

Here, Room temperature = $27^{\circ}\text{C} = 300\text{K}$

$$V_D = ?$$

$$I_D = 12\text{mA}$$
$$= 12 \times 10^{-3}\text{A}$$

$$I_S = 10\text{mA}$$
$$= 10 \times 10^{-6}\text{A}$$

We know,

$$V_T = \frac{KT}{q} = \frac{1.36 \times 10^{-23} \times 300}{1.6 \times 10^{-19}}$$

$$= 0.0255\text{V} //$$

Now,

$$\frac{I_D}{I_S} = e^{\frac{V_D}{nV_T} - 1} \quad \text{or,} \quad \frac{I_D}{I_S} = e^{\frac{V_D}{0.255 \times 2} - 1}$$

$$\text{or,} \quad \frac{12 \times 10^{-3}}{10 \times 10^{-6}} = e^{\frac{V_D}{0.51} - 1}$$

$$\text{or,} \quad \frac{12 \times 10^{-3}}{10 \times 10^{-6}} + 1 = e^{\frac{V_D}{0.51}}$$

$$\text{or,} \quad 1201 = e^{\frac{V_D}{0.51}}$$

$$\text{or,} \quad \frac{V_D}{0.51} = \ln(1201)$$

$$\text{or,} \quad V_D = \ln(1201) \times 0.51$$

$$\text{or,} \quad V_D = 0.36\text{V across diode.}$$