CHAPTER 11

DUAL NATURE OF MATTER AND RADIATION

1. (A) The wavelength of matter waves is called de Broglie Wavelength.

(a) An α -particle, a proton and an electron having de Broglie wavelengths λ_α, λ_p and λ_e respectively are moving with the same momentum. Then

(i) $\lambda_\alpha > \lambda_p > \lambda_e$ (ii) $\lambda_p > \lambda_e > \lambda_\alpha$

(iii) $\lambda_\alpha = \lambda_p = \lambda_e$ (iv) $\lambda_p = \lambda_e \neq \lambda_\alpha$

(b) The de Broglie wavelength of a ball of mass 0.12 Kg is 2.76×10^{-34} m. Calculate the speed of the ball. [h= 6.625×10^{-34} Js]

(Score: 1+ 2)

OR

(B) Photoelectric current depends on the intensity of incident light.

(a) The maximum current emitted by a photoelectric material is called

(i) Emitter current (ii) Collector current

(iii) Saturation current (iv) Peak current

(b) Work function of caesium and platinum are 2.14 eV and 5.65 eV respectively. Which one of the metals has higher threshold wavelength? Justify.

(Score: 1+ 2) **[JUNE-2016]**

2. (a) The work function a metal is 6eV.If two photons each having energy 4 eV strike with the metal surface.

(i) will the emission be possible?

(ii) Why?

(b) The waves associated with matter is called matter waves. Let λ_e and λ_p be the de Broglie wavelengths associated with electron and proton respectively. If they accelerated by same potential, then

(i) $\lambda_e > \lambda_p$ (ii) $\lambda_p > \lambda_e$

(iii) $\lambda_p = \lambda_e$ (iv) $-\lambda_e = \frac{1}{\lambda_p}$

(Score: 2+ 1) **[MARCH-2016]**

3. Electron can undergo diffraction just like waves. What is the wavelength of an electron accelerating in a potential difference of 54 V?

(Score:2) **[JUNE-2015]**

4. When light falls on a certain metals photo electrons are generated.

a) Express the phenomenon in terms of equation.
b) Explain the terms used.
(Score: 1+ 2) **[JUNE-2015]**

5. (A) Work function of a metal is the

(a) energy required by an electron to get absorbed in the metal surface.

(b) minimum energy required by an electron to escape from the metal surface.

(c) energy required by an electron to be retained by a metal surface.

(d) maximum energy required by an electron to escape from the metal surface.

(B) Write Einstein's photoelectric equation and explain the terms involved in it.

(C) All photoelectrons are not emitted with the same energy as the incident photons. Why? (Score: ½ +1 ½ +1) **[MARCH-2015]**

6. (a) What is de Broglie hypothesis?

(b) Write the formula for de Broglie wavelength.

(c) Calculate the de Broglie wavelength associated by an electron accelerated through a potential difference of 100 volts.

Given mass of the electron =9.1 x 10^{-31} kg, h= 6.634 x 10^{-34} JS, 1eV =1.6 x 10 -^{19} J

(Score: 1+ 1+ 1 ½) [**MARCH-2015]**

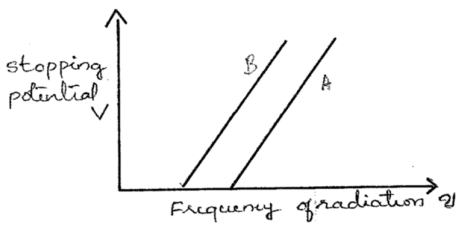
7. According to wave nature of matter, there is a wave associated with every material body.

a) Mention any two differences between light wave and matter wave. (Score: 1)

b) What is the wavelength of electron when it is accelerated by a voltage of 54 V? (Score: 2) **[JUNE-2014]**

8. When photons incident on a metallic surface electric current is produced. The work function of the metal is given by $\phi_0 = \frac{hc}{\lambda_0} = h\nu_0$. Where λ_0, c, h, ν_0 has their usual meaning.

