



**THE DOPPING GAME**

The image features the title 'THE DOPPING GAME' in a bold, red, bubbly font. The word 'DOP' is written on a white, torn-edge paper strip that is tilted diagonally across the middle of the title. The background is white and decorated with several colorful, stylized five-petaled flowers in shades of yellow, green, orange, blue, and purple. The overall style is playful and childlike.

# Contestant 1

$$N_a = 1 \times 10^{16} \text{cm}^{-3} \quad N_d = 1 \times 10^{16} \text{cm}^{-3}$$

$$qV_o = kT \ln \left( \frac{N_d N_a}{n_i^2} \right) = 0.0259 * \ln \left( \frac{1 \times 10^{16} * 1 \times 10^{16}}{(1.5 \times 10^{10})^2} \right)$$

$$qV_o = 0.695 \text{eV} \quad V_o = 0.695 \text{V}$$

$$W = \sqrt{\frac{2\epsilon V_o}{q} \left( \frac{N_d + N_a}{N_d N_a} \right)} = \sqrt{\frac{2 * 11.8 * 8.85 \times 10^{-14} * 0.695}{1.6 \times 10^{-19}} \left( \frac{1 \times 10^{16} + 1 \times 10^{16}}{1 \times 10^{16} * 1 \times 10^{16}} \right)}$$

$$W = 0.378 \mu\text{m}$$

# Contestant 2

$$N_a = 1 \times 10^{16} \text{cm}^{-3} \quad E_c - E_F = 0.25 \text{eV}$$

$$n_o = N_c e^{-(E_c - E_F)/kT}$$

$$N_c = 2 \left( \frac{2\pi m_n^* kT}{h^2} \right)^{1.5} = 2.87 \times 10^{25} \rightarrow [m^{-3}]$$

$$n_o = 2.87 \times 10^{19} e^{-.25/.0259} = 1.6 \times 10^{15} \text{cm}^{-3}$$

$$qV_o = kT \ln \left( \frac{N_d N_a}{n_i^2} \right) = 0.0259 * \ln \left( \frac{1 \times 10^{16} * 1.6 \times 10^{15}}{(1.5 \times 10^{10})^2} \right)$$

$$qV_o = 0.651 \text{eV} \quad V_o = 0.651 \text{V}$$

$$W = \sqrt{\frac{2\epsilon V_o}{q} \left( \frac{N_d + N_a}{N_d N_a} \right)} = \sqrt{\frac{2 * 11.8 * 8.85 \times 10^{-14} * 0.65}{1.6 \times 10^{-19}} \left( \frac{1 \times 10^{16} + 1.6 \times 10^{15}}{1 \times 10^{16} * 1.6 \times 10^{15}} \right)}$$

$$W = 0.718 \mu\text{m}$$

# Contestant 3

$$N_a = 1 \times 10^{16} \text{cm}^{-3} \quad E_F - E_i = 0.285 \text{eV}$$

$$n_o = n_i e^{(E_F - E_i)/kT}$$

$$n_o = 1.5 \times 10^{10} e^{0.285/0.0259} = 9.015 \times 10^{14} \text{cm}^{-3}$$

$$qV_o = kT \ln \left( \frac{N_d N_a}{n_i^2} \right) = 0.0259 * \ln \left( \frac{1 \times 10^{16} * 9 \times 10^{14}}{(1.5 \times 10^{10})^2} \right)$$

$$qV_o = 0.632 \text{eV} \quad V_o = 0.632 \text{V}$$

$$W = \sqrt{\frac{2\epsilon V_o}{q} \left( \frac{N_d + N_a}{N_d N_a} \right)} = \sqrt{\frac{2 * 11.8 * 8.85 \times 10^{-14} * 0.63}{1.6 \times 10^{-19}} \left( \frac{1 \times 10^{16} + 9 \times 10^{14}}{1 \times 10^{16} * 9 \times 10^{14}} \right)}$$

$$W = 0.999 \mu\text{m}$$