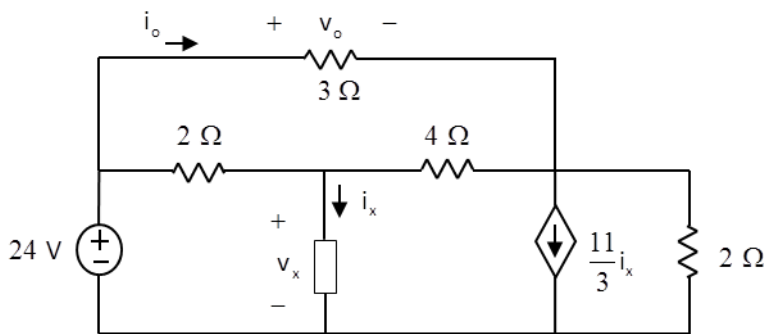# HOMEWORK V

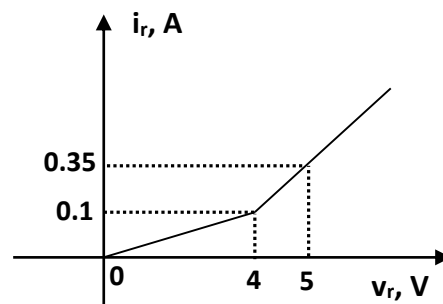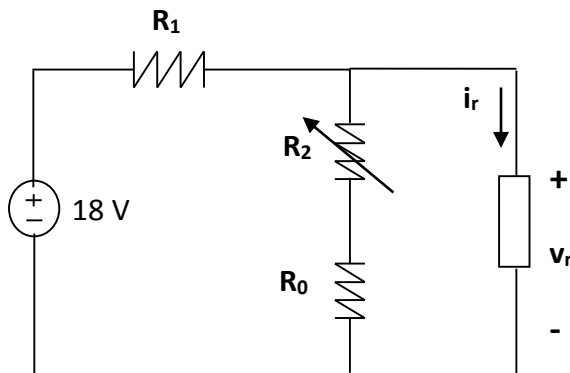**Question 1** Find the current i_o in the circuit below.

$$i_x = \begin{cases} \dfrac{3}{8} v_x^2, & v_x \geq 0 \\ 0, & v_x < 0 \end{cases}$$
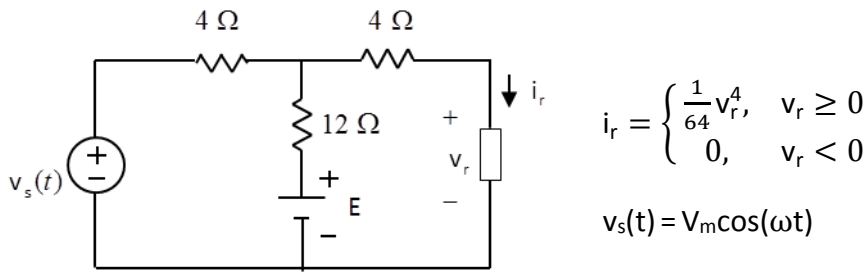
Answer $i_o = 12$ A.

Question 2 In the circuit given below, the resistor R_2 can take any value in the range $[0, +\infty]$. Determine the R_1 and R_0 values so that the current through the nonlinear element is limited to the range 100 mA $\leq i_r \leq 600$ mA whatever the R_2 value is.
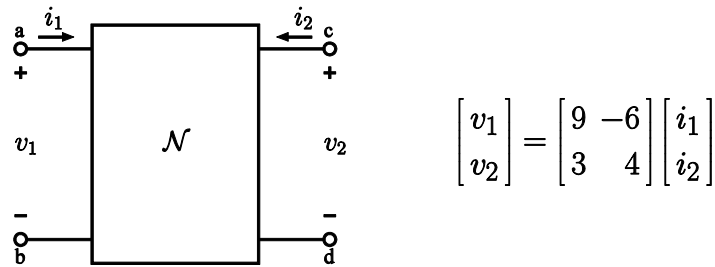

Answer $R_1 = 20$ Ω, $R_0 = 20/3$ Ω.

