1.

STATEMENT – 1

The number of photoelectrons emitted by a metal plate illuminated by light of a certain frequency, greater than the threshold of frequency, depends on the area of the plate. Correct.

STATEMENT – 2

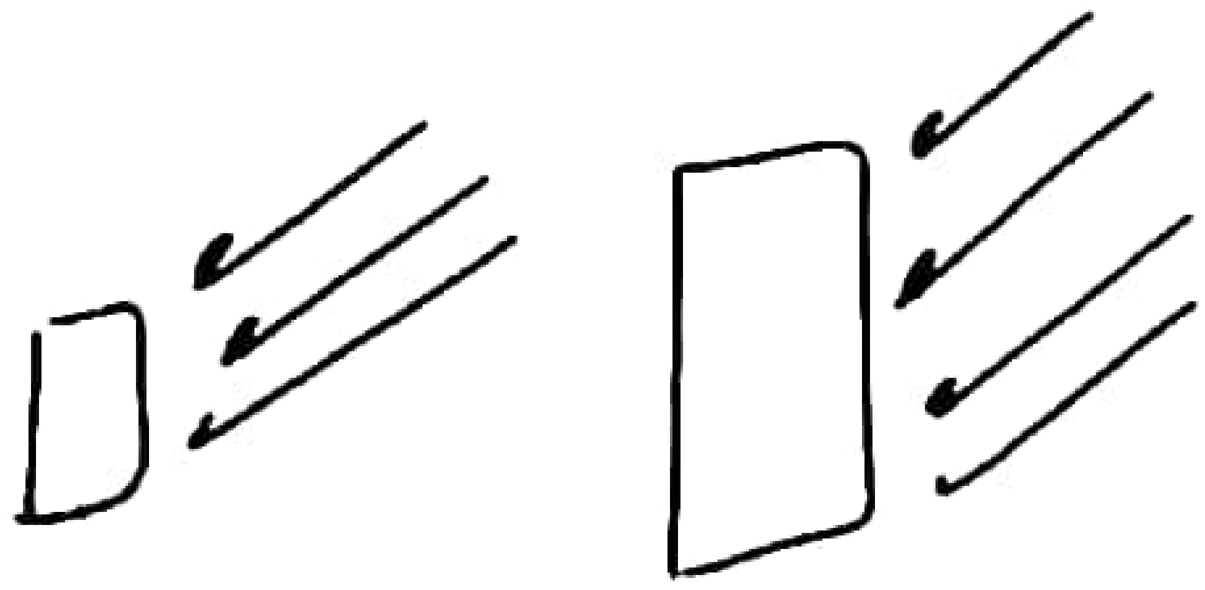
The number of electrons emitted per second will depend on the number of photons falling on the plate per second. Correct.

(A*) Statement – 1 and Statement – 2 are True ✓

(B) Statement – 1 and Statement – 2 are False.

(C) Statement – 1 is True, Statement – 2 is False.

(D) Statement – 1 is False, Statement – 2 is True.



2.

A particle of mass M at rest decays into two particles of masses m_1 and m_2 having non-zero velocities. The ratio of the de Broglie wavelength of the particles -

(A) $\frac{m_1}{m_2}$ (B) $\frac{m_2}{m_1}$ (C*) 1 (D) $\sqrt{\frac{m_2}{m_1}}$

$0 = -m_1 v_1 + m_2 v_2$

$m_1 v_1 = m_2 v_2$

$\lambda_1 = \frac{h}{m_1 v_1}$ $\lambda_1 = \lambda_2$

$\lambda_2 = \frac{h}{m_2 v_2}$ $\Rightarrow \frac{\lambda_1}{\lambda_2} = 1$

3.

The de Broglie wavelength of a bus moving with speed v is λ. Some passengers left the bus at a stopage. Now when the bus moves with twice its initial speed. Now kinetic energy is found to be twice its initial value. What will be the de Broglie wavelength, now -

(A) λ (B) 2λ (C) λ/2 (D) λ/4

Sol: $\lambda = \frac{h}{mv}$

New speed $v' = 2v$

$K' = 2K$

$\frac{1}{2}m'v'^2 = 2 \times \frac{1}{2}mv^2$

$m' \times 4v^2 = 2mv^2$

$m' = \frac{m}{2}$

$\lambda' = \frac{h}{\frac{m}{2} \times 2v}$

$\lambda' = \frac{h}{mv} = \lambda$

4.

The number of photons of wavelength 540 nm emitted per second by an electric bulb of power 100 W is (taking h = 6 × 10^{-34} J-s)-

(A) 100 (B) 1000 (C) 3 × 10^{20} (D) 3 × 10^{18}

$\text{Power} = \frac{E}{t} = \frac{N \times h\nu}{t}$

$\frac{N}{t} = \frac{\text{Power} \times \lambda}{hc}$

$= \frac{100 \times 540 \times 10^{-9}}{20 \times 10^{-26}}$

$\frac{N}{t} = 3 \times 10^{20}$

5.

A proton accelerated through a potential difference of 100V, has de-Broglie wavelength λ_0. The de-Broglie wavelength of an α-particle, accelerated through 800V is-

(A) $\frac{\lambda_0}{\sqrt{2}}$ (B) $\frac{\lambda_0}{2}$ (C) $\frac{\lambda_0}{4}$ (D) $\frac{\lambda_0}{8}$ ✓

$$\lambda_0 = \frac{0.286\ \mathring{A}}{\sqrt{100}} = \frac{0.2 \times \sqrt{2}\ \mathring{A}}{\sqrt{100}}$$

$$\lambda_\alpha = \frac{0.1\ \mathring{A}}{\sqrt{800}} = \frac{0.1\ \mathring{A}}{2\sqrt{2} \cdot \sqrt{100}}$$

$$\frac{\lambda_0}{\lambda_\alpha} = 2\sqrt{2} \times 2\sqrt{2} = \frac{8}{1}$$

$$\lambda_\alpha = \frac{\lambda_0}{8}$$

6.

The magnitude of the de Broglie wavelength (λ) of an electron (e), proton (p), neutron (n) and α-particle (α) all having the same energy of MeV, in the increasing order will follow the sequence

(A) $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$ (B) $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$ ✓

(C) $\lambda_e, \lambda_n, \lambda_p, \lambda_\alpha$ (D) $\lambda_p, \lambda_e, \lambda_\alpha, \lambda_n$

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$\lambda \propto \frac{1}{\sqrt{m}}$$

$$m_e < m_p < m_n < m_\alpha$$

$$\lambda_e > \lambda_p > \lambda_N > \lambda_\alpha$$

Increasing → $\lambda_\alpha < \lambda_N < \lambda_P < \lambda_e$

7.

De Broglie wavelength of an electron in the n^{th} bohr orbit is λ_n and angular momentum is J_n then-

(A) $J_n \propto \lambda_n$ (B) $\lambda_n \propto \frac{1}{J_n}$

(C) $\lambda_n \propto J_n^2$ (D) None of these

$$\lambda_n = 2\pi a_0 \times \frac{n}{Z}$$

$$J_n = \frac{nh}{2\pi}$$

$$\frac{\lambda_n}{J_n} = \frac{4\pi^2 a_0}{h \times Z}$$

$$\lambda_n \propto J_n$$

8.

A proton with KE equal to that a photon (E = 100 keV). λ_1 is the wavelength of proton and λ_2 is the wavelength of photon. Then $\frac{\lambda_1}{\lambda_2}$ is proportional to -

(A) $E^{1/2}$ (B) $E^{-1/2}$ (C) E (D) E^{-1}

$$E = K_p = 100 \text{ KeV}$$

$$\lambda_1 = \frac{h}{\sqrt{2mE}}$$

$$\lambda_2 = \frac{hC}{E}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{E}{\sqrt{2mE}} \times C$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{E}{2m}} \times C.$$

$$\frac{\lambda_1}{\lambda_2} \propto E^{1/2}.$$

9.

