QUESTION BANK

DUAL NATURE OF RADIATION AND MATTER

LEVEL A

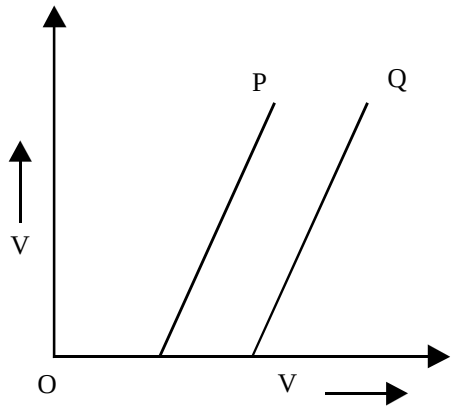
1) Define work function of a metal. 1
2) On what factors does the work function of metal depend? 1
3) Mention one physical process for the release of electrons from a metal surface. 1
4) Name a phenomenon, which illustrates particle nature of light. 1
5) What are light quanta? What is a photon? 1
6) Which photon is more energetic-violet or red one? Give reasons. 1
7) If the wavelength of electromagnetic radiation is doubled, what will happen to the energy of photons? 1
8) What is the energy associated in joules with a photon of wavelength 4000 Å? 1
9) What is the momentum of a photon of frequency ν? 1
10) If h is Planck's constant, find the momentum of a photon of wavelength 0.01 A^o 1
11) Determine the wavelength of a photon of energy 10^{10} eV. 2
12) Calculate the longest wavelength of radiation that will eject an electron from the surface having work function 1.9 eV, h = 6.625 x 10-34 Js. 2
13) Calculate de-Broglie wavelength of an electron beam accelerated through a potential difference of 60 V.
14) Explain working of Davision and Germer Experiment with the help of a labeled diagram. 3
15) Explain the functioning of photocell. Give its two uses. 3

LEVEL B

1) What is photoelectric effect? Give the effect of increase of frequency of the incident radiation on the number of photoelectrons emitted by a phototube. 2

2) What is meant by work function of a metal? How does the value of work function influence the K.E. of electrons liberated during photoelectric emission. 2

3) The graphs between the stopping potential 'V' and frequency 'ν' of the incident radiation of on two different metal plates P and Q are shown in the fig.



a) Which metal, out of P and Q, has greater value of work function?
b) What does the slope of the line depict? 2

4) Draw a graph to show the variation of stopping potential with frequency of radiation incident on a metal plate. How can the value of Planck's constant be determined from this graph? 2

5) Radiation of frequency 10^{15} Hz is incident on two photosensitive surfaces P and Q. Following observations are recorded
(i) Surface P. No photoemission occurs.
(ii) Surface Q. Photoemission occurs but photoelectrons have zero K.E.
Based on Einstein's photoelectric equation, explain two observations. 2

6) Derive de-Broglie wave equation for material particles. 2

7) An electron and photon have the same de-Broglie wavelength (say A) which one possesses more K.E.? 2

8) de-Broglie wavelength of a proton is 2 A. What is its (i) velocity and (ii) kinetic energy ? Given mass of proton = 1.67×10^{-27} kg. 2

9) Calculate the energy of an electron which has de-Broglie wavelength 1 A.
Given h= 6.6×10^{-34} Js. 2

10) Find the energy of a photon of light of wavelength 5000 Å. Given h = 6.62×10^{-34} J. 2

11) State the laws of photoelectric emission. Write Einstein's photoelectric equation. Briefly explain these laws on the basis of photoelectric equation. 3

12) What is photoelectric effect? Why is cannot be explained on the basis of wave nature of light? 3

LEVEL C

1) Ultraviolet light is incident on two photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$), In which case will the kinetic energy of the emitted electrons be greater? Why? 2

2) Define the term 'work function' of a metal. The threshold frequency of a metal is f_0. When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5f_0$, the maximum velocity of electrons emitted is v_2. Find the ratio of v_1 to v_2. 3

3 An electron and a proton are accelerated through the same potential. Which one of the two has i) greater value of de-Broglie wavelength associated with it and ii) less momentum? Justify your answer. 3

4. An electron and a proton have same de-Broglie wavelength .which one possesses have more kinetic energy? 3

5. Why are de-Broglie waves associated with a moving football not visible? The wavelength, λ, of a photon and the de-Broglie wavelength of an electron have the same value. Show that the energy of the photon is $\frac{2\lambda mc}{h}$ times the kinetic energy of the electron, where m, c and h have their usual meanings. 3

6. Electrons are emitted from a photosensitive surface when it is illuminated by green light but electron emission does not take place by yellow light. Will the electrons be emitted when the surface is illuminated by (i) red light, and (ii) blue light?