EE210: Analog Electronics - Quiz 2

NAME (in capital)	Roll No

Time: 15 minutes

1) : Consider the circuit in Fig. 1. $I_B = 2mA$, $V_{in} = 0$, $R = 1k\Omega$. The I-V characteristics of the non-linear element, E is given by $I_N = \alpha {V_N}^2$, for $V_N \geq 0$, and $I_N = 0$ for $V_N < 0$, where $\alpha = 1mA/V^2$.

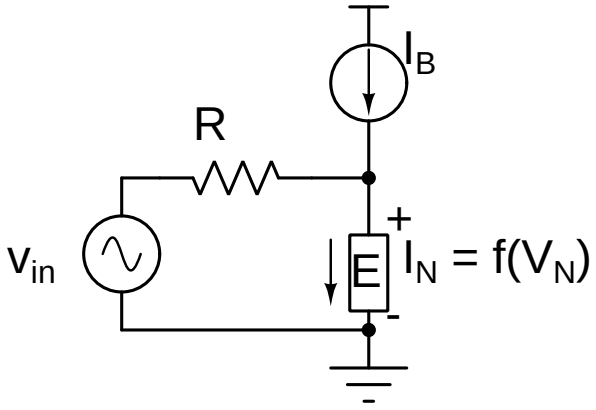


Fig. 1. Problem 1

a) : Find the quiescent current through E. **[4]**

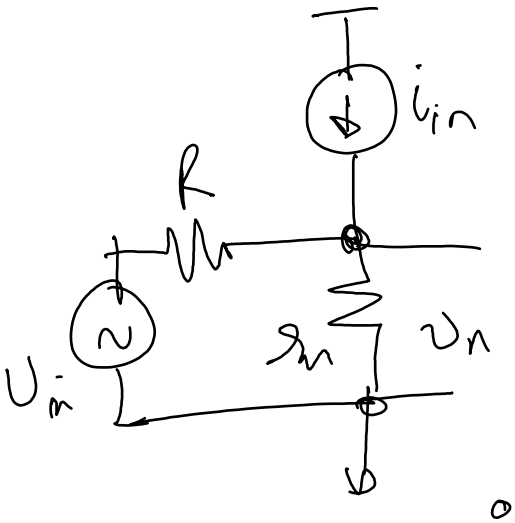
KCL @ V_N $\Rightarrow$ $I_B = \frac{V_N}{R} + \alpha V_N^2$

$\Rightarrow 2m = 1m\, V_N + 1m\, V_N^2$

$\Rightarrow V_N = 1V$ or $-2V$ $\Rightarrow$ Not possible as per condition.

$\therefore$ $I_N = 1mA$

b) : Assume $I_B = 2mA + 0.2mA\sin(\omega t)$ and $v_{in} = 100mV\sin(\omega t)$. Find the total voltage across the non-linear element. **[6]**



$$R_N = \frac{1}{(\partial I/\partial V)_{V_N = 1V}} = \frac{1}{2\alpha V_N} = 0.5\,k\Omega$$

$$\therefore v_N = U_{in}\frac{R_N}{R + R_N} + i_{in}\frac{R\,R_N}{R_N + R}$$

$$= \frac{R_N}{R_N + R}\left(U_{in} + i_{in}R\right)$$

$$= \frac{1}{3}\left(0.1 + 0.2\right)V\sin(\omega t)$$

$$= 100mV\sin(\omega t)$$

$$U_N = 1V + 100mV\sin(\omega t)$$