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

(A) $\frac{2h}{eEt^2}$ (B) $-\frac{2h}{eEt^2}$ (C) $\frac{h}{eEt^2}$ (D) $-\frac{h}{eEt^2}$

$u = 0$

$a = \frac{eE}{m}$

$-\frac{d\lambda}{dt} = ?$

$v = u + at$

$v = \frac{eEt}{m}$

$\lambda = \frac{h}{mv}$

$\lambda = \frac{h}{eEt}$

$\frac{d\lambda}{dt} = -\frac{h}{eEt^2}$

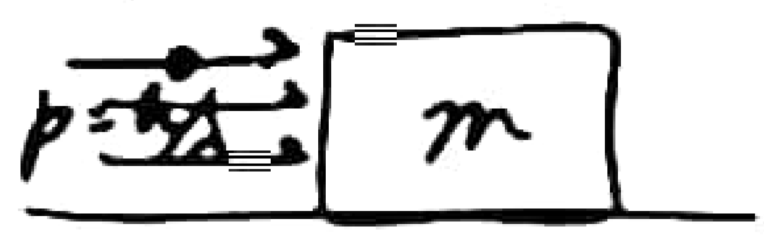
$-\frac{d\lambda}{dt} = \frac{h}{eEt^2}$

10.

Number of identical photons incident on a perfectly black body of mass m kept at rest on smooth horizontal surface. Then the acceleration of the body if n number of photons incident per second is : (Assume wavelength of photon to be λ)

(A) $\frac{nh}{2\pi\lambda m}$ (B) $\frac{nh}{\lambda m}$ (C) $\frac{2\pi nh}{\lambda m}$ (D) $\frac{\lambda m}{nh}$

n photons/sec



$\Delta p = \frac{h}{\lambda}$

$F = \frac{N\Delta p}{\Delta t} = n \times \frac{h}{\lambda}$

$F = ma$

$\frac{nh}{\lambda} = ma$

$a = \frac{nh}{\lambda m}$

11.

λ is proportional to -

(A) $\frac{1}{E}$ for both photons and particles

(B) $\frac{1}{E}$ for photons, $\frac{1}{\sqrt{E}}$ for particle

(C) $\frac{1}{\sqrt{E}}$ for both photons and particles

(D) $\frac{1}{\sqrt{E}}$ for photons, $\frac{1}{E}$ for particles

$$\lambda_{photon} = \frac{hc}{E}$$

$$\lambda_{particle} = \frac{h}{\sqrt{2mE}}$$

$$\lambda_{photon} \propto \frac{1}{E}$$

$$\lambda_{particle} \propto \frac{1}{\sqrt{E}}$$

12.

A radiation of energy E falls normally on a perfectly reflecting surface. Find the change in momentum -

(A) E/c (B) 2E/c (C) Ec (D) E/c^2

$$\Delta p = 2E/c.$$

13.

A double slit interference experiment is performed by a beam of electrons of energy 100 eV and the fringe spacing is observed to be β. Now if the electrons energy is increased to 10 keV, then the fringe spacing -

(A) remains the same
(B) becomes 10β
(C) becomes 100β
(D) becomes β/10

$\beta = \frac{\lambda D}{d}$

$\beta \propto \lambda \propto \frac{1}{\sqrt{V}}$

$\beta \propto \frac{1}{\sqrt{100}}$

$\beta' \propto \frac{1}{\sqrt{10^4}}$

$\frac{\beta}{\beta'} = \sqrt{100} = 10$

$\beta' = \beta/10$

14.

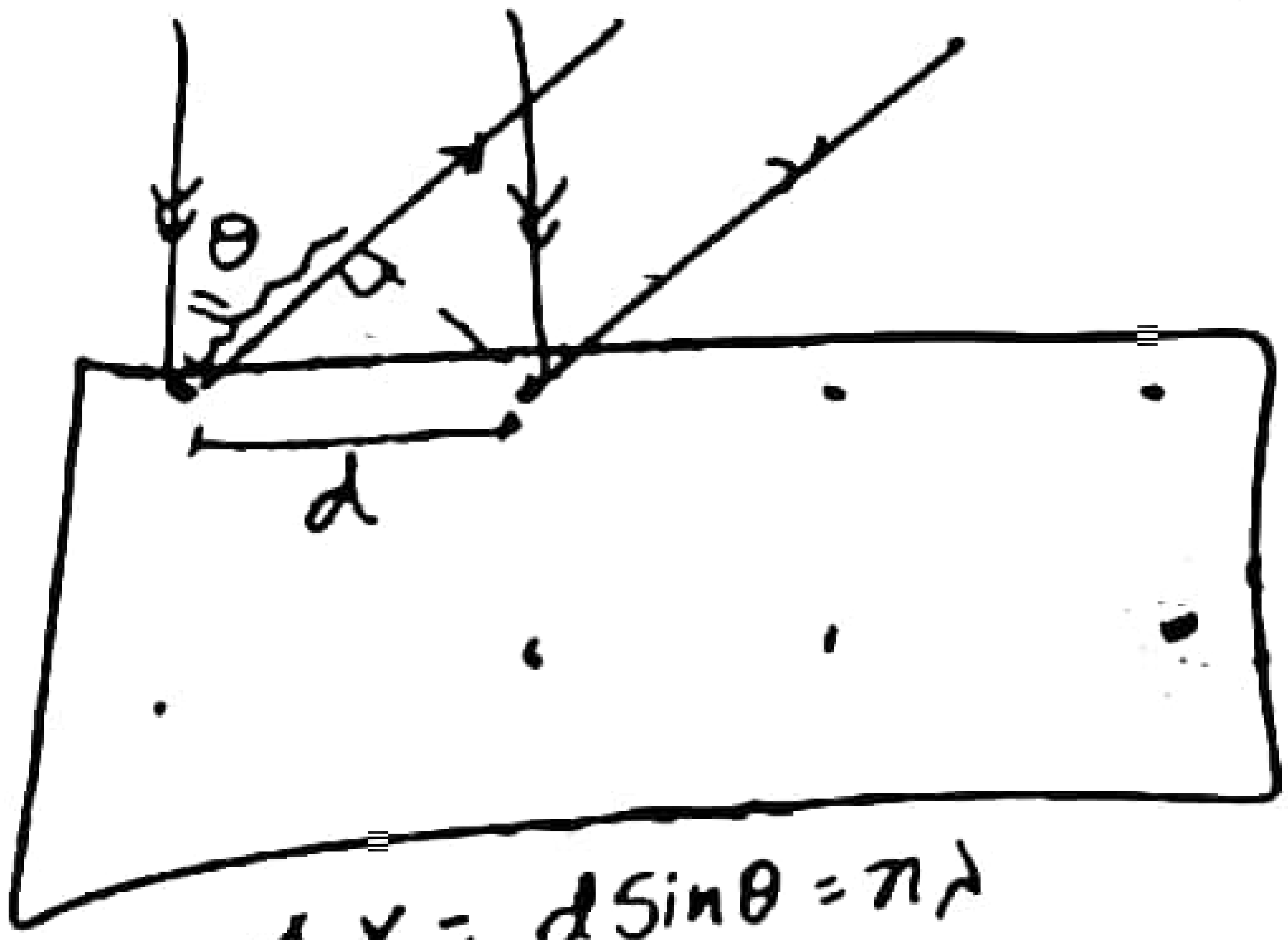
In Davisson-Germer experiment maximum intensity is observed at -

(A) 50° and 54 volt
(B) 54° and 50 volt
(C) 50° and 50 volt
(D) 65° and 50 volt

15.

The interatomic distance between atoms in a crystal is 2.8Å. Then if such a crystal is used in Davisson-Germer experiment, the maximum order of diffraction that can be observed for a beam of electrons accelerated by 100V shall be -

(A) n = 1 (B*) n = 2 (C) n = 10 (D) n = ∞



$\Delta x = d\sin\theta = n\lambda$

$\lambda = \frac{12.27\,\text{Å}}{\sqrt{100}}$

$\lambda = 1.227\,\text{Å}$

for max. order of max.

