

Question 4a

Thermal voltage at 25°C

$$V_T = \frac{kT}{q}$$

At a temperature of 25°C (approximately 300K), the thermal voltage \Rightarrow

$$V_T = 0.026\text{ V}$$

Therefore, the thermal voltage at 25°C is 0.026 V

(4b) Saturation current

$$I_S = 40\text{ nA} = 40 \times 10^{-9}\text{ A}$$

Ideality factor $n = 2$

Applied voltage, $V_D = 0.5\text{ V}$

Thermal voltage $V_T = 0.026\text{ V}$

The diode current equation is

$$I_D = I_S \left(e^{\frac{V_D}{nV_T}} - 1 \right)$$

Substitute

$$I_D = 40 \times 10^{-9} \left(e^{\frac{0.5}{2 \times 0.026}} - 1 \right)$$

$$I_D = 40 \times 10^{-9} \left(e^{9.62} - 1 \right)$$

$$e^{9.62} \approx 15000$$

$$I_D = 40 \times 10^{-9} \times 15000$$

$$= 6.0 \times 10^{-4}\text{ A}$$

Therefore the diode current is approximately 0.6 mA .