Useful formulae:

1. Concentration of electrons in CB:

$$n_o = N_c \exp\left[-\frac{E_c - E_F}{kT}\right]$$

$$N_C = 2\left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/2}$$

where,

2. Concentration of holes in VB:

$$p_o = N_V \exp\left[-\frac{E_F - E_V}{kT}\right]$$

where,

$$N_V = 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2}$$

3. For *n*-type semiconductor:

$$n = n_i e^{(E_{Fn} - E_i)/kT}$$

4. For *p*-type semiconductor:

$$p = n_i e^{(E_i - E_{Fp})/kT}$$

5. Carrier concentration equation:

$$n = \frac{N_D - N_A}{2} + \left[\left(\frac{N_D - N_A}{2}\right)^2 + n_i^2\right]^{1/2}$$

$$p = \frac{N_A - N_D}{2} + \left[\left(\frac{N_A - N_D}{2}\right)^2 + n_i^2\right]^{1/2}$$

6. Total diffusion current density:

$$J = q\left(D_n \frac{dn}{dx} - D_p \frac{dp}{dx}\right)$$

9. Current density in a solar cell: $$J = J_0\left(e^{qV/kT} - 1\right) - J_{sc}$$

10. Saturation Current Density: $$J_0 = \frac{qD_p p_{n0}}{L_p} + \frac{qD_n n_{p0}}{L_n} = \frac{qD_p n_i^2}{L_p N_d} + \frac{qD_n n_i^2}{L_n N_a}$$

PHYSICAL CONSTANTS:

Charge of electron, $\boldsymbol{q} = 1.602 \times 10^{-19}$ Coulomb

Electron rest mass, $\boldsymbol{m_0} = 9.108 \times 10^{-31}$ kg

Velocity of light, $\boldsymbol{C} = 3 \times 10^{8}$ m/s

Permittivity of free space = 8.854×10^{-12} Farad/m

Planck's constant, $\boldsymbol{h} = 6.625 \times 10^{-34}$ Joule-s

Boltzmann Constant, $k = 8.62 \times 10^{-5}$ eV/K