PYQ Solution [IIT-JAM]

(Chapter 1 Kirchhoff's Law)

Ans. 1: (d)

Solution: Since R_L and $2R_L$ are in parallel so load $R = \frac{R_L \times 2R_L}{R_L + 2R_L} = \frac{2}{3}R_L$.

Power through load $P = I^2 R = \left(\frac{\varepsilon}{r_i + R}\right)^2 R$

For maximum power through load

$$\frac{dP}{dR} = 0 \Rightarrow \frac{(r_i + R)^2 \varepsilon^2 - \varepsilon^2 R \times 2(r_i + R)}{(r_i + R)^4} = 0 \Rightarrow (r_i + R) - 2R = 0 \Rightarrow R = r_i$$

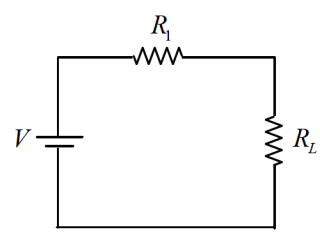
Thus, $R = r_i \Rightarrow \frac{2}{3}R_L = r_i \Rightarrow R_L = \frac{3}{2}r_i$

PYQ Solution [GATE]

Ans. 1: 22.09

Solution: For dc voltage source

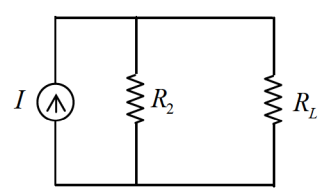
$$P_{total} = \frac{V^2}{R_1 + R_L} \text{ and } P_{R_L} = \left(\frac{V}{R_1 + R_L}\right)^2 R_L$$



$$\eta_{dc\ vol} = \frac{P_{R_L}}{P_{total}} = \frac{R_L}{R_1 + R_L}$$

For dc current source

$$P_{total} = I^2\left(\frac{R_2 R_L}{R_2 + R_L}\right) \text{ and } P_{R_L} = I_L^2 R_L = \left(\frac{R_2 I}{R_2 + R_L}\right)^2 R_L$$



$$\eta_{dc\ curr} = \frac{P_{R_L}}{P_{total}} = \frac{R_2}{R_2 + R_L}$$

Since $\eta_{dc\ vol} = \eta_{dc\ curr}$

$$\Rightarrow \frac{R_L}{R_1 + R_L} = \frac{R_2}{R_2 + R_L} \Rightarrow R_L(R_2 + R_L) = R_2(R_1 + R_L) \Rightarrow R_1 R_2 = R_L^2$$

$$\Rightarrow R_1 R_2 = (4.7)^2 = 22.09\ \Omega^2$$

Ans. 2: (d)

Solution: $I_0 = \frac{CdV_0}{dt} \Rightarrow V_0 = \frac{I_0}{C}t$