$\sin\theta = \text{max} = 1$

$d = n\lambda$

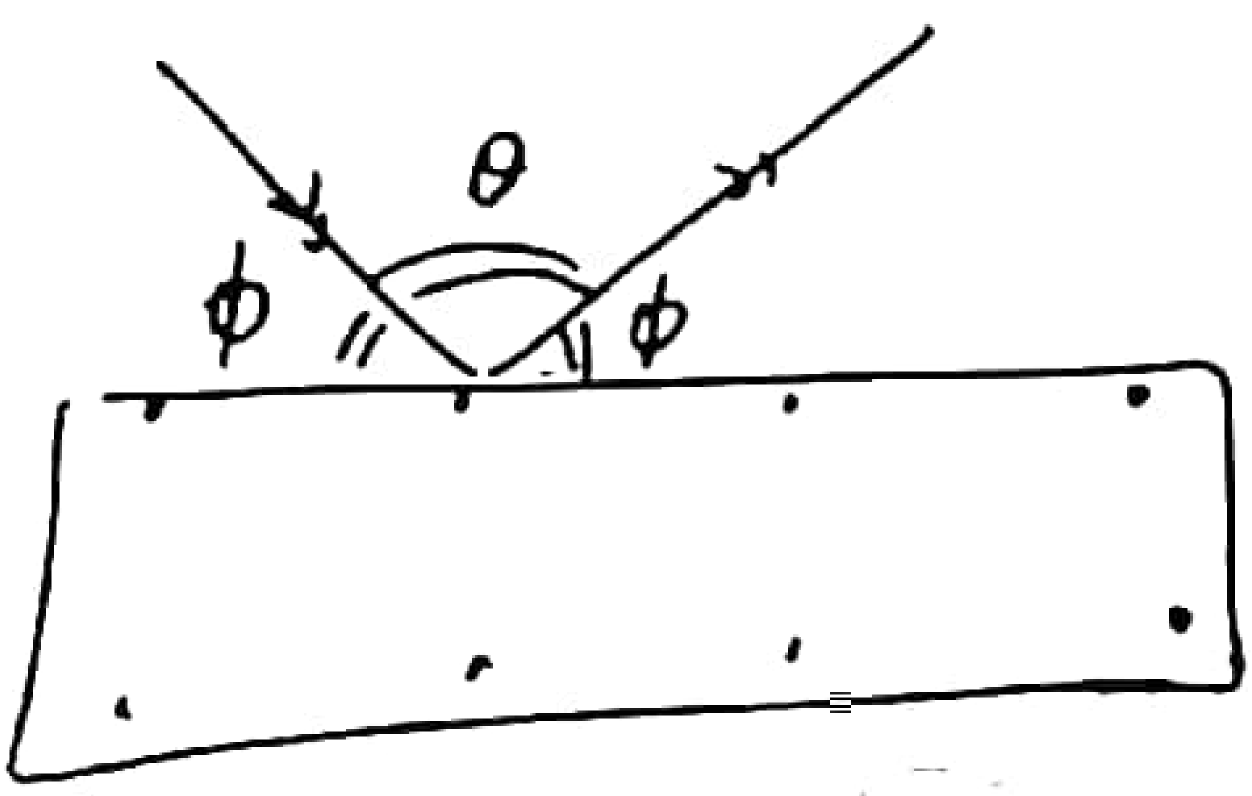
$2.8\,\text{Å} = n \times 1.227\,\text{Å}$

$n_{max} = 2$, order = 2

16.

In Davisson-Germer experiment the relation between Bragg's angle ϕ and diffraction angle θ is-

(A) θ = 90º – ϕ (B) $\theta = \frac{90° - \phi}{2}$ (C) θ = 180º – ϕ (D*) $\phi = \frac{180° - \theta}{2}$



$2\phi + \theta = 180$

$\phi = \frac{180 - \theta}{2}$

17.

STATEMENT – 1

An insulated metal plate emits photoelectrons when first illuminated by ultraviolet light but then the number of photoelectrons emitted per unit time decreases until it stops altogether. Correct

STATEMENT – 2

As more and more electrons leave the plate, its potential increases, decreasing the number of free electrons and finally stopping them. Correct

(A) Statement – 1 and Statement – 2 are True ✓

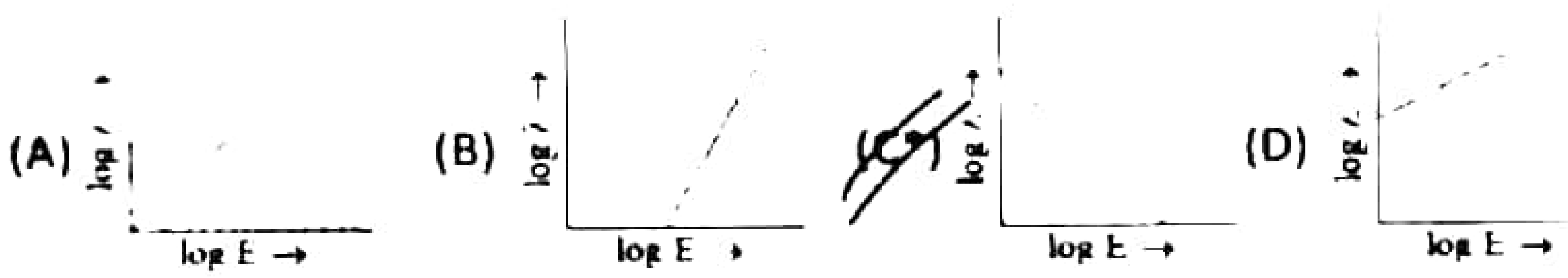
(B) Statement – 1 and Statement – 2 are False.

(C) Statement – 1 is True, Statement – 2 is False.

(D) Statement – 1 is False, Statement – 2 is True.

18.

The log-log graph between the energy E of an electron and its de-Broglie wavelength λ will be -



$\lambda = \frac{h}{\sqrt{2mE}}$

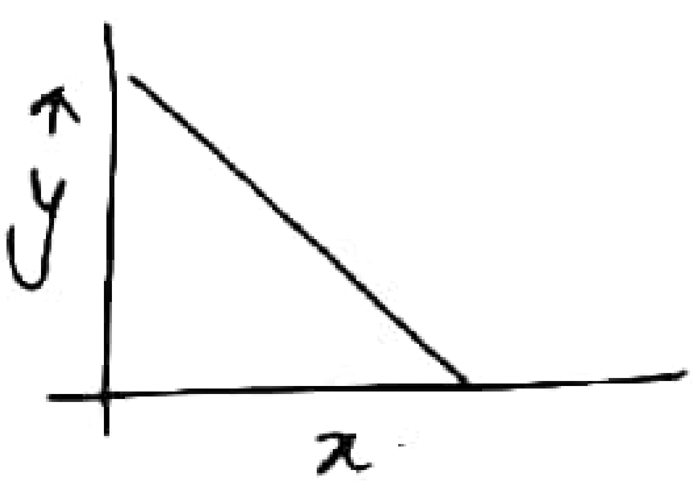
$\lambda \propto \frac{1}{\sqrt{E}}$

$\log \lambda = \log \frac{C}{\sqrt{E}}$

$\log \lambda = \log C - \frac{1}{2}\log E$

$\log \lambda = -\frac{1}{2}\log E + \log C$

$y = -\frac{1}{2}x + C$



19.

The de-Broglie wavelength of a vehicle moving with velocity v is λ. Its load is changed so that the velocity as well as the momentum are doubled. Then the new de-Broglie wavelength of the vehicle will be -

(A) λ (B) 2λ (C) λ/2 (D) λ/4

$\lambda = \frac{h}{p}$

$\lambda' = \frac{h}{2p}$

$\lambda' = \frac{\lambda}{2}$

20.

An electron moving with a velocity of 10^6 m/s in the X-direction enters a region of uniform magnetic field of strength 0.2T in Y-direction. Then its de-Broblie wavelength (in the magnetic field region in comparison to outside) -

(A) increases (B) decreases

(C) remains the same (D) nothing can be predicted

21.

The wavelength of a photon is equal to the de-Broglie wavelength of a thermal neutron at 127°C. The energy of that photon is –

(A) 6×10^3 eV (B) 3×10^4 eV (C) 8.0×10^3 eV (D) 1.2×10^4 eV

$$\lambda_{thermal} = \frac{30.83\ \text{Å}}{\sqrt{T}} = \frac{30.83\ \text{Å}}{20} = \frac{3.083\ \text{Å}}{2}$$

$$\lambda_{photon} = \frac{hc}{E} = \frac{12400\ eV\text{-Å}}{E}$$

$$\frac{12400\ eV\text{-Å}}{E} = \frac{3\ \text{Å}}{2}$$

$$E = \frac{12400 \times 2}{3}\ eV$$

$$E = 8200\ eV \Rightarrow 8.2 \times 10^3\ eV$$

22.

A proton and an α-particle are accelerated through the same potential differences. The ratio of their de-Broglie wavelengths λ_p/λ_α is -

(A) 1 (B) 2 (C) $\sqrt{8}$ (D) $1/\sqrt{8}$

$$\lambda_p = \frac{0.286\ \text{Å}}{\sqrt{V}} = \frac{0.2\sqrt{2}}{\sqrt{V}}$$

$$\lambda_\alpha = \frac{0.101\ \text{Å}}{\sqrt{V}} = \frac{0.1}{\sqrt{V}}$$

$$\frac{\lambda_p}{\lambda_\alpha} = 2\sqrt{2} = \sqrt{8}$$

23.

