SEMICONDUCTOR (SLOT- B1 + TB1)

DA-3

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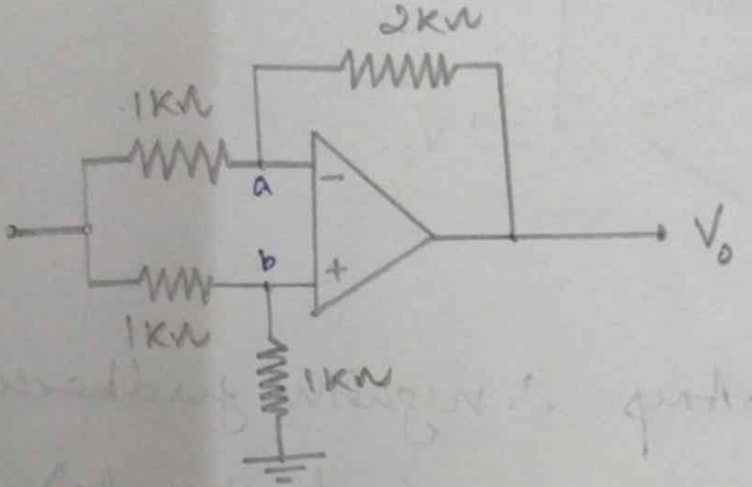
① The ideal op Amp is used. V_0 = ___ ?



Sol^n: Here, Op Amp in negative feedback

$\therefore V^+ = V^-$ (Virtual short)

$\therefore V_b = \frac{1 \times 1\,k\Omega}{(1+1)\,k\Omega} = 0.5\ V$ (voltage division across two 1kΩ resistance)

$\therefore V^+ = V^- = 0.5\,V$

Now, at node a, nodal analysis,

$$\frac{-V_a + 1}{1k\Omega} = \frac{V_a - V_0}{2k\Omega} \quad (\because V_a = V^- = 0.5V)$$

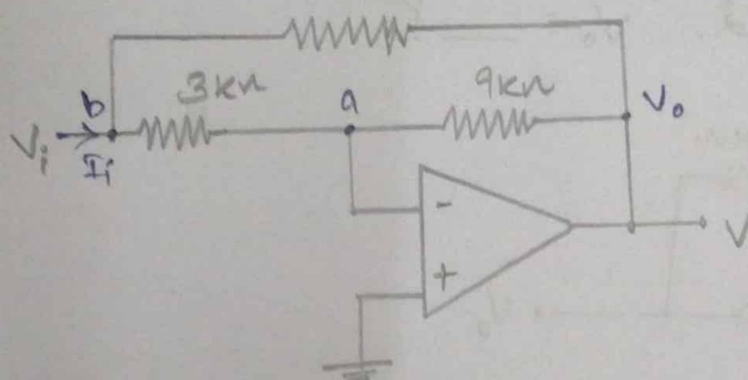
$\Rightarrow 2(-0.5+1) = 0.5 - V_0$

$\Rightarrow 1 - 0.5 = -V_0$

$\boxed{\therefore V_0 = -0.5V}$

Ans

Q2 Assume OpAmp to be ideal. The input resistance of the circuit is ___



Sol^n: Here, ideal opAmp ∴ negative feedback

$$V^+ = V^- = 0V \quad (\text{virtual short})$$

$$\boxed{V_a = 0V} \quad (1)$$

Assume, I_i input current

Now, current across 3kΩ & 9kΩ will be same as they are in series.

$$\therefore \frac{V_i - V_a}{\cancel{3k\Omega}} = \frac{V_a - V_o}{3\,\cancel{9k\Omega}} \Rightarrow 3V_i = -V_o$$

$$\boxed{\therefore V_o = -3V_i} \quad (2)$$

Now, Applying KCL at node b,

$$I_i = \frac{V_i - V_a}{3k\Omega} + \frac{V_i - V_o}{6k\Omega} \quad \text{| substituting values (1) \& (2)}$$

$$\Rightarrow I_i = \frac{V_i - 0}{3k\Omega} + \frac{V_i + 3V_i}{6k\Omega}$$

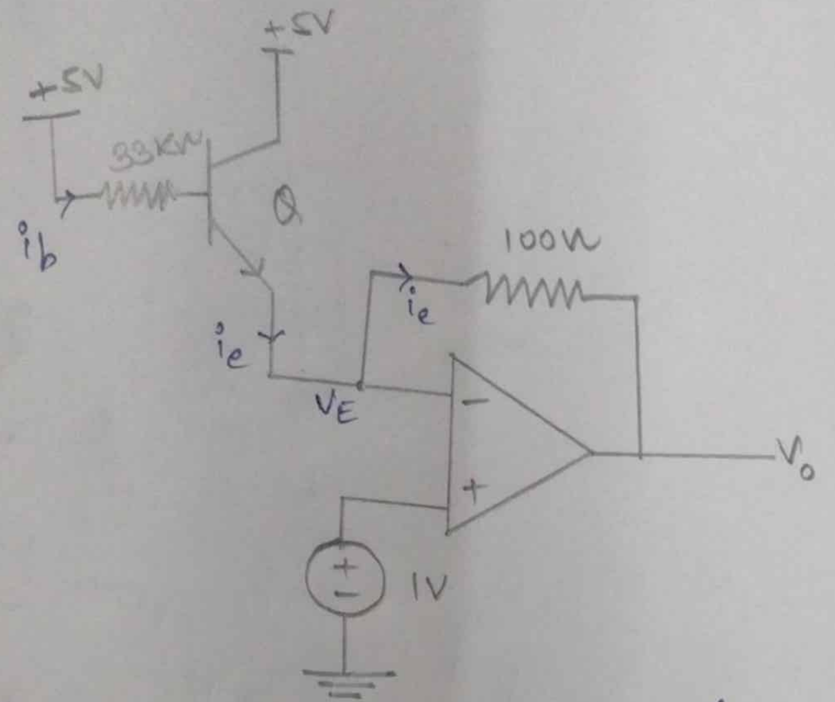
$$\Rightarrow I_i = \frac{V_i}{3k\Omega} + \frac{4V_i}{6k\Omega} \Rightarrow I_i = \frac{6V_i}{6k\Omega}$$

$$\Rightarrow \frac{V_i}{I_i} = 1k\Omega \quad \text{i.e.} \boxed{R_i = 1k\Omega} \text{ Ans}$$

Input resistance is 1kΩ

Ans

(Q3) Assuming $V_{BE} = 0.7V$ & $\beta = 99$ of transistor Q. output voltage V_o in ideal opAmp circuit is ______ .



Solⁿ: Here opAmp in negative feedback

$\therefore V^+ = V^- = 1V = V_E$ (virtual short)

Therefore In BJT,

$$i_b = \frac{V_{BB} - V_{BE} - V_E}{R_B} = \frac{5 - 0.7 - 1}{33K\Omega}$$

$$\boxed{i_b = 0.10\,mA}$$

Now, $i_e = (1+\beta) i_b$

$= 100\, i_b = 10\,mA$ $\quad \boxed{\therefore i_e = 10\,mA}$

Now, this i_e will flow throw 100Ω resistance

$\therefore$ we can say, $\frac{V_E - V_o}{100\Omega} = 10\,mA$

$\Rightarrow 1 - V_o = \frac{\cancel{10}}{\cancel{1000}} \times \cancel{100} \Rightarrow 1 - V_o = 1$

$$\boxed{\therefore V_o = 0V}$$

Ans

Hence, output will be 0V.