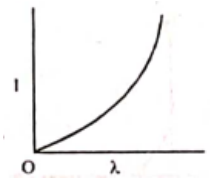
DUAL NATURE
PART-I (SINGLE CORRECT MCQS)
PHYSICS

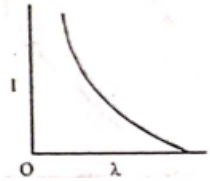
1. **Two identical photocathodes receive light of frequencies f_1 and f_2. If the velocities of the photo electrons (of mass m) coming out are respectively v_1 and v_2, then**

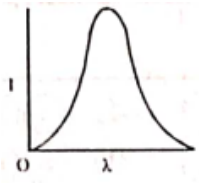
1) $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$ 2) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{1/2}$

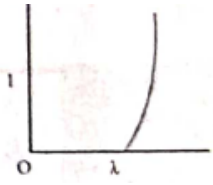
3) $v_1^2 + v_2^2 = \frac{2h}{m}(f_1 + f_2)$ 4) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}$

2. **The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows**

1) 

2) 

3) 

4) 

3. **In a photoelectric experiment, with light of wavelength λ the fastest electron has speed v. If the exciting wavelength is changed to $5\lambda/4$, the speed of the fastest emitted electron will become**

1) $v\sqrt{\frac{5}{4}}$ 2) $v\sqrt{\frac{5}{3}}$ 3) less than $v\sqrt{\frac{5}{3}}$ 4) greater than $v\sqrt{\frac{5}{3}}$

4. **The wavelength λ_e of an electron and λ_p of a photon are of same energy E are related by**

1) $\lambda_p \alpha \lambda_e$ 2) $\lambda_p \alpha \sqrt{\lambda_e}$ 3) $\lambda_p \alpha \frac{1}{\sqrt{\lambda_e}}$ 4) $\lambda_p \alpha \lambda_e^2$

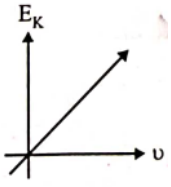
5. **The cathode of a photoelectric cell is changed such that the work function changes from W_1 to W_2 ($W_2 > W_1$). If the current before and after changes are I_1 and I_2, all other conditions remaining unchanged, then (assuming $h\nu > W_2$)**

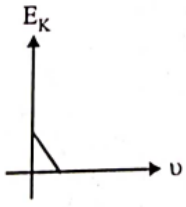
1) $I_1 = I_2$ 2) $I_1 < I_2$ 3) $I_1 > I_2$ 4) $I_1 < I_2 < 2I_1$

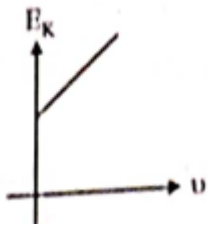
6. **The maximum velocity of an electron emitted by light of wavelength λ incident on the surface of a metal of work function ϕ is**

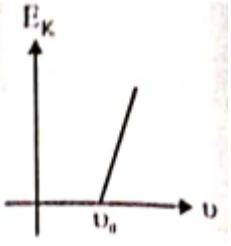
1) $\sqrt{\frac{2(hc + \lambda\phi)}{m\lambda}}$ 2) $\frac{2(hc + \lambda\phi)}{m\lambda}$ 3) $\sqrt{\frac{2(hc - \lambda\phi)}{m\lambda}}$ 4) $\sqrt{\frac{2(h\lambda - \phi)}{m}}$

7. **Which one of the following graphs represents the variation of maximum kinetic energy (E_K) of the emitted electrons with frequency ν in photoelectric effect correctly?**

1) 

2) 

3) 

4) 

8. **If E_1, E_2 , E_3 are the respective kinetic energies of an electron, an alpha-particle and a proton, each having the same dc-Broglie wavelength, then**

1) $E_1 > E_3 > E_2$ 2) $E_2 > E_3 > E_1$ 3) $E_1 > E_2 > E_3$ 4) $E_1 = E_2 = E_3$

9. **In photoelectric effect, stopping potential for a light of frequency n_1 is V_1. If light is replaced by another having a frequency n_2 then its stopping potential will be**

1) $V_1-\frac{h}{e}(n_2-n_1)$ 2) $V_1+\frac{h}{e}(n_2+n_1)$ 3) $V_1+\frac{h}{e}(n_2-2n_1)$ 4) $V_1+\frac{h}{e}(n_2-n_1)$

10. A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photoelectric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photo-electric effect is

1) 4λ 2) $\lambda/4$ 3) $\lambda/6$ 4) 6λ

11. The ratio of the respective de Broglie wavelengths associated with electrons accelerated from rest with the voltages 100 V, 200 V and 300 V is

1) 1:2:3 2)1:4:9 3) $1:\frac{1}{\sqrt{2}}:\frac{1}{\sqrt{3}}$ 4) $1:\frac{1}{2}:\frac{1}{3}$

12. Two radiations of photons energies 1 eV and 2.5 eV successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is:

1) 1:4 2) 1:2 3) 1:1 4) 1:5

13. Photoelectric emission is observed from a metallic surface for frequencies v_1 and v_2 of the incident light rays ($v_1>v_2$). If the maximum values of kinetic energy of the photoelectrons emitted in the two cases are in the ratio of 1: k, then the threshold frequency of the metallic surface is

1) $\frac{v_1-v_2}{k-1}$ 2) $\frac{kv_1-v_2}{k-1}$ 3) $\frac{kv_2-v_1}{k-1}$ 4) $\frac{v_2-v_1}{k-1}$

14. In an electron gun, the potential difference between the filament and plate is 3000 V. What will be the velocity of electron emitting from the gun?

