CHAPTER-11

Dual Nature of Radiation and Matter

ASSIGNMENT-2

1 Mark Questions

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c)If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is false but Reason is correct

Q.22 **Assertion :** In process of photoelectric emission, all emitted electrons do not have same kinetic energy.

Reason : If radiation falling on photosensitive surface of a metal consists of different wavelength then energy acquired by electrons absorbing photons of different wavelengths shall be different.

Q.23 **Assertion :** The kinetic energy of photoelectrons emitted from metal surface does not depend on the intensity of incident photon.

Reason : The ejection of electrons from metallic surface is not possible with frequency of incident photons below the threshold frequency.

Q.24 **Assertion :** Photoelectric saturation current increases with the increase in frequency of incident light.

Reason : Energy of incident photons increases with increase in frequency and as a result photoelectric current increases.

Q.25 The de- Broglie wavelength of a moving particle is ……. proportional to its momentum.

Q26. The phenomenon of photoelectric emission was discovered by……..in……..

Q.27. In photoelectric effect what determines the maximum velocity of the electron reacting with the collector?

a. Frequency of incident radiation alone

b. The potential difference between the emitter and the collector

c. The work function of metal

d. All of these

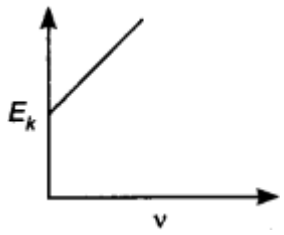
Q. 28. Calculate the de Broglie wavelength associated with the electron which has a kinetic energy of 5 eV.

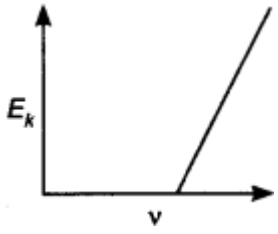
a. 5.47 Å b. 2.7 Å c. 5.9 Å d. None of the above

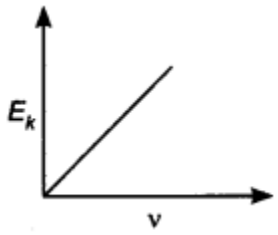
Q.29. For a metal having a work function W_0, the threshold wavelength is λ. What is the threshold wavelength for the metal having work function $2W_0$?

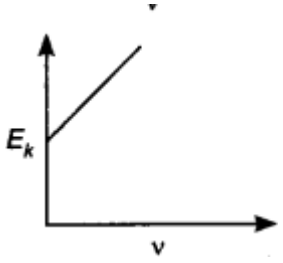
a. $\lambda/4$ b. $\lambda/2$ c. 2λ d. 4λ

Q.30. How does the maximum kinetic energy of a photoelectron vary with the frequency (ν) of the incident radiation?

a. 

b. 

c. 

d. 

Q.31. Kinetic energy of emitted electrons depends upon:

(a) frequency

(b) intensity

(c) nature of atmosphere surrounding the electrons

(d) none of these

CASE STUDY BASED QUESTIONS

Q.32 The discovery of the phenomenon of photoelectric effect has been one of the most important discoveries in modern science. The experimental observations associated with this phenomenon made us realize that our, 'till then', widely accepted picture of the nature of light – The electromagnetic (wave) theory of light– was quite inadequate to understand this phenomenon. A 'new picture' of light was needed and it was provided by Einstein through his 'photon theory' of light. This theory, regarded light as a stream of particles. Attempts to understand photoelectric effect thus led us to realize that light, which was being regarded as 'waves', could also behave like 'particles'. This led to the idea of 'wave-particle duality' vis-à-vis the nature of light. Attempts to understand this 'duality', and related phenomenon, led to far reaching, and very important developments, in the basic theories of Physics**.**

I. Which of the following phenomena explain the wave nature of light?

(a) Interference (b) Diffraction (c) polarization (d) all of them

II. Wave –particle duality is shown by

(a) Light only (b) matter only (c) both light and matter (d) None of them

III. The experiment to explain the wave nature of light i.e electromagnetic wave theory is given by

(a) Hertz (b) Einstein (c) Lenard (d) Huygen

IV. The concept of photoelectric effect given by Einstein explains that the light is a

(a) Photon (b) Wave (c)Particle (d) Both

V. The practical application of the phenomenon of photoelectric effect and the concept of 'matter waves' is

(a) Photocells

(b) Automatic doors at shops and malls

(c) automatic light switches

(d) All of them

Two Marks Questions

Q.33 Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W Calculate the (i) energy of a photon in the light beam and (ii) number of photons emitted on an average by the source.

Q.34. Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based.

Q.35. The Kinetic Energy (K.E.), of a beam of electrons, accelerated through a potential V, equals the energy of a photon of wavelength 5460 nm. Find the de Broglie wavelength associated with this beam of electrons.

3 Marks Questions

Q.36. (a) Define photoelectric work function? What is its unit?

(b) In a plot of photoelectric current versus anode potential, how does

(i) Saturation current varies with anode potential for incident radiations of different frequencies but same intensity?

(ii) The stopping potential varies for incident radiations of different intensities but same frequency.

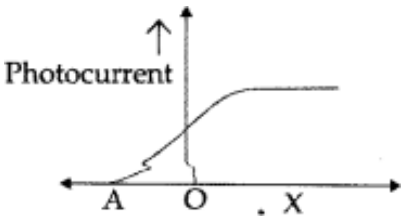
(iii) Photoelectric current vary for different intensities but same frequency of radiations? Justify your answer in each case?

Q.37 Draw a graph showing the variation of stopping potential with frequency of the incident radiations. What does the slope of the line with the frequency axis indicate. Hence define threshold-frequency?

Q.38.(a) why photoelectric effect cannot be explained on the basis of wave nature of light? Give

reason. (b) Write the basic features of photon picture of electromagnetic radiation on which Einstein's photoelectric equation is based. CBSE2013

Q.39. The given graph shows the variation of photocurrent for a photosensitive metal:



(a) Identify the variable X on the horizontal axis.

(b) What does the point A on the horizontal axis represent?

(c) Draw this graph for three different values of frequencies of incident radiation v_1, v_2 and v_3 ($v_1 > v_2 > v_3$) for same intensity.

(d) Draw this graph for three different values of intensities of incident radiation I_1 I_2 and I_3 ($I_1 > I_2 > I_3$) having same frequency.