Question 3 Consider the circuit given below.

$$i_r = \begin{cases} \frac{1}{64}v_r^4, & v_r \geq 0 \\ 0, & v_r < 0 \end{cases}$$

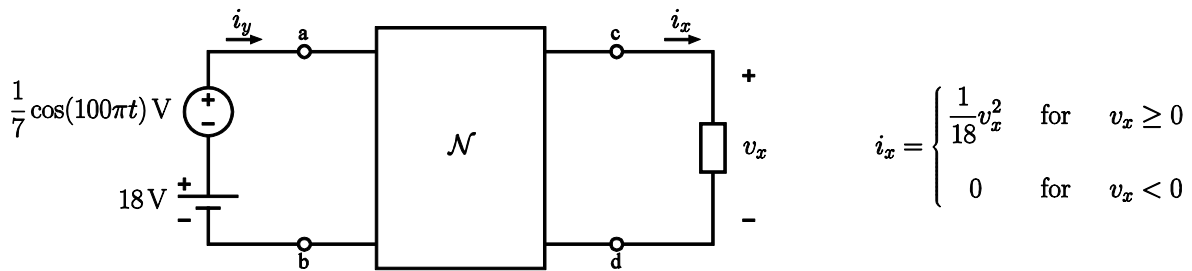$$v_s(t) = V_m\cos(\omega t)$$

Given $v_r(t) \cong 2 + 0.15\cos(\omega t)$ V, find E and V_m.

Answer   E = 15 V, V_m = 0.9 V.

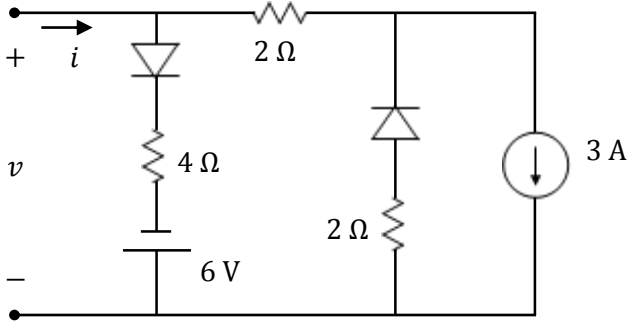**Question 4** Consider the following two-port circuit.

$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 9 & -6 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

Find (approximately) the current $i_y(t)$ in the below circuit.

$$i_x = \begin{cases} \frac{1}{18}v_x^2 & \text{for} & v_x \geq 0 \\ 0 & \text{for} & v_x < 0 \end{cases}$$
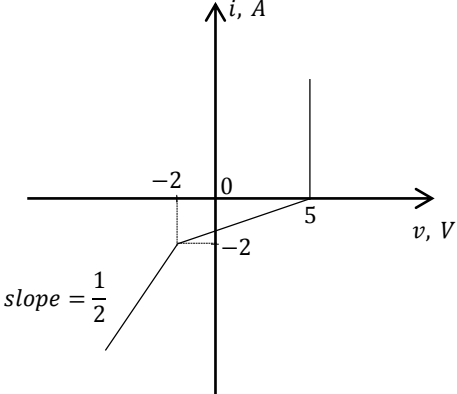
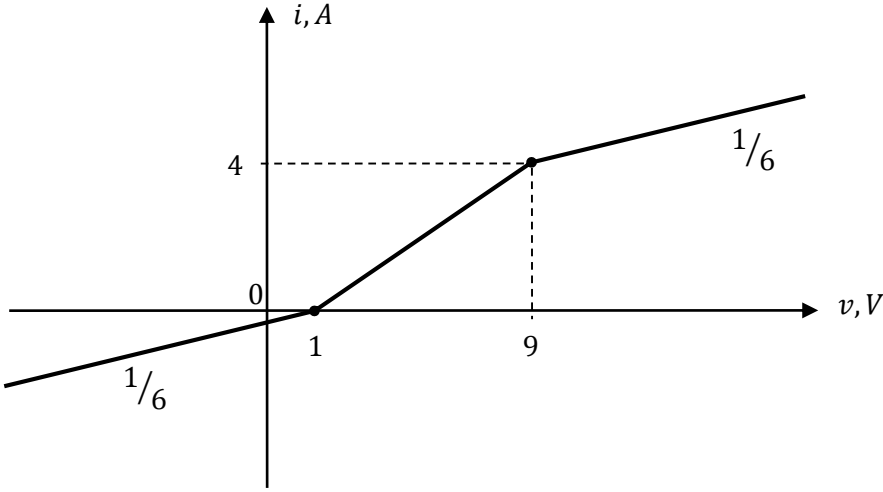*Answer* $i_y(t) \cong (5/3) + (1/81)\cos(100\pi t)$ A.

Question 5 Given the following one-port circuit with ideal diodes, obtain and sketch the port, i.e. the i - v, characteristic.

Question 6 Design one-port circuits realizing the given i - v characteristics. The available elements are LTI passive resistors, constant independent sources, and ideal diodes.

(a)

(b)