The ratio of de-Broglie wavelength of molecules of hydrogen and helium in two gas jars kept separately at temperatures of 27ºC and 127ºC respectively is -

(A) $2/\sqrt{3}$ (B) 2/3 (C) $\sqrt{3}/4$ (D) $\sqrt{8/3}$

$$\lambda = \frac{h}{\sqrt{3mkT}}$$

$$\frac{\lambda_{Hyd}}{\lambda_{He}} = \sqrt{\frac{m_{He} T_{He}}{m_{H_2} T_{H_2}}}$$

$$= \sqrt{\frac{4}{2} \times \frac{400}{300}} = \sqrt{\frac{8}{3}}$$

24.

If the kinetic energy of the particle is increased by 16 times, the percentage change in the de-Broglie wavelength of the particle is -

(A) 25% (B) 75% (C) 60% (D) 50%

$$\lambda \propto \frac{1}{\sqrt{K}}$$

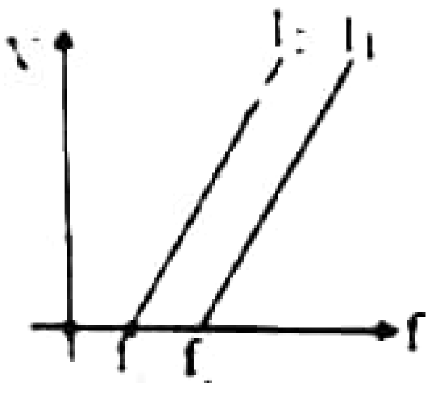
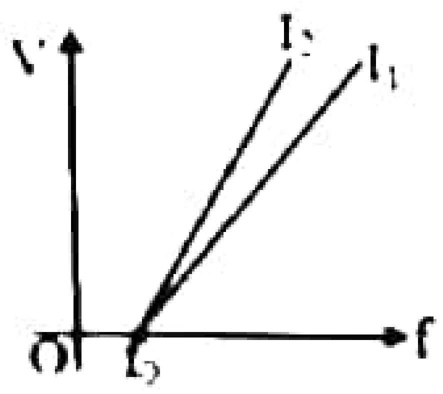
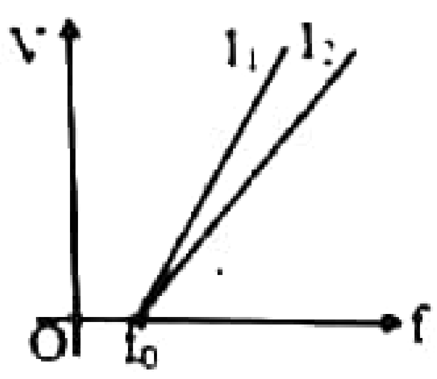
$$\lambda' \propto \frac{1}{\sqrt{16K}}$$

$$\lambda' = \frac{\lambda}{4}$$

% dec in de broglie $= \dfrac{\frac{\lambda}{4} - \lambda}{\lambda} \times 100 = 75\%$

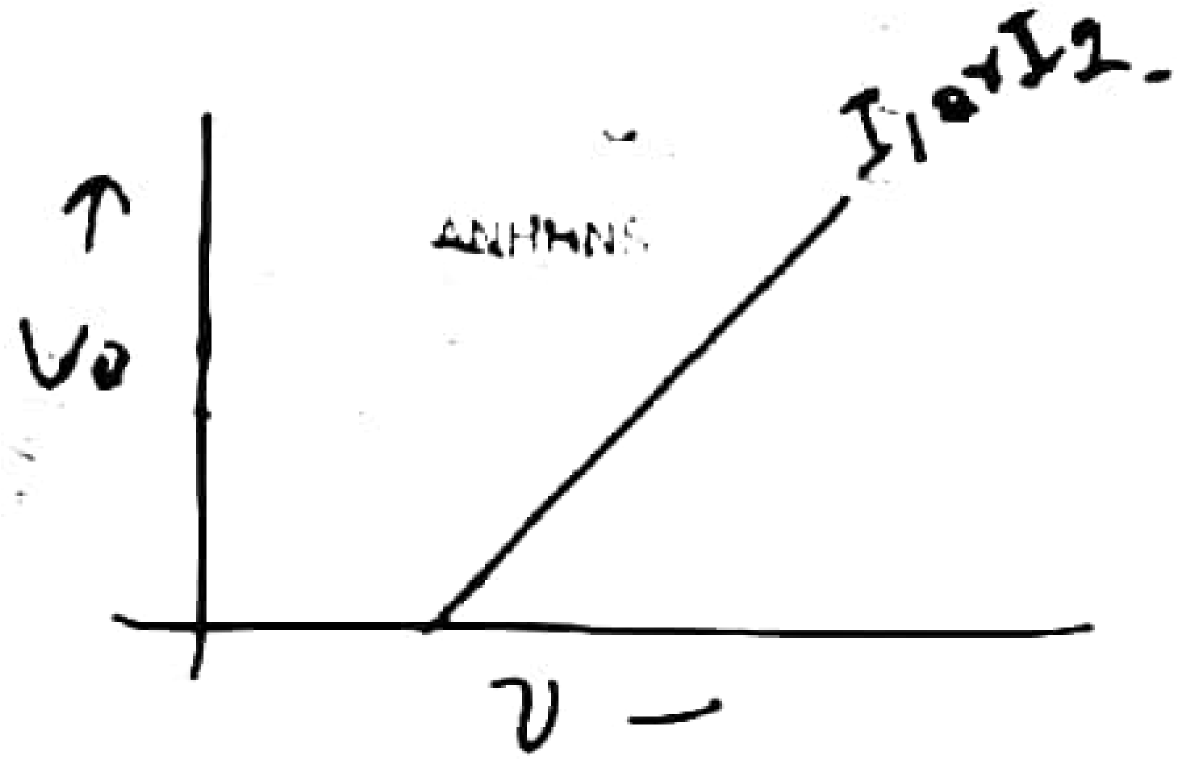
25.

A photoelectric experiment is performed at two different light intensities I_1 and I_2 (> I_1). Choose the correct graph showing the variation of stopping potential versus frequency of light.

(A) 
(B) 
(C) 
(D) None of these

$eV_0 = h\nu - w$

$V_0 = \frac{h}{e}\nu - W$



26.

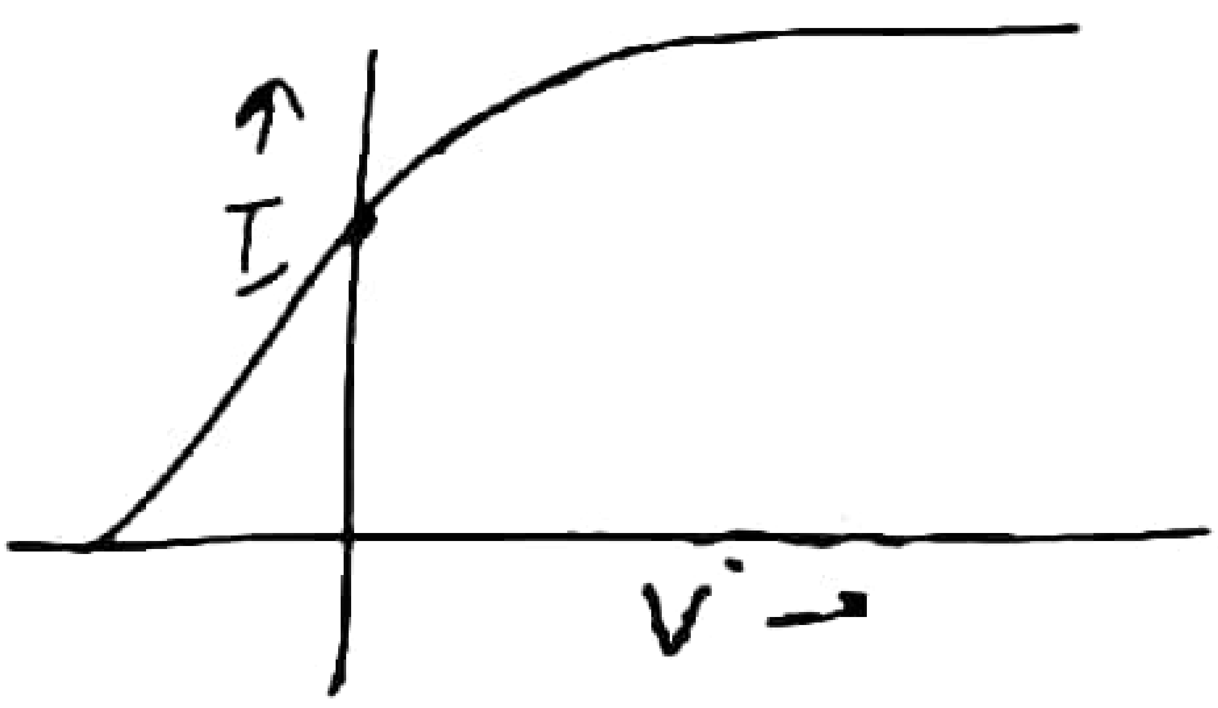
Choose the correct statement (s) related to the photocurrent and the potential difference between the plate and the collector-

(A) Photocurrent always increase with the increase in potential difference

(B) when the potential difference is zero, the photocurrent is also zero

(C) Photocurrent attain a saturation value of some positive value of the potential difference

(D) None of these



27.

