✓ Planck's constant =6.626×10^{-34} J-s, Boltzmann's constant = 1.38×10^{-23} J/K or 8.62×10^{-5} eV/K.

✓ electron charge = 1.602 x 10^{-19} C , electron mass = 9.11 x 10^{-31} kg

1. A stick with length 1m moves parallel to its length with speed 0.8c relative to you.　　**(20%)**
   (a) Find the length of the stick measured by you ?
   (b) How long does it take for the stick to pass you (in m/c unit) ?

2. The threshold wavelength for Copper is 264 nm.　　**(20%)**
   (a) What is the work function for Copper (in eV unit) ?
   (b) What is stopping potential when light of λ = 200 nm is used ?

3. A photon with wavelength $\lambda = \dfrac{h}{mc}$ is scattered elastically by an electron at rest, where m is the mass of electron, c is the speed of light and h is the Plank constant. What is the maximum possible momentum of the electron after scattering (in mc unit) ?　　**(10%)**

4. A particle of mass $\boldsymbol{m}$ with energy E is trapped inside an asymmetric potential well ($0 < E < V_o$) given by

   $$V(x) = \begin{cases} \infty & x < 0 \quad \text{(region I)} \\ 0 & 0 < x < a \ \text{(region II)} \\ V_o & x > 0 \quad \text{(region III)} \end{cases}$$　　**(20%)**

   (a) What is the form of wave function of this particle in regions I, II and III? You need to define all symbols used and give explanation.
   (b) Please sketch the wave functions for the ground state in three regions and compare the probability to find this particle in regions I, II and III.

5. At room temperature, there is a semiconductor solid with a bandgap of 1 eV.　　**(30%)**
   (a) Please calculate the probability of electron distribution on the conduction band by assuming Boltzman distribution?
   (b) Please calculate the emission photon wavelength of a light emitting diode (LED) made by this solid.
   (c) If an X-ray with a wavelength of 3.5 Å is incident into this solid, a strong Bragg diffraction peak is obtained at an angle of 32°. Please calculate the distance between two adjacent atomic planes for this semiconductor.