

Unit: 7. Dual Nature of matter & Radiation (15 marks)	
1 mark → 2 Questions	5 mark → 1 Question 58,59
3 mark → 2 Questions 42	10 mark No ten mark qtn

**UNIT – 7. DNMR & Relativity – 1 mark Questions**

- Photo electric effect can be explained on the basis of -----  
a) corpuscular theory      b) wave theory [DPM,M-10,J-10]  
c) electromagnetic theory      **d) quantum theory**
- In the photoelectric phenomenon if the ratio of the frequency of incident radiation incident on a photosensitive surface is 1 : 2 : 3, the ratio of the photoelectric current is ----- [M-12]  
a) 1 : 2 : 3      b)  $\sqrt{1} : \sqrt{2} : \sqrt{3}$       c) 1 : 4 : 9      **d) 1 : 1 : 1**
- The value of stopping potential when the frequency of light is equal to the threshold frequency is ----- [M-06, M-09, S-12]  
a) maximum      **b) zero**      c) minimum      d) infinity
- The wave length of matter wave is independent of -----  
a) mass      b) velocity [DPM, J-08,13,S-09,M-11]  
c) momentum      **d) charge**
- When the momentum of a particle increases, its de-Broglie wavelength ----- [J-12]  
a) increases      **b) decreases**      c) does not change      d) infinity
- The stopping potential of a metal surface is independent of : [M-13]  
a) frequency of incident radiation  
**b) intensity of incident radiation**  
c) the nature of the metal surface      d) the velocity of the electron
- At the threshold frequency, the velocity of photoelectrons is --  
a) maximum      b) minimum      c) infinity      **d) zero** [O-06,09]
- When an electron is accelerated with potential difference V, its de-Broglie wavelength is directly proportional to --- [S-12]  
a) V      b)  $V^{-1}$       c)  $V^{1/2}$       **d)  $V^{1/2}$**
- A graph is drawn between frequency of radiation ( $\nu$ ) along the x-axis and its stopping potential ( $V_0$ ) along the y-axis. The nature of the graph is --- [M-11]  
**a) a straight line**      b) a parabola  
c) an ellipse      d) a circle
- The KE of the moving particle is E, then the de-Broglie wavelength is ----- [M-12]  
a)  $\lambda = \frac{h}{\sqrt{2mE}}$       b)  $\sqrt{2mE}/h$       c)  $h\sqrt{2mE}$       d)  $\lambda = h/\sqrt{2m}$
- The de-Broglie wavelength of electron accelerated with a potential V is ----- [O-10,11]  
a)  $\lambda = h/\sqrt{Ve}$       b)  $\frac{h}{\sqrt{2eVm}}$   
c)  $\lambda = h/m\sqrt{2Ve}$       d)  $\lambda = h/m\sqrt{Ve}/m$
- Einstein's photoelectric equation is --- [J-09]  
a)  $W + h\nu = \frac{1}{2} m v_{\max}^2$       b)  $W = \frac{1}{2} m v_{\max}^2$   
c)  $h\nu + \frac{1}{2} m v_{\max}^2 = W$       **d)  $W + \frac{1}{2} m v_{\max}^2 = h\nu$**
- A photon of frequency ' $\gamma$ ' is incident on a metal surface of threshold frequency ' $\gamma_0$ '. The kinetic energy of the emitted photon is [S-07,08]  
**a)  $h(\gamma - \gamma_0)$**       b)  $h\gamma$       c)  $h\gamma_0$       d)  $h(\gamma + \gamma_0)$
- An electron of mass 'm' and charge 'e' accelerated from rest through a potential difference of 'V' volt, then its final velocity is [S-08]  
a)  $\sqrt{Ve}/m$       b)  $\sqrt{Ve}/2m$       c)  $\sqrt{2eV}/m$       d)  $2Ve/m$

- Electron microscope works on the principle of ---- [M-10]  
a) photoelectric effect      b) particle nature of electron  
**c) wave nature of moving electron**      d) dual nature of matter
- The number of de-broglie waves of an electron in the  $n^{\text{th}}$  orbit of an atom is : [M-13]  
**a) n**      b)  $n - 1$       c)  $n + 1$       d)  $2n$
- According to the theory of relativity, the length of a rod in motion -- ----- [J-06,07,09,10]  
**a) is less than its rest length**      b) is same as its rest length  
c) is more than its rest length  
d) may be more or less than or equal rest length depending upon the speed of the rod
- According to the special theory of relativity, the only constant in all frames is ---- [M-09, O-06,M-07]  
a) mass      b) length      **c) velocity of light**      d) time
- Photon has --- [J-08]  
**a) energy but has zero mass**      b) mass but zero energy  
c) zero mass and zero energy      d) infinite mass and energy
- A particle which has zero mass but has energy, is --- [M-08]  
a) electron      **b) photon**  
c) proton      d) neutron
- If C is the velocity,  $\gamma$  the frequency and  $\lambda$  the wavelength of a radiation, then its frequency is defined as --- [O-10]  
a) the number of waves in a distance of one metre  
b) the number of waves in a distance of  $\lambda$   
c) the number of waves in a distance of C  
**d) the number of waves produced in a period of T seconds**