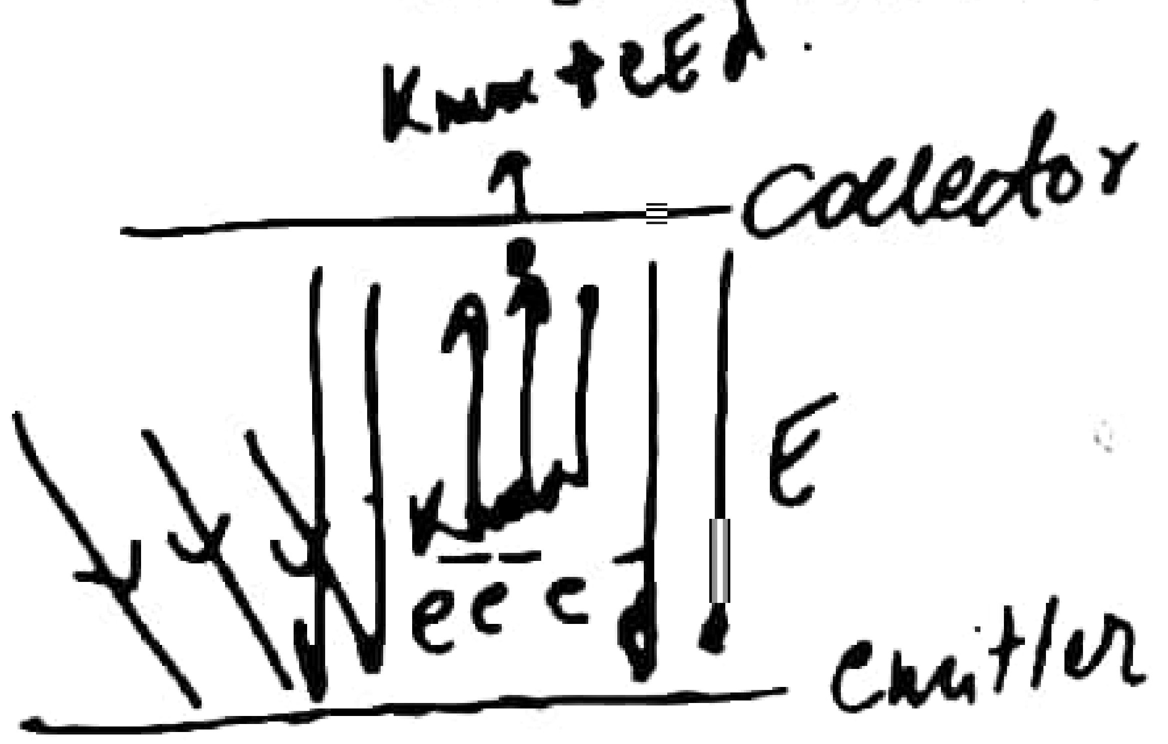
The collector plate in an experiment on photoelectric effect is kept vertically above the emitter plate. Light source is put on and a saturation photocurrent is recorded. An electric field is switched on which has a vertically downward direction.

(A) The photocurrent will increase ✗

(B•) The kinetic energy of the electrons will increase ✓

(C) The stopping potential will decrease ✗

(D) The threshold wavelength will increase ✗



28.

The frequency and intensity of a light source are both doubled. Consider the following statements.

(a) The saturation photocurrent remains almost the same. Correct

(b) The maximum kinetic energy of the photoelectrons is doubled. Incorrect

(A) Both a and b are true
(B•) a is true but b is false
(C) a is false but b is true
(D) Both a and b are false

Intensity $= \frac{N}{t} \times \frac{h\nu}{A}$ $\left(\frac{N}{t}\right)' =$ Same.

Int $= 2I$ $\nu' = 2\nu$

$2I = \left(\frac{N}{t}\right)' \times \frac{h 2\nu}{A}$

No. of photon / time are same so photoelectric current will be same

∵ Energy is double so Kmax will be more than double

29.

Match column I with column II

	COLUMN I		COLUMN II
(A)	De-Broglie wavelength associated with electron in Å → R	(P)	$\frac{0.286}{\sqrt{V}}$
(B)	De-Broglie wavelength associated with proton in Å → P	(Q)	$\frac{0.202}{\sqrt{V}}$
(C)	De-Broglie wavelength associated with alpha particle in Å → S	(R)	$\frac{12.27}{\sqrt{V}}$
(D)	De-Broglie wavelength associated with deuteron in Å → Q	(S)	$\frac{0.101}{\sqrt{V}}$

1. A → Q ; B → R ; C → P ; D → S
2. ✓ A → R ; B → P ; C → S ; D → Q
3. A → S ; B → R ; C → P ; D → Q
4. A → P ; B → R ; C → Q ; D → S

$\lambda_e = \frac{12.27\ \text{Å}}{\sqrt{V}}$

$\lambda_p = \frac{0.286\ \text{Å}}{\sqrt{V}}$

$\lambda_\alpha = \frac{0.101\ \text{Å}}{\sqrt{V}}$

$\lambda_D = \frac{0.202\ \text{Å}}{\sqrt{V}}$

30.

It takes 4.2 eV to remove one of the least tightly bound electrons from a metal surface. When UV photons of a single frequency strike a metal, electrons with kinetic energies ranging from 0 to 2.6 eV are ejected. The energy of incident photon is -

(A) 2.6 eV (B) ✓ 6.8 eV (C) 13.6 eV (D) 13.6/4 eV

$W = 4.2\ eV$

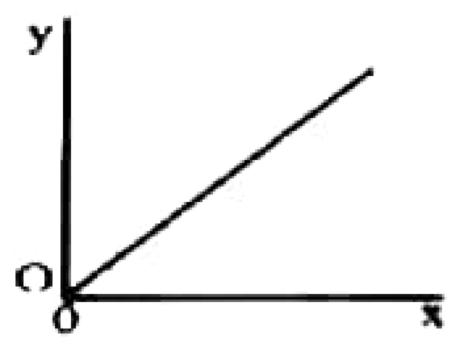
$K_{max} = 2.6\ eV$

$E = W + K_{max}$

$= 6.8\ eV$

31.

In a series of photoelectric emission experiments on a certain metal surface, possible relationships between the following quantities were investigated : threshold frequency f_0, light intensity P, photocurrent I, maximum kinetic energy of photoelectrons T_{max}.



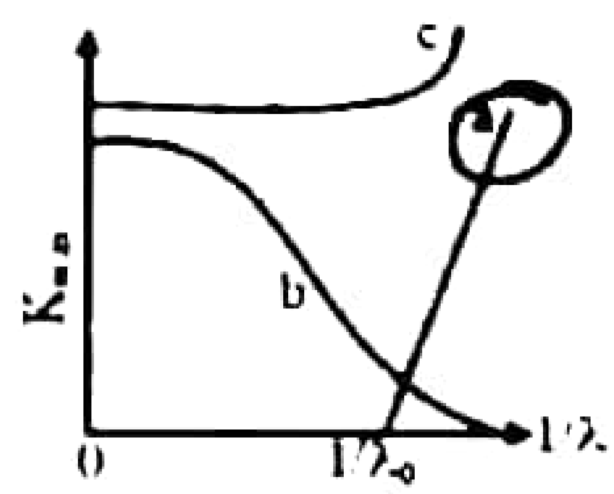
$y \propto x$

Two of these quantities, when plotted as a graph of y against x, give a straight line through the origin. Which of the following correctly identifies x and y with the photoelectric quantities ?

	x	y
(A)	I	f_0 ✗
(B)	f_0	T_{max} ✗
(C)	P	I ✓
(D)	P	T_{max} ✗

32.

