DUAL NATURE OF MATTER AND RADIATION

MM MARK: 20] **[TIME: 45 MINUTES**

General Instructions:

- ***Question no. 1 to 4 consist of one marks questions, which are very short answer type questions.***
- ***Question no. 5 to 7consist of two marks questions, which are short answer type questions.***
- ***Question no. 8 to 9 consists of three marks questions, which are long answer type questions.***
- ***Question no. 10 consists of four marks question, which are very long answer type question.***
- ***All the questions are compulsory***
- ***There is no overall internal choice given.***
- ***Use of calculators is not permitted.***
- ***You may use the value of the following physical constants:***

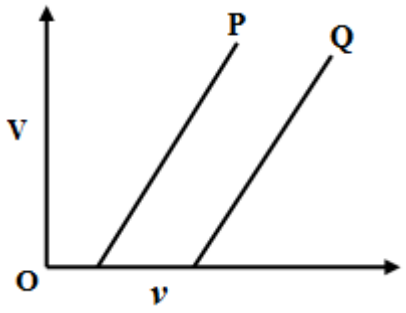
Speed of light (c)	**3×10^{8}m/s**
Plank's constant(h)	**6.626×10^{-34}Js**
Electric charge (e)	**1.602×10^{-19}C**
Mass of Neutron (m_N)	**1.67×10^{-27}Kg**
Mass of proton (m_P)	**1.67×10^{-27}Kg**
Mass of electron (m_e)	**9.10×10^{-31}Kg**

1. When a monochromatic yellow colored light beam is incident on a photosensitive surface, photoelectrons are not ejected, while the same surface gives photoelectrons when exposed to green colored monochromatic beam. Justify your answer if the same photosensitive surface is exposed to :

(a) Violet coloured monochromatic beam of light

(b) Red coloured monochromatic beam of light

2. The graph's between stopping potential V and frequency *v* of the incident radiation on two different metal plates P and Q are shown below.



(a) Which metal out of P and Q has a greater value of work function?

(b) What does the slope of the line depict?

3. The de Broglie wavelength of a particle of kinetic energy K is λ . What would be the wavelength of the particle, if the kinetic energy were K/4?

4. An electron and proton have the same wavelength. Which one possesses:

(a) Greater value of energy.

(b) Less value of momentum .

5. Show that the rest mass of a photon is zero. A radio transmitter operates at a frequency of 800 kHz and has a power of 1kW. Find the number of photons emitted per second.

6. Ultraviolet radiations of wavelength 800A^o and 700A^o, when allowed to fall on a photosensitive surface are found to liberate electrons with maximum kinetic energies of 2eV and 4.1eV respectively. Calculate the value of the plank's constant.

7. What is the effect on the velocity of the photoelectrons, if the wavelength of the incident light is reduced? The wavelength of a photon is 1.4 A^o. It collides with an electron at rest. Its wavelength after collision is 2.0 A^o. Calculate the energy of the scattered electron.

8. Write the Einstein's photoelectric equation. Explain how it enables us to understand:

(a) Linear dependence, of the maximum kinetic energy of the emitted electrons, on the frequency of the radiation.

(b) Existence of a threshold frequency for a given photoemmiter.

(c) Independence of the maximum energy of the emitted photoelectrons from the intensity of the incident light.

9. Show that the de Broglie wavelength of an electron accelerated through a potential difference of V volts is equal to $\frac{12.3}{\sqrt{V}}$**.** Hence find the de Broglie wavelength associated with an electron, accelerated through a potential difference of 100 volts.

10. Answer the following: **(1+1+ 2)**

(a) The maximum kinetic energy of a photoelectron is 3eV. What is its cut-off voltage?

(b) What are alkali metals most suited as photosensitive metals?

(c) Radiations of frequencies v_1 and v_2 are made to fall in turn, on a photosensitive surface. The stopping potentials required for stopping the most energetic photoelectrons in the two cases are V_1 and V_2 respectively. Show that the threshold frequency is equal to $\frac{v_1 V_2 - v_2 V_1}{V_2 - V_1}$**.**