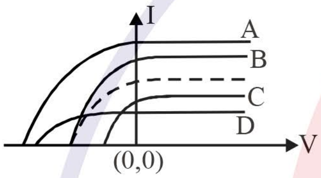
**1.** A 200 W sodium street lamp emits yellow light of wavelength 0.6 μm. Assuming it to be 50% efficient in converting electrical energy to light, the number of photon of yellow light it emits per second is :-

(1) $62 \times 10^{20}$ (2) $3 \times 10^{20}$

(3) $1.5 \times 10^{20}$ (4) $6 \times 10^{18}$

**2.** Across a photoelectric cell a source of variable potential difference is connected and the photoelectric current is plotted against the applied potential difference. The graph in broken lines represents a curve of current vs applied potential difference. If the frequency is increased and the intensity is reduced, the curve which may now represents the situation is:

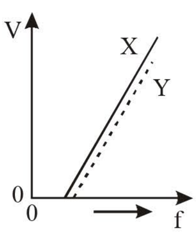


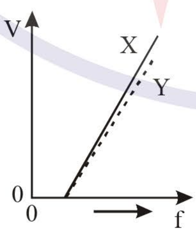

(1) A (2) B (3) C (4) D

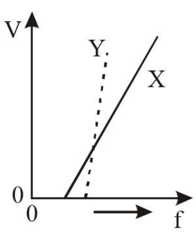
**3.** A silver ball of radius 4.8 cm is suspended by a thread in the vacuum chamber. UV light of wavelength 200 nm is incident on the ball for some times during which a total energy of $1 \times 10^{-7}$ J falls on the surface. Assuming on an average one out of $10^3$ photons incident is able to eject electron. The potential on sphere will be

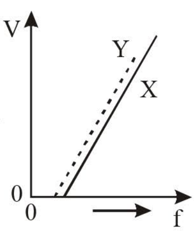
(1) 1 V (2) 2 V (3) 3 V (4) Zero

**4.** In a photoelectric emission, electrons are ejected from metals X and Y by light of frequency f. The potential difference V required to stop the electrons is measured for various frequencies. If Y has a greater work function than X, which graph illustrates the expected results :-

(1) 


(2) 


(3) 


(4) 


**5.** A beam of white light is incident normally on a plane surface absorbing 70% of the light and reflecting the rest. If the incident beam carries 10W of power, find the force exerted by it on the surface.

(1) $4.33 \times 10^{-8}$ N (2) $5.76 \times 10^{-8}$ N

(3) $10.11 \times 10^{-6}$ N (4) None

**6.** When a photosensitive surface is illuminated with light of wavelength $\lambda$, the stopping potential is V. When the same surface is illuminated by light of wavelength $2\lambda$, stopping potential is $\frac{V}{3}$. If the threshold wavelength for the surface is $n\lambda/2$, then n =

(1) 2 (2) 4

(3) 8 (4) 12

**7.** A metal plate is exposed to light with wavelength $\lambda$. It is observed that electrons are ejected from the surface of the plate. When a retarding uniform electric field E is imposed, no electron can move away from the plate farther than a certain distance d. Then the threshold wavelength $\lambda_0$ for the material of plate is (e is the electronic charge, h is Planck's constant and c is the speed of light) :-

(1) $\lambda_0 = \left(\frac{1}{\lambda} - \frac{hc}{eEd}\right)^{-1}$ (2) $\lambda_0 = \left(\frac{1}{\lambda} - \frac{eEd}{hc}\right)^{-1}$

(3) $\lambda_0 = \lambda - \frac{hc}{eEd}$ (4) $\lambda_0 = \lambda - \frac{eEd}{hc}$

**8.** When photons of energy hν fall on an aluminium plate (of work function $E_0$), photoelectrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be-

(1) 2K (2) K

(3) K + hν (4) K + $E_0$

**9.** When a certain metallic surface is illuminated with mono-chromatic light of wavelength $\lambda$, the stopping potential for photo electric current is $6V_0$. When the same surface is illuminated with light of wavelength $2\lambda$, the stopping potential is $2V_0$. The threshold wavelength of this surface for photoelectric effect is-

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

(3) $4\lambda$ (4) $8\lambda$

**10.** A source of light is placed at a distance of 20 cm from a photo cell and stopping potential is found to be 0.6 V. If the distance of source is now changed to 40 cm the stopping potential will be-