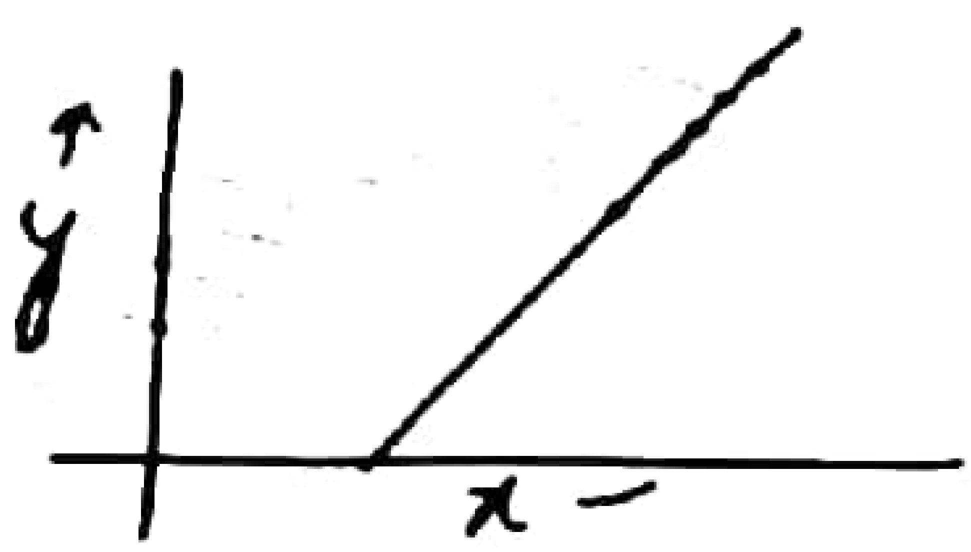
The correct graph between the maximum energy of a photoelectron and the inverse of wavelength of the incident radiation is given by the curve -



(A) a (B) b (C) c (D) None of above

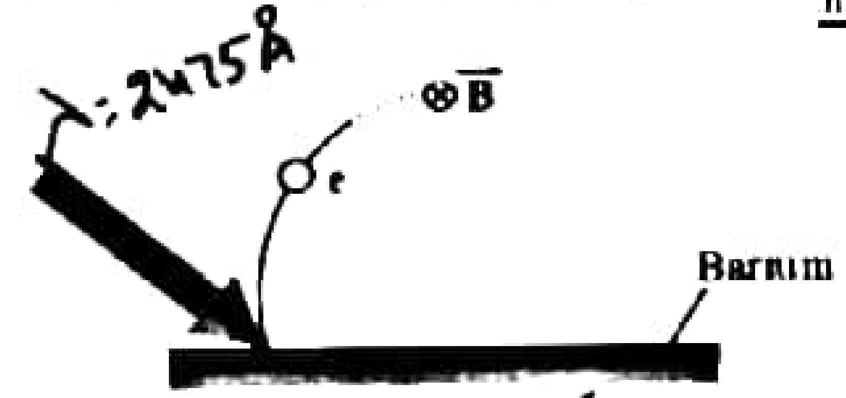
$K_{max} = \frac{hc}{\lambda} - W$

$y = hc \cdot x - W$



33.

Light of wavelength 2475 Å is incident on barium. Photoelectrons emitted describe a circle of radius 100 cm by a magnetic field of flux density ... Tesla. Work function of the barium is (Given $\frac{e}{m} = 1.7 \times 10^{11}$)



(A) 1.8 eV (B) 2.1 eV (C) 4.5 eV (D) 3.3 eV

$r = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$

$\frac{e^2B^2r^2}{2m} = K$

$K(\text{in eV}) = \frac{e}{2m}B^2r^2$

$= \frac{1}{2} \times 1.7 \times 10^{11} \times \frac{1}{17} \times 10^{-10} \times 1$

$= \frac{1}{2}\text{ eV} = 0.5\text{ eV}$

$E = \frac{hc}{\lambda} = \frac{12400\text{ eV-Å}}{2475\text{ Å}} = 5\text{ eV}$

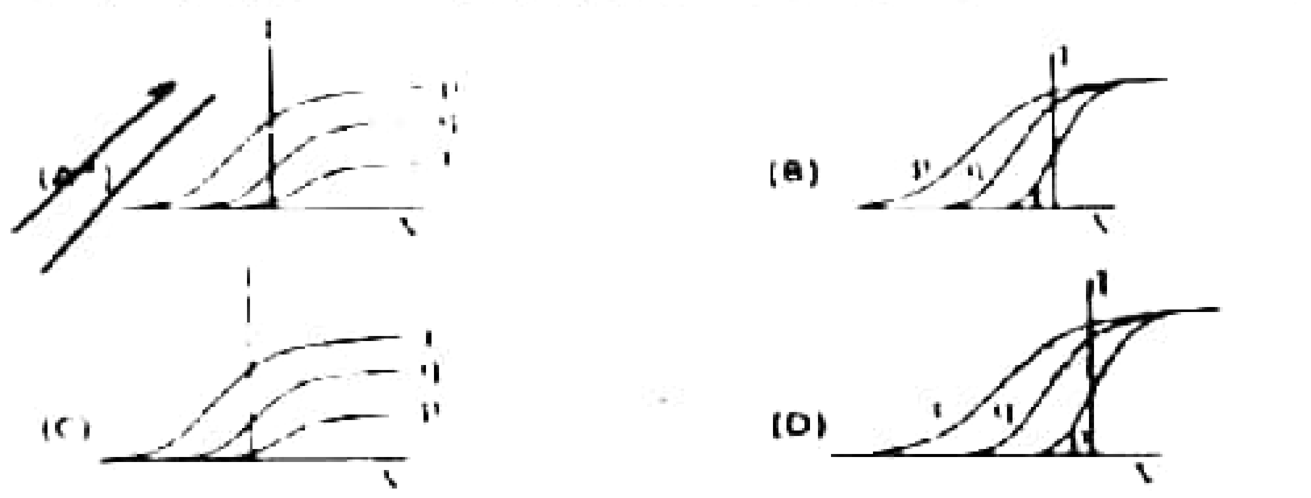
$W = E - K_{max}$

$= 5\text{ eV} - 0.5\text{ eV}$

$= 4.5\text{ eV}$

34.

Photoelectric effect experiments are performed using three different metal plates p, q and r having work functions $\phi_p = 2.0$ eV, $\phi_q = 2.5$ eV and $\phi_r = 3.0$ eV, respectively. A light beam containing wavelengths of 550 nm, 450 nm and 350 nm with equal intensities illuminates each of the plates. The correct I-V graph for the experiment is [Take hc = 1240 eV nm]



$\phi_P = 2\text{ eV}$ $\phi_Q = 2.5\text{ eV}$ $\phi_R = 3\text{ eV}$

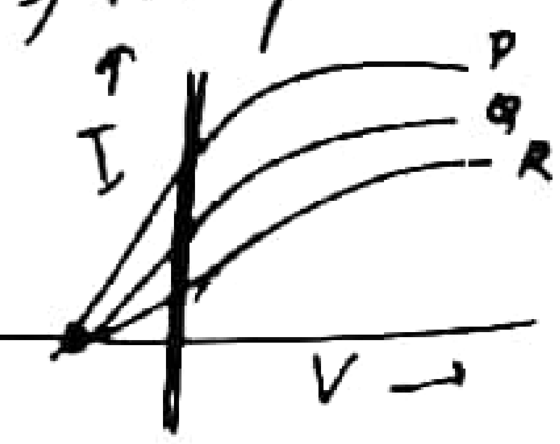
$E_1 = \frac{12400\text{ eV-Å}}{550\text{ nm}} = 2.25\text{ eV}$ $E_2 = \frac{12400\text{ eV-Å}}{450\text{ nm}}$, $E_2 = 2.75\text{ eV}$ $E_3 = \frac{12400}{350} = 3.5\text{ eV}$

$V_{0P} = 3.5 - 2 = 1.5$ volt $V_{0Q} = 1.5$ volt $V_{0R} = 1.5$ volt

at P: $E_1, E_2, E_3 > \phi_P$
all three wavelength will emit photon. Total $= n_1 + n_2 + n_3$

at Q: $E_2, E_3 > \phi_Q$
Total photon $= n_2 + n_3$

at R: $E_3 > \phi_R$
⇒ Total photon $= n_3$



35.

