

### Exercise 1

Neutrons produced in a reactor are used for chain reaction after they are "thermalized", i.e., their kinetic energies are reduced to that of the energy of air molecules at room temperature. Taking the room temperature as 300 K, estimate the de Broglie wavelength of such thermal neutrons. (mass of neutron =  $1.67 \times 10^{-27}$  kg.)

(Ans. 0.145 nm)

### Exercise 2

Calculate de Broglie wavelength of a proton moving with a velocity of  $10^4$  m/s.

(Ans.  $4 \times 10^{-11}$  m/s)

### Exercise 3

The resolving power of a microscope is approximately equal to the wavelength of light used to illuminate the object. In an *electron microscope*, instead of light, the object is irradiated with a beam of electron. If the resolving power of an electron microscope is 0.01 nm, find the kinetic energy of the electrons used.

(Ans. 15 keV)

### Exercise 4

Through what potential difference should an electron be accelerated to have a de Broglie wavelength of  $1 \text{ \AA}$ ?

(Ans. 150 volts)

### Exercise 5

An electron is released at a large distance from a proton. What will be the wavelength of the electron when it is at a distance of (i) 1 m (ii) 0.1 nm from the proton? [Hint : The potential through which the electron moves is  $e/4\pi\epsilon_0 r$ .]

(Ans. (i)  $3.24 \times 10^{-5}$  m (ii)  $3.24 \times 10^{-10}$  m)

### Exercise 6

Thermal neutrons having a wavelength of 0.145 nm are diffracted by a crystal of lattice spacing 0.29 nm. Find the angle at which the first order diffraction maximum occurs.

(Ans.  $14^\circ$ )

### Exercise 7

Calculate the wavelength of an electron the ground state of hydrogen atom. (First Bohr radius of hydrogen atom is 0.053 nm)

(0.33 nm)

### Exercise 8

The position of an electron is determined with an accuracy of 0.01 nm. Find the uncertainty in its momentum.(Ans.

$$6.63 \times 10^{-23} \text{ kg m/s})$$