(1) 0.3 V (2) 0.6 V

(3) 1.2 V (4) 2.4 V

**11.** Ultraviolet light of wavelength 300 nm and intensity 1.0 watt/m$^2$ falls on the surface of a photosensitive material. If 1 % of the incident photons produce photoelectrons, then the number of photoelectrons emitted from an area of 1.0 cm$^2$ of the surface-

(1) $9.61 \times 10^{14}$ per sec

(2) $4.12 \times 10^{13}$ per sec

(3) $1.51 \times 10^{12}$ per sec

(4) $2.13 \times 10^{11}$ per sec

**12.** A sensor is exposed for time t to a lamp of power P placed at a distance $\ell$. The sensor has an opening that is 4d in diameter. Assuming all energy of the lamp is given off as light, the number of photons entering the sensor if the wavlength of light is $\lambda$ is-

(1) $N = \frac{P\lambda d^2 t}{hcl^2}$ (2) $N = \frac{4P\lambda d^2 t}{hcl^2}$

(3) $N = \frac{P\lambda d^2 t}{4hcl^2}$ (4) $N = \frac{P\lambda d^2 t}{16hcl^1}$

**13.** The intensity of sunlight on the surface of earth is 1400 W/m$^2$. Assuming the mean wavelength of sunlight to be 6000 Å, calculate:–

(a) The photon flux arriving at 1 m$^2$ area on earth perpendicular to light radiations and

(b) The number of photons emitted from the sun per second (Assuming the average radius of Earth's orbit to be $1.49 \times 10^{11}$ m)

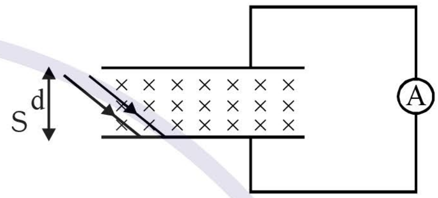
(1) $4.22 \times 10^{21}$ photons/sec, $1.18 \times 10^{45}$

(2) $1.18 \times 10^{45}$ photons/sec, $4.22 \times 10^{21}$

(3) $2.22 \times 10^{21}$ photons/sec, $1.18 \times 10^{45}$

(4) $4.22 \times 10^{21}$ photons/sec, $0.18 \times 10^{45}$

**14.** In an experiment on photoelectric effect, the emitter and the collector plates are placed at a separation d and are connected through an ammeter without any cell. A magnetic field B exists parallel to the plates (as shown). The work function of the emitter is $\phi$ and light incident on it has wavelength $\lambda$. Then the minimum value of B for which ammeter registers zero current will be
(Take mass of electron as m and charge on it is e)




(1) $\frac{1}{2d}\sqrt{m\left(\frac{hc}{\lambda}-\phi\right)}$ (2) $\frac{2}{ed}\sqrt{2m\left(\frac{hc}{\lambda}-\phi\right)}$

(3) $\frac{1}{ed}\sqrt{m\left(\frac{hc}{\lambda}-\frac{\phi}{2}\right)}$ (4) $\frac{2}{ed}\sqrt{m\left(\frac{2hc}{\lambda}-\phi\right)}$

**15.** In P.E.E, $K_{max}$ of electrons is 2.0 eV. If frequency of light is decreased by 40% then $K_{max}$ is 1.0 eV. Work function of electron emitter is :-

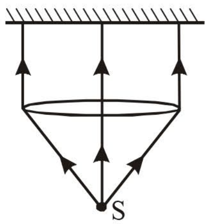
(1) 4 eV (2) 0.5 eV (3) 2 eV (4) 1 eV

**16.** A cathode emits $1.8 \times 10^{14}$ electrons per second, when heated, when 400V is applied to anode all the emitted electrons reach the anode. The charge on electron is $1.6 \times 10^{-19}$C. The maximum anode current is :-

(1) 27μA (2) 29μA

(3) 72μA (4) 29mA

**17.** A totally reflecting small plane mirror placed horizontally faces a parallel beam of light as shown in figure. The mass of mirror is 20 gm. Assume that there is no absorption in the lens and that 30% of the light emitted by the source goes through the lens. Find the power of the source needed to support the weight of the mirror (take g = 10 m/s$^2$) :-




(1) 80 MW (2) 100 MW

(3) 20 MW (4) 25 MW

**18.** Electromagnetic wave of intensity 1400 W/m² falls on metal surface on area 1.5 m² is completely absorbed by it. Find out force exerted by beam.

