



CHAPTER TEST

STD-XII

PHYSICS – DUAL NATURE OF MATTER AND RADIATION

TIME: 35 MIN. All the questions. Section A carries 1 mark, Section B carries 2 marks, Section C carries 3 marks, Section D carries 5 marks, Section E carries 4 marks.

SECTION – A

- Dimensions of Plank's constant are same as of:
 - Force \times time
 - force
 - Energy/ time
 - energy \times time
- Photoelectric effect is the phenomenon in which:
 - Photons comes out of a metal when it is hit by a beam of electron
 - Photon comes out of the nucleus of an atom under the action of an electric field
 - Electrons comes out of a metal with a constant velocity which depends on the frequency and intensity of incident light wave
 - Electrons come out of a metal with different velocities not greater than a certain value which depends only on the frequency of the incident light wave and not on its intensity.
- The wavelength of the de-Broglie waves associated with a moving particles is independent of it's?
 - Mass
 - Charge
 - Velocity
 - Momentum
- A proton, a neutron, an electron and an α -particle have same energy. Then their de-Broglie wavelength compare as
 - $\lambda_p = \lambda_n > \lambda_e \lambda_a$
 - $\lambda_a < \lambda_p = \lambda_n \lambda_e$
 - $\lambda_e < \lambda_p = \lambda_n > \lambda_a$
 - $\lambda_e = \lambda_p = \lambda_n = \lambda_a$
- Assertion (A) : The energy (E) and momentum (p) of the photon are related as $p = E/c$
Reason(R): the photon behaves like a particle
 - Both A and R is true and R is correct explanation of A.
 - Both A and R is true and R is NOT correct explanation of A
 - A is true but R is false
 - A is false and R is true
- Assertion(A): de-Broglie equation is significant for microscopic particles
Reason(R): de- Broglie wavelength is inversely proportional to the mass of a particle when velocity is kept constant.
 - Both A and R is true and R is correct explanation of A.
 - Both A and R is true and R is NOT correct explanation of A.
 - A is true but R is false.
 - A is false and R is true.



SECTION – B

7. What is threshold wavelength in photoelectric effect?
8. The work function of aluminum is 4.2 eV . If two photons each of energy 2.5 eV are incident on aluminum surface, will photoelectric emission occurs?
9. Show that the wave length of electromagnetic radiation is equal to the de-Broglie wavelength of its quantum (photons)
10. An electron and a proton have the same de-Broglie wavelength. Which one has higher kinetic energy? Which one is moving faster?

SECTION – C

11. a monochromatic source of light emits light of wavelength 198 nm . calculate.
 - (i) Energy of each photon
 - (ii) Momentum of the photon.
12. Explain the variation of photoelectric current in a photo-tube with
 - (i) Voltage across the tube and
 - (ii) Intensity of incident radiation, with graphs.
13. Show that the wavelength of electromagnetic radiation is equal to de-Broglie wavelength of its quantum (photon).
14. Show that the de-Broglie wavelength of electron of energy K is given by $\lambda = h/\sqrt{2mK}$.

SECTION – D

15. Explain the work function and threshold frequency in photoelectric emission. Give Einstein's equations for photoelectric emission. What do the symbols stand for?

SECTION – E

16. Case Study Based Question:

A group of students performs a photoelectric effect experiment using a clean sodium surface inside an evacuated quartz tube. They shine monochromatic ultraviolet (UV) light of wavelength 250 nm on the sodium surface and observe the emission of electrons. The intensity and frequency of the incident light can be varied, and the tube has two electrodes connected to a variable power supply and a microammeter to measure photoelectric current. The work function of sodium is 2.3 eV .

The students conduct the following investigations:

- They vary the intensity of incident UV light while keeping its wavelength fixed at 250 nm and measure the photoelectric current each time.
- They use a different monochromatic source with wavelength 500 nm at the same intensity as before and observe the result.
- They measure the stopping potential required to reduce the photoelectric current to zero with 250 nm light.

Based on this scenario, answer the following:



- i) State the law that governs the emission of photoelectrons from a metal surface when light is incident on it.
- ii) Write the equation connecting the maximum kinetic energy of ejected electrons, frequency of incident light, and work function of the material.
- iii) Calculate the maximum kinetic energy, in electron-volts (eV), of the electrons emitted when the sodium surface is illuminated with UV light of wavelength 250 nm.
($h=6.63\times 10^{-34} \text{ J s}$, $c=3.0\times 10^8 \text{ m s}^{-1}$, $1\text{eV}=1.6\times 10^{-19} \text{ J}$)
- iv) What happens to the photoelectric current if the intensity of 250 nm UV light is increased, keeping the wavelength fixed? Explain briefly why.