Chapter14. Dual Nature of Radiation and Matter.

MCQ'S (1 Mark Each)

1) The electrons are emitted in the photoelectric effect from a metal surface.

a) only if the frequency of radiation is above a certain threshold value.

b) only if the temperature of the surface is high.

c) at the that is independent of the nature of metal.

d) with a maximum velocity proportional to the frequency of incident radiation

Ans: a) only if the frequency of radiation is above a certain threshold value

2) As the intensity of incident light increases

a) photoelectric current increases

b) photoelectric current decreases.

c) kinetic energy of emitted photoelectrons increases

d) kinetic energy of emitted photoelectrons decreases.

Ans: a) photoelectric current increases.

3) The maximum kinetic energy of the photoelectrons depends only on

a) potential b) frequency c) incident angle d) pressure

Ans : b) frequency .

4) According to De-Broglie, the waves are associated with

a) moving neutral particles only.

b) moving charged particle only.

c) electrons only

d) all moving matter particles

Ans : d) all moving matter particles

5) The work function of a metal is 4.2 Ev.Its threshold wavelength will be

a) 4000 A° b) 3500 A° c) 2959 A° d) 2500 A°

Ans : c) 2959 A° **,** $\lambda = \frac{hc}{\emptyset_{\circ}}$

6) Ultraviolet radiation of 6.2 eV falls on an Aluminum surface (work function 4.2 eV).

The kinetic energy in joules of the fastest electron emitted is

a) 3.2×10^{-21} b) 3.2×10^{-19} c) 3.2×10^{-17} d) 3.2×10^{-15}

Ans: b) 3.2×10^{-19} **,** $K.E_{max} = h\nu - \emptyset_{\circ}$

7) Plancks constant is 6.6×10^{-34} Js. The momentum of each photon in a given radiation is 3.3×10^{-29} kg/s. The λ of radiation is

a) 2×10^{10} m b) 2×10^{7} m c) 2×10^{5} m d) 2×10^{-5}m

Ans: d) 2×10^{-5} **m ,** $\lambda = \frac{h}{p}$

Very Short Answer (VSA) (1 MARK Each)

1 Define photoelectric effect.

2 Define threshold frequency.

3 What is cut off or stopping potential.

4 Define the work function of the metal.

5 The minimum frequency for photoelectric effect on a metal is 7×10^{14} Hz, Find the work function of the metal. Ans: $\emptyset_{\circ} = h\nu_{\circ} = 4.62\times10^{-19}$ J

6 Find the kinetic energy of emitted electron, if in a photoelectric effect energy of incident Photon is 4 eV and work function is 2.4 eV. **(Ans:** $K.E._{max}$ **=1.6 eV.)**

7 Find energy of photon which have momentum 2×10^{-16} gm-cm/sec.

(Ans : E = 6×10^{-6} **erg)**

Short Answer I (SA1) (2 MARKS Each)

1 Explain the term 'wave particle duality' of matter.

2 Draw a neat labeled diagram of schematic of experimental set up for photoelectric effect.

3 What is mean by dual nature of matter.

4 Explain the concept of photoelectric effect.

5 If the total energy of radiation of frequency 10^{14}Hz is 6.63 J , Calculate the number of photons in the radiation**.** ***(Ans n=*** $\frac{E}{h\nu} = 10^{20}$***)***

6 An electron is accelerated through a potential of 120 V. Find its de Broglie wavelength**.**

(Ans $\lambda = \frac{1.228}{\sqrt{V}}$ ***= 0.112 nm)***

7 Calculate the stopping potential when the metal with the work function 0.6 eV is illuminated with the light of 2 eV. **(***Ans* $V_0 = \frac{E - \emptyset_\circ}{e}$ ***= 1.4 V)***

Short Answer II (SA2) (3 MARKS Each)

1) State Einstein photoelectric equation. Explain 2 characteristics of photoelectric effect on the basis of Einstein's photoelectric equation.
2) With the help of circuit diagram describe an experiment to study photoelectric effect.
3) What is the photoelectric effect? Define stopping potential and photoelectric work function.
4) Describe photocell construction and working with a neat, labelled diagram.
5) With a neat, labelled diagram, describe the Davisson and Germer experiment in support of the concept of matter waves.
6) Calculate De Broglie wavelength of bullet moving with speed 90m/sec and having a mass 5 gm**.** ***(Ans.*** $\lambda = 1.472 \times 10^{-31}$ ***m,*** $\lambda = \frac{h}{mv}$***)***
7) The energy of photon is 2 eV. Find its frequency and wavelength.

(Ans. Frequency, $v = \frac{E}{h} = 4.826 \times 10^{14}$ ***Hz., Wavelengh*** $\lambda = \frac{c}{\nu} = 6229\ A^\circ$***)***

8) The work function of a surface is 3.1 eV. A photon of frequency 1 x 10^{15} Hz. Is incident on it. Calculate the incident wavelength is photoelectric emission occur or not. ***(Ans*** $\lambda_\circ = \frac{hc}{\emptyset_\circ} = 4000\ A^\circ$ ***photoelectric emission occur.)***

Long Answer (LA) (4 marks Each)

1) With the help of circuit diagram describe the experiment to study the characteristics of photoelectric effect, Hence discuss any 2 characteristics of photoelectric effect.
2) State Einstein's photoelectric equation. Explain all characteristics of photoelectric effect, on the basis of Einstein's photoelectric equation.
3) Explain De Broglie's Hypothesis.