(1) $14 \times 10^{-5}$ N (2) $14 \times 10^{-6}$ N
(3) $7 \times 10^{-5}$ N (4) $7 \times 10^{-6}$ N

**19.** A proton is accelerated through a potential difference of 400 V. To have same de-Broglie wavelength, what potential difference must be applied across doubly ionised $_8O^{16}$ atom :-

(1) 50 volt (2) 12.5 volt
(3) 100 volt (4) 25 volt

**20.** The de-Broglie wavelength of a particle moving with a velocity $2.25 \times 10^8$ m/s is equal to the wavelength of photon. The ratio of kinetic energy of the particle to the energy of the photon is
(velocity of light is $3 \times 10^8$ m/s)

(1) 1/8 (2) 3/8
(3) 5/8 (4) 7/8

**21.** The ratio of de-Broglie wavelength of α-particle to that of a proton being subjected to the same magnetic field so that the radii of their path are equal to each other assuming the field induction vector $\vec{B}$ is perpendicular to the velocity vectors of the α-particle and the proton is

(1) 1 (2) $\frac{1}{4}$ (3) $\frac{1}{2}$ (4) 2

**22.** An e-m wave of wavelength λ is incident on a photo sensitive surface of negligible work function. If the photoelectrons emitted from this surface have the de-Broglie wavelength $\lambda_1$. Find relation between 'λ' and '$\lambda_1$' :-

(1) $\lambda = \left(\frac{2mC}{h}\right)\lambda_1^2$ (2) $\lambda = \left(\frac{mC}{2h}\right)\lambda_1^2$

(3) $\lambda_1 = \left(\frac{2mC}{h}\right)\lambda^2$ (4) None

**23.** A particle of mass 3m at rest decays into two particle of masses m and 2m having non-zero velocities. The ratio of the de-Broglie wavelength of the particles $(\lambda_1/\lambda_2)$ is :-

(1) 1/2 (2) 1/4
(3) 2 (4) None of these

**24.** With what potential an electron should be accelerated so that its de Broglie wave-length becomes equal to the wave length of second line of Balmer series for He⁺ ion ?

(1) $\frac{9R^2h^2}{32me}$ (2) $\frac{162R^2h^2}{25me}$ (3) $\frac{81R^2h^2}{32me}$ (4) $\frac{32R^2h^2}{81me}$

**25.** A particle of mass 'm' is projected from ground with velocity 'u' making angle θ with the vertical. The de-Broglie wavelength of the particle at the highest point is -

(1) ∞ (2) h/musinθ
(3) h/mucosθ (4) h/mu

**26.** The de–Broglie wavelength of a neutron at 27°C is λ. What will be its wavelength at 927°C?

(1) $\frac{\lambda}{2}$ (2) $\frac{\lambda}{3}$ (3) $\frac{\lambda}{4}$ (4) $\frac{\lambda}{9}$

**27.** In Davisson-Germer experiment an electron beam of energy 60 eV falls normally on the surface of a crystal. If the maximum intensity is obtained at an angle of 60° to the direction of incident beam, then the inter-atomic distance in the lattice plane of the crystal will be-

(1) 18 Å (2) 3.6 Å
(3) 1.8 Å (4) 0.18 Å

**28.** An α–particle moves in circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb/m². Find the De Broglie wavelength associated with the particle.

(1) 0.01 Å (2) 0.02 Å (3) 0.03 Å (4) 0.04 Å

**29.** Proton, deutron and α particles are accelerated through the same potential difference. Then the ratio of their de-Broglie wavelength as

(1) $1:\sqrt{2}:1$ (2) 1 : 1 : 1
(3) $1:2:2\sqrt{2}$ (4) $2\sqrt{2}:2:1$

**30.** An alpha particle and a proton are fired through the same magnetic field which is perpendicular to their velocity vectors. Both move such that radius of curvature of their paths is same. The ratio of their de-Broglie wave lengths is :-

(1) 2 : 3 (2) 3 : 4 (3) 5 : 7 (4) 1 : 2

## ANSWER KEY — Exercise-I

| Que. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ans.** | **2** | **4** | **3** | **1** | **1** | **3** | **2** | **3** | **3** | **2** |
| **Que.** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Ans.** | **3** | **1** | **1** | **2** | **2** | **2** | **2** | **4** | **2** | **2** |
| **Que.** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| **Ans.** | **3** | **1** | **4** | **1** | **2** | **1** | **3** | **1** | **4** | **4** |