The graph given below shows the variation in stopping potential **V** with frequency ν of the incident radiation of the materials A and B.



a) Which of the material has higher work function? (Score: ½)

b) Which material is more photosensitive? (Score: ½)

c) What happens to the slope of the graph when intensity of radiation increases? Why? (1) **[JUNE-2014]**

9. Albert Einstein, the great physicist proposed a clear picture to explain photoelectric effect.

a) Explain Einstein's photoelectric equation. (Score: 2½)

b) Name the quanta of light. (Score: ½) **[MARCH-2014]**

10. De Broglie proposed the wave nature of electrons suggesting matter waves.

Find the momentum, speed and De-Broglie wavelength of an electron with kinetic energy of 120 eV. (Score: 2) **[MARCH-2014]**

11. Moving particles of matter should display wavelike properties under suitable conditions.

a) Name the scientist who put forward this hypothesis. (Score: ½)

b) Which experiment established the wave nature of particle? (Score: ½)

c) An electron of mass 'e' is accelerated from rest by a potential difference v. Find the wavelength associated with the electron. (Score: 1½)

e) Calculate the frequency associated with a photon of energy 3.3×10^{-20}J. h=6.6×10^{-34}Js. (Score: 1)

[MAY-2013]

12. Photon is a quanta of light.

a) Who introduced the concept of photon? (Score: 1)

b) Briefly explain the effect of intensity and energy of the incident radiation on the photo electric effect. (Score: 2)

[MARCH 2013]

13. Einstein got Nobel Prize in physics in1921 for his explanation of photoelectric effect

a) Write down Einstein's photoelectric equation. (Score: 1)

b) Draw a graph to show the variation of stopping potential with frequency of incident radiation. How the value of Plank's constant can be determined from the graph? (Score: 2)

[JUNE 2012]

14. Read the following statements and write whether they are TRUE or FALSE.

a) Matter waves are electromagnetic.

b) When wavelength of incident light is decreased, the velocity of emitted photoelectrons increases.

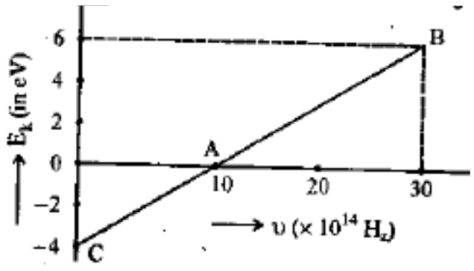
c) Alkali metals are most suitable for photoelectric emission.

d) Davisson-Germen experiment proved the particle nature of electrons.

(Score: 2)

[MARCH 2012]

15. Given below is the graph between frequency (υ) of the incident light and maximum kinetic energy (E_k) of emitted photoelectrons.



a) Define the terms, work function and threshold frequency. (Score: 2)

b) Find the values of

i. threshold frequency and

ii. Work function from the graph.

(Score: 1) **[MARCH 2012]**

16. Einstein was awarded Nobel prize in 1921 for his work on photoelectric effect.

a) What is meant by photoelectric work function?

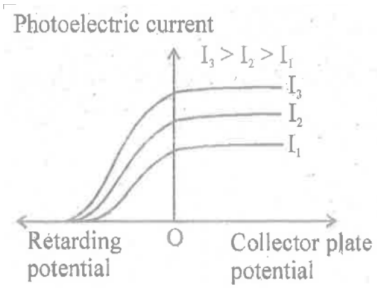
b) Which of the following is not a photosensitive material for visible light?

i. Sodium ii. Magnesium

iii. Rubidium iv. Caesium

c) Write down Einstein's photoelectric equation and explain the symbols.

d) Following graph is obtained in an experiment on photoelectric effect. Which characteristics of incident radiation is kept constant in this experiment?



(Score:1+1+2+1) **[SAY- 2011]**

17. To emit a free electron from a metal surface a minimum amount of energy must be supplied.

a) This energy is called.....

b) State three methods to supply this energy to the free electron.

c) When light of frequency 7.21 x 10^{14}Hz is incident on a metal surface, the maximum speed of the ejected electrons is 6 x 10^5 m/s. Calculate the threshold frequency for the metal.

(Score: ½ +1 ½ +3)[**MARCH-2011]**

18. According to de Broglie, matter exhibits particle as well as wave nature.

a) What will be the de Broglie wave length of a moving particle and that of a photon?
b) Name the experiment which proves the wave nature of electrons. Illustrate the experiment, with a suitable diagram.
(Score: 1½ +3 ½) **[JUNE-2010]**

19. Light meters in photographic cameras make use of photoelectric effect.

a) What is photoelectric effect?
b) Which of the following is a photosensitive material?

(a) Quartz (b) Caesium

(c) Germanium (d) Silicon

c) Represent graphically the variation of photoelectric current with the intensity of incident radiation.
d) Red light however bright, cannot produce the emission of photoelectrons from a clean zinc surface. But even a weak ultraviolet radiation can do.
Do you agree with statement? Why?
(Score: 1 +1 +1 +2) **[MARCH-2010]**