V_{DD} - V_{G4} = \sqrt{\frac{2I}{B_{n4}}} + V_t$$

$$V_{G2} - V_{SS} = \sqrt{\frac{2I}{B_{n2}}} + V_t$$

$$V_{G4} - V_{DD} = -\sqrt{\frac{2I}{B_{n4}}} - V_t$$

$$V_{G4} - V_{G2} = 10 - 10$$

$$V_{SS} - V_{G2} = -\sqrt{\frac{2I}{B_{n2}}} - V_t$$

$$V_{G4} - V_{G2} = R_R \cdot I$$

$$V_{G4} - V_{G2} = 20 - 2\sqrt{\frac{2I}{B}} - 2V_t$$

$$R_R \cdot I = 20 - 2\sqrt{\frac{2I}{B}} - 2V_t$$

$$R_R I - 18 = 2\sqrt{\frac{2I}{B}}$$

$$3500 I - 9 = \sqrt{\frac{2I}{B}}^2$$

$$3500^2 I^2 - 67000 I + 81 = \frac{2I}{B} = 2000 I$$

$$3500^2 I^2 - 65000 I + 81 = 0$$

$$I_{1/2} = \frac{65000 \pm 16000}{2 \cdot 3500^2}$$

$$I_1 = 31306 \mu A$$

$I_2 = 2 \text{ mA}$	$I_4 = 2 \text{ mA}$	$I_3 = 8 \text{ mA}$	$I_5 = I_6 = 10 \text{ mA}$
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