When the electromagnetic radiations of frequencies 4×10^{15} Hz and 6×10^{15} Hz fall on the same metal, in different experiments, the ratio of maximum kinetic energy of electrons liberated is 1 : 3 . The threshold frequency for the metal is :

(A) 2×10^{15} Hz
(B) 1×10^{15} Hz
(C) 3×10^{15} Hz
(D) 1.67×10^{15} Hz

Sol^n

$K_1 = h\nu_1 - W$

$K_2 = h\nu_2 - W$

$\frac{K_1}{K_2} = \frac{h\nu_1 - W}{h\nu_2 - W}$

$\frac{1}{3} = \frac{h\nu_1 - W}{h\nu_2 - W}$

$h\nu_2 - W = 3h\nu_1 - 3W$

$2W = h(3\nu_1 - \nu_2)$

$\nu_0 = \left(\frac{3\nu_1 - \nu_2}{2}\right) = \frac{12 \times 10^{15} - 6 \times 10^{15}}{2}$

$= 3 \times 10^{15}$ Hz

36.

When one centimetre thick surface is illuminated with light of wavelength λ, the stopping potential is V. When the same surface is illuminated by light of wavelength 2λ, stopping potential is $\frac{V}{3}$, threshold wavelength for metallic surface is :

(A) $\frac{4\lambda}{3}$
(B) 4λ
(C) 6λ
(D) $\frac{8\lambda}{3}$

Sol^n

$\frac{1}{3}eV = \frac{1}{3}\frac{hc}{\lambda} - \frac{W}{3}$

$\frac{eV}{3} = \frac{hc}{2\lambda} - W$

$0 = \frac{hc}{\lambda}\left(\frac{1}{3} - \frac{1}{2}\right) + \frac{2W}{3}$

$\frac{hc}{6\lambda} = \frac{2}{3} \times \frac{hc}{\lambda_0}$

$\lambda_0 = 4\lambda$

37.

The surface of a metal is illuminated with the light of 400 *nm*. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is (hc = 1240 eV. nm)–

(A) 3.09 eV (B✓) 1.41 eV (C) 1.51 eV (D) 1.68 Ev

$E = \frac{hc}{\lambda} = \frac{1240 \text{ eV-nm}}{400 \text{ nm}}$

$E = 3.1 \text{ eV}$

$K_{max} = 1.68 \text{ eV}$

$W = E - K_{max} = 1.42 \text{ eV}$

38.

A nonmonochromatic light is used in an experiment on photoelectric effect. The stopping potential -

(A) is related to the mean wavelength

(B) is related to the longest wavelength

(C✓) is related to the shortest wavelength

(D) is not related to the wavelength

39.

The electric field associated with a light wave is $E = E_0 \sin[1.57 \times 10^7 (x - ct)]$ where x is in metre and t is in second. If this light is used to produce photoelectric emission from the surface of a metal of work function 1.9 eV, then the stopping potential will be -

(A*) 1.2 V (B) 1.5 V (C) 1.75 V (D) 1.9 V

$E = E_0 \sin(1.57\times10^7 x - 1.57\times10^7 ct)$

$\frac{2\pi}{\lambda} = 1.57\times10^7$

$\lambda = \frac{2\pi}{1.57\times10^7} m$

$E = \frac{hc}{\lambda}$

$= \frac{1240 \text{ eV (nm)} \times 1.57\times10^7 / m}{2\pi}$

$= \frac{1240\times1.57\times10^7\times10^{-9}}{2\pi} eV$

$E = 3 eV$

$W = 1.9 eV$

$eV = E - W = 1.1 eV$

$V_0 \approx 1.1$ volt

40.

When a light source is placed at a distance of 1m from the emitter, it emits electrons of energy 4 eV. If the distance is changed to 0.5 m, then -

(A) the number of electrons emitted will be same but their energy will become double

(B) the number of electrons emitted will be same but their energy will become four times

(C) it will emit twice the number of electrons of same energy

(D*) it will emit four times the number of electrons in earlier case with same energy

41.

In photoelectric effect, the number of photoelectrons emitted is proportional to -

(A*) intensity of incident beam

(B) frequency of incident beam

(C) velocity of incident beam

(D) work function of photo cathode

42.

Light of wavelength λ strikes a photo-sensitive surface and electrons are ejected with kinetic energy E. If the kinetic energy is to be increased to 2E, the wavelength must be changed to λ' where -

(A) $\lambda' = \frac{\lambda}{2}$ (B) $\lambda' = 2\lambda$ (C) $\frac{\lambda}{2} < \lambda' < \lambda$ (D) $\lambda' > \lambda$

$E = \frac{hc}{\lambda} - W$ — (1)

$2E = \frac{hc}{\lambda'} - W$ — (2)

$2E = \frac{2hc}{\lambda} - 2W$

$2E = \frac{hc}{\lambda'} - W$

$0 = \frac{2hc}{\lambda} - \frac{hc}{\lambda'} - W$

$\frac{2hc}{\lambda} - \frac{hc}{\lambda'} = W$

$\Rightarrow \frac{2hc}{\lambda} > \frac{hc}{\lambda'}$

$\lambda' > \frac{\lambda}{2}$

$E = \frac{hc}{\lambda'} - \frac{hc}{\lambda} > 0$

$\frac{hc}{\lambda'} > \frac{hc}{\lambda}$

$\lambda' < \lambda$

$\frac{\lambda}{2} < \lambda' < \lambda$

43.

How many photons are emitted by a laser source of 5×10^{-3} W operating at 632.2 nm in 2 seconds -

(A) 3.2×10^{16} (B) 1.6×10^{16} (C) 8.4×10^{16} (D) None of these

$\text{Power} = \frac{N}{t}\frac{hc}{\lambda}$

$N = \frac{P \times \lambda \times t}{hc}$

$= \frac{5\times10^{-3} \times 632\times10^{-9} \times 2}{20\times10^{-26}}$

$N = 3.2\times10^{16}$

44.

The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential in volt is -

(A) 2 (B) 4 (C) 6 (D) 10

$E = 6eV$

$K_{max} = 4eV = eV_0$

$V_0 = 4$ Volt

45.

The work function of a metal is 2.3 eV. If light of wave number $2 \times 10^6\ m^{-1}$ falls on it, the kinetic energies of fastest and slowest ejected electron will be respectively -

(A) 2.48 eV and 0.18 eV

(B) 0.18 eV and 0.18 eV

(C) 1.8 eV and 0.18 eV

(D) 0.18 eV and zero

Sol $W = 2.3\ eV$

Wave Number $= \frac{1}{\lambda} = 2 \times 10^6$ /m

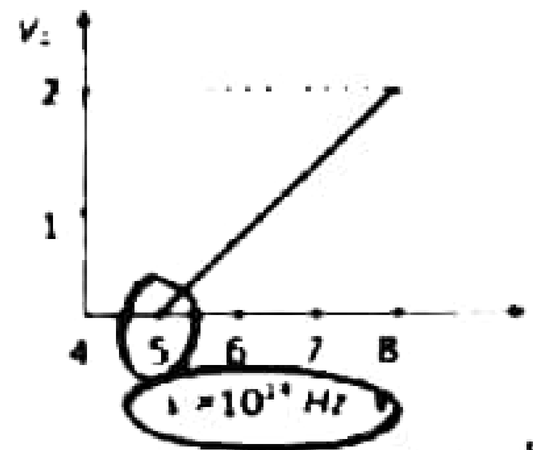
$K_{max} = E - W$

$= 1240\ eV \times 10^{-9} \times 2 \times 10^6 - 2.3$

$= 0.18\ eV$

46.