1) $3\times10^8 m/s$ 2) $3.18\times10^7 m/s$ 3) $3.52\times10^7 m/s$ 4) $3.26\times10^7 m/s$

15. In the photoelectric effect, electrons are emitted

1) at a rate that is proportional to the amplitude of the incident radiation
2) with a maximum velocity proportional to the frequency of the incident radiation
3) at a rate that is independent of the emitter
4) only if the frequency of the incident radiations is above a certain threshold value

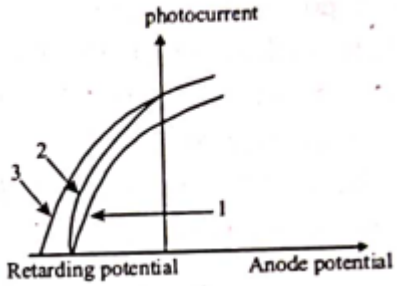
16. Light of wavelength 500 nm is incident on a metal with work function 2.28 eV. The de Broglie wavelength of the emitted electron is:

1) $<2.8\times10^{-9}m$ 2) $\geq2.8\times10^{-9}m$ 3) $\leq2.8\times10^{-12}m$ 4) $<2.8\times10^{-10}m$

17. An electron of mass m and charge e initially at rest gets accelerated by a constant electric field E. The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is

1) $\frac{-h}{eEt^2}$ 2) $\frac{-eht}{E}$ 3) $\frac{-mh}{eEt^2}$ 4) $\frac{-h}{eE}$

18. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement?

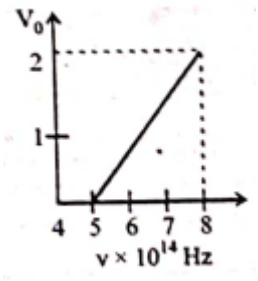


1) Curves (1) and (2) represent incident radiations of same frequency but of different intensities.
2) Curves (2) and (3) represent incident radiations of different frequencies and different intensities.
3) Curves (2) and (3) represent incident radiations of same frequency having same intensity.
4) Curves (1) and (2) represent incident radiations of different frequencies and different intensities.

19. The de-Broglie wavelength of neutron in thermal equilibrium at temperature T is

1) $\frac{30.8}{\sqrt{T}}A^0$ 2) $\frac{3.08}{\sqrt{T}}A^0$ 3) $\frac{0.308}{\sqrt{T}}A^0$ 4) $\frac{0.0308}{\sqrt{T}}A^0$

20. The stopping potential (V_0) versus frequency (v) plot of a substance is shown in figure, the threshold wavelength is



1) $5\times10^{14}m$ 2) $6000A^0$ 3) $5000A^0$ 4) Cannot be estimated from given data

PART-II
(NUMERIC/INTEGER TYPE QUESTIONS)

21. A 200 W sodium street lamp emits yellow light of wavelength 0.6 μm. Assuming it to be 25% efficient in converting electrical energy to light, then find the number of photons of yellow light it emits per second?

22. Monochromatic radiation emitted when electron on hydrogen atom jumps from first excited to the ground state irradiates a photosensitive material. The stopping potential is measured to be 3.57 V. Then what will be the threshold frequency (in Hz) of the materials?

23. When the energy of the incident radiation is increased by 20%, the kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. Then what is the work function (in eV) of the metal?

24. A 5 watt source emits monochromatic light of wavelength 5000 A^0. When placed 0.5 m away, it liberates photoelectrons from a photosensitive metallic surface. When the source is moved to a distance of 1.0m, the number of photoelectrons liberated will be reduced by a factor x. Then find the value of x.

25. An X-ray tube is operated at 15 kV. Calculate the upper limit of the speed (in m/s) of the electrons striking the target.

KEY SHEET

PHYSICS

1) **1**	2) **2**	3) **3**	4) **4**	5) **1**	6) **3**	7) **4**	8) **1**	9) **4**	10) **1**
11) **3**	12) **2**	13) **2**	14) **4**	15) **4**	16) **2**	17) **1**	18) **1**	19) **1**	20) **2**
21) 1.5×10^{20}	22) 1.6×10^{15}	23) **1**	**24)** 0.25	24) 7.26×10^{7}					