**UNIT – 7. DNMR & Relativity – 1 mark Problems**

- The work function of a photoelectric material is  $6.626 \times 10^{-19}$  J. The threshold frequency is ---- [M-07]  
**a)  $1 \times 10^{15}$  Hz**      b)  $10 \times 10^{-19}$  Hz  
c)  $1 \times 10^{-15}$  Hz      d)  $10 \times 10^{19}$  Hz
- The work function of a photoelectric material is 3.3eV. The threshold frequency will be equal to --- [M-08,J-11,13]  
**a)  $8 \times 10^{14}$  Hz**      b)  $8 \times 10^{10}$  Hz  
c)  $5 \times 10^{23}$  Hz      d)  $4 \times 10^{14}$  Hz
- A photon of energy 2E is incident on a photosensitive surface of photoelectric workfunction E. The maximum KE of photoelectron emitted is ---- [J-11]  
**a) E**      b) 2E      c) 3E      d) 4E
- Two photons, each of energy 2.5 eV are simultaneously incident on the metal surface. If the work function of the metal is 4.5 eV, then from the surface of the metal ---- [J-06]  
a) one electron will be emitted      b) two electron will be emitted  
c) more than two electrons      **d) not a single electron will be emitted**
- The momentum of the electron having wavelength  $2 \text{ \AA}$  is ----  
a)  $3.3 \times 10^{-24} \text{ kgms}^{-1}$       b)  $6.6 \times 10^{-24} \text{ kgms}^{-1}$   
c)  **$3.3 \times 10^{-24} \text{ kgms}^{-1}$**       d)  $6.6 \times 10^{-24} \text{ kgms}^{-1}$  [J-07]
- If 1 kg of substance is fully converted into energy, the energy produced is  
a)  **$9 \times 10^{16} \text{ J}$**       b)  $9 \times 10^{24} \text{ J}$       c) 1      d)  $3 \times 10^8 \text{ J}$  [O-10,11]
- When a material particle of mass ' $m_0$ ' attains the velocity of light, its mass becomes -  
a) 0      b)  $2m_0$       c)  $4m_0$       **d) infinity**

**UNIT – 7. DNMR & Relativity – 3 mark Questions**

1. Define stopping potential [S-09,S-12]
2. Define threshold frequency. [J-13]
3. What is photoelectric effect? State the laws of photoelectric effect? [M-11]
4. Mention any three applications of photoelectric cells. [DPM,J-06,M-10,O-10,J-12]
5. What are the limitations electron microscopes? [M-06, M-09,12]
6. Mention the uses of electron microscope. [M-07]
7. According to classical mechanics, what is the concept of time? [J-10]
8. State the special theory of relativity. [S-07,J-09,M-13,11]
9. What are inertial and non-inertial frames of reference? [O-06,M-08]

**UNIT – 7. DNMR & Relativity – 3 mark Problems**

1. What is De brolie wavelength of an electron of kinetic energy 120 eV? [J-07J-08,S-12/5m]
2. Calculate the threshold WL of certain metal of work function 1.8 eV. [S-08]
3. Find de Broglie wavelength of electron in the fourth orbit of hydrogen atom. [J-11]

**UNIT – 7. DNMR & Relativity – 5 mark Questions**

1. Define work function. State the laws of photo-electric emission.
2. What is photoelectric effect? State the laws of PEE. [M-09,11,O-11]
3. Explain the construction and working of photo-emissive cell with diagram. [S-08]
4. Write any five applications of photoelectric cells [O-06,J-07,M-08,J-08,09,13,M-12]
5. Obtain Einstein's photoelectric equation [DPM,M-06,J-06,S-09, M-10,J-10,S-12]
6. Explain the wave mechanical concept of atom. [S-07,M-09]
7. Derive an expression for De-broglie WL of matter waves. [O-06,M-07,J-10,O-10,J-11,12,M-13]
8. Explain FitzGerald – Lorentz contraction with an example. [M-06,08,10,O-10,O-11,J-13]
9. Explain time-dilation with an example. [J-06,J-08]
10. At what speed is particle moving if the mass is equal to three times its rest mass? [S-08]
11. Establish Einstein's mass energy equivalence  $E = mc^2$  [DMP, J-07]

**UNIT – 7. DNMR & Relativity – 5 mark Problems**

1. What is De brolie wavelength of an electron of kinetic energy 120 eV? [J-07J-08,/3m S-12/5m]
2. The work function of iron is 4.7 eV. Calculate the cut off frequency and the corresponding cut-off WL for this metal? [J-09,M-12/com]
3. How fast would a rocket have to go relative to an observer for its length to be corrected to 99% of its length at rest? [M-12/com]
4. A metallic surface when illuminated by light of wavelength  $3333 \text{ \AA}$  emits electrons with energies upto 0.6 eV. Calculate the work function of the metal. [S-09,J-12,M-13]

5. The time interval measured by an observer at rest is  $2.5 \times 10^{-8}$  s. What is the time interval measured by an observer moving with a velocity  $v = 0.73 C$ ? [J-09]
6. A proton is moving at a speed of 0.900 time the velocity of light. Find its kinetic energy in joule and in MeV. [M-11]
7. How fast would a rocket have to go relative to an observer for its length to be corrected to 99% of its length at rest? [S-07,J-11]

13th August 2013