The stopping potential (V_0) versus frequency (ν) plot of a substance is shown in figure the threshold wave length is



a) $5 \times 10^{14} m$ ✓b) 6000 Å

c) 5000 Å d) Cannot be estimated from given data

Sol)

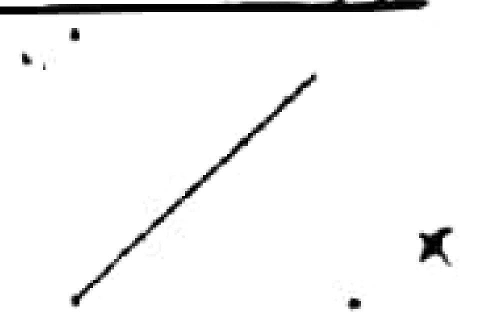
$$\nu_0 = 5 \times 10^{14} = \frac{c}{\lambda_0}$$

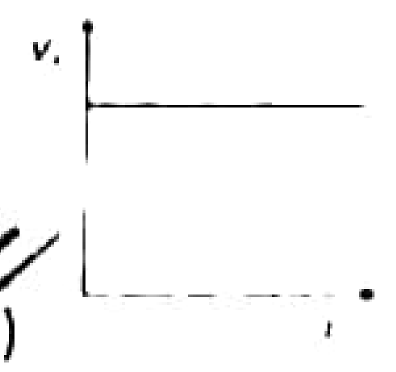
$$\lambda_0 = \frac{3 \times 10^8}{5 \times 10^{14}}$$

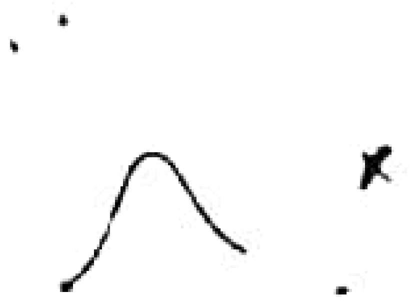
$$= 6000 \text{Å}$$

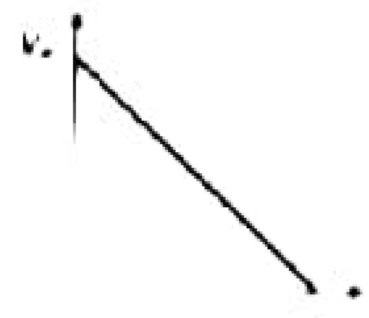
47.

The correct curve between the stopping potential (V) and intensity of incident light (I) is

a) 

✓b) 

c) 

d) 

Sol)

48.

A particle A has a charge q and particle B has charge $+4q$ with each of them having the mass m. When they are allowed to move from rest through same potential difference, the ratio of their de broglie wavelengths $\lambda_A : \lambda_B$ will be

a) 4:1 b) 1:4

c) 1:2 ✓d*) 2:1

Sol

$q_A = q \qquad q_B = 4q$

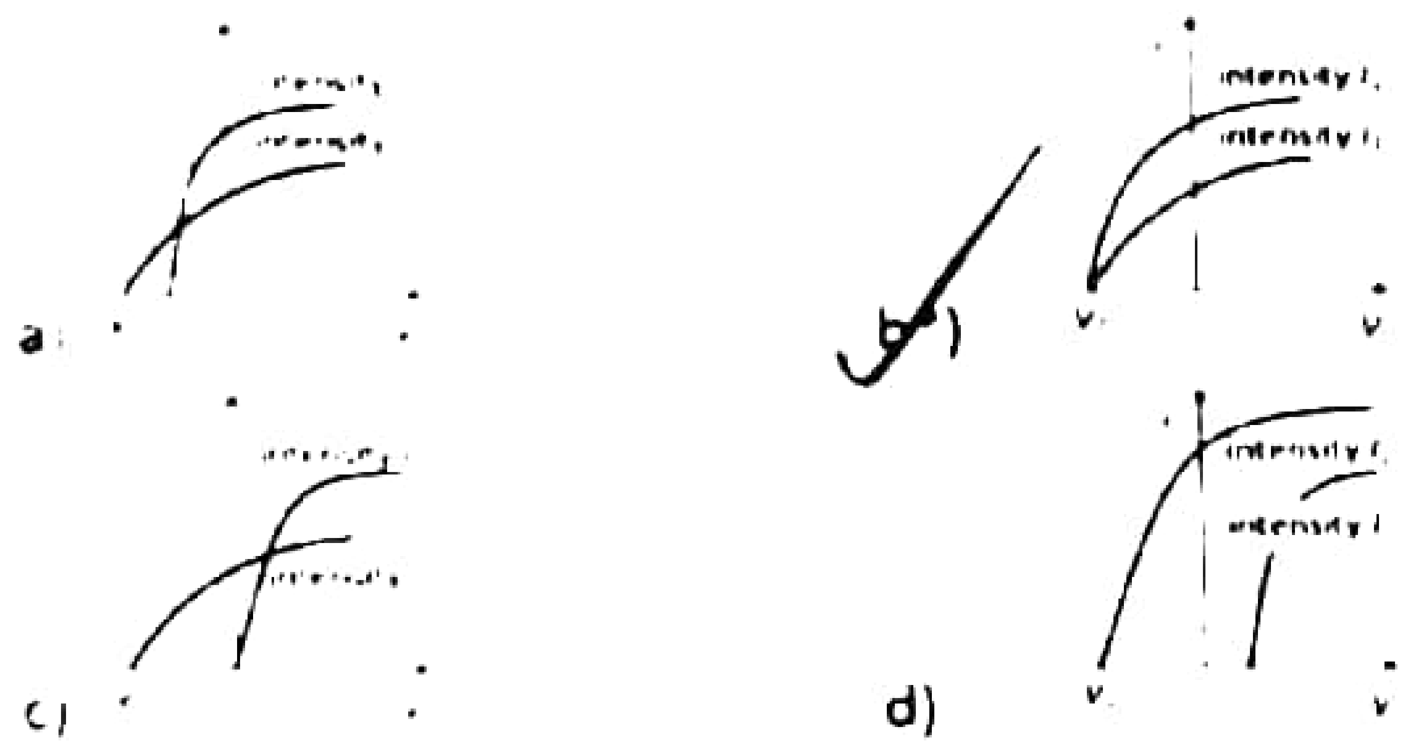
$m_A = m_B = m$

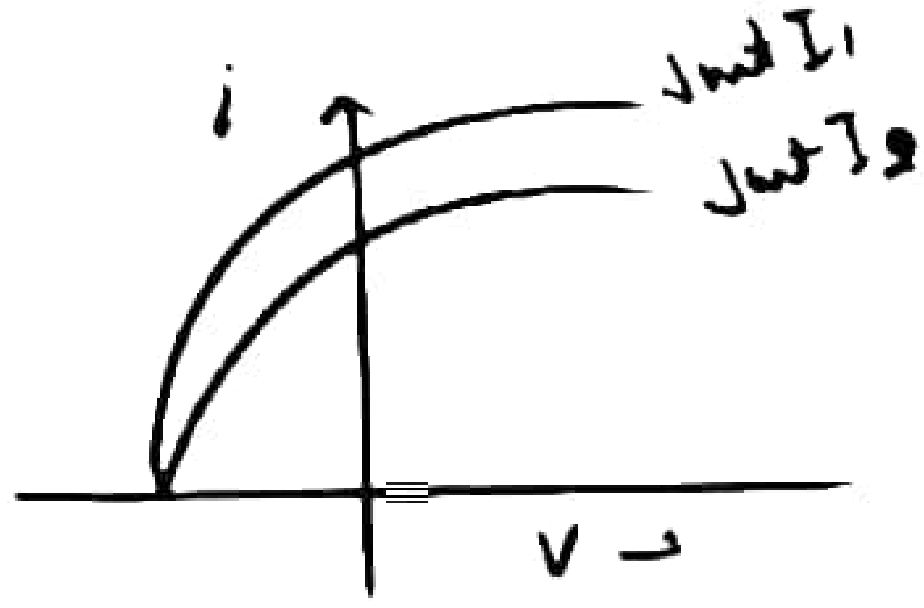
$K_A = qV$

$K_B = 4qV \qquad \lambda \propto \frac{1}{\sqrt{K}} \qquad \frac{\lambda_A}{\lambda_B} = \sqrt{\frac{4qV}{qV}} = \frac{2}{1}$

49.

The curves (a), (b) (c) and (d) show the variation between the applied potential difference (V) and the photoelectric current (i), at two different intensities of light ($I_1 > I_2$). In which figure is the correct variation shown





50.

The work functions of metals A and B are in the ratio 1:2. If light of frequencies f and $2f$ are incident on the surfaces of A and B respectively, the ratio of the maximum kinetic energies of photoelectrons emitted is (f is greater than threshold frequency of A, $2f$ is greater than threshold of B)

a) 1 :1 b) 1 :2 ✓
c) 1 :3 d) 1 :4

Sol

$\frac{W_A}{W_B} = \frac{1}{2}$

$W_A = W$

$W_B = 2W$

$K_1 = hf - W = hf - W$

$K_2 = 2hf - 2W = 2(hf - W)$

$\frac{K_1}{K_2} = \frac{1}{2}$