PHOTO ELECTRIC EFFECT

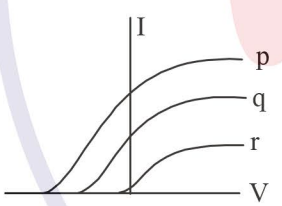
1. The threshold frequency for a metallic surface corresponds to an energy of 6.2 eV and the stopping potential for a radiation incident on this surface is 5V. The incident radiation lies in- **[AIEEE - 2006]**

(1) ultra-violet region
(2) infra-red region
(3) visible region
(4) X-ray region

2. 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) **[AIEEE - 2009]**

(1) 1.51 eV (2) 1.68 eV
(3) 3.09 eV (4) 1.41 eV

3. Photoelectric effect experiments are performed using three different metal plates p, q and r having work functions ϕ_p = 2.0 eV, ϕ_q = 2.5 eV and ϕ_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 : **[JEE-2009]**

(1)


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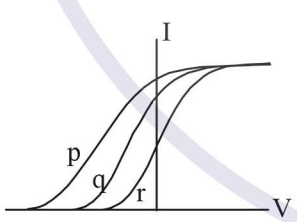

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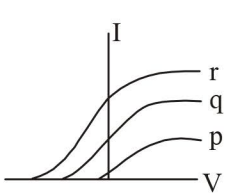

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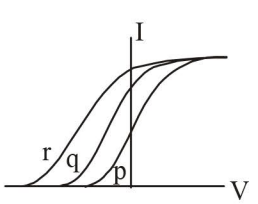


4. **Statement-1 :** When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is K_{max}. When the ultraviolet light is replaced by X-rays, both V_0 and K_{max} increase.

Statement-2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light. **[AIEEE - 2010]**

(1) Statement–1 is true, Statement–2 is false.
(2) Statement–1 is true, Statement–2 is true; Statement–2 is the correct explanation of Statement–1
(3) Statement–1 is true, Statement–2 is true; Statement–2 is not the correct explanation of Statement–1
(4) Statement–1 is false, Statement–2 is true

5. If a source of power 4kW produces 10^{20} photons/second, the radiation belongs to apart of the spectrum called :- **[AIEEE - 2010]**

(1) γ-rays
(2) X-rays
(3) ultraviolet rays
(4) microwaves

6. This question has Statement 1, Statement 2. Of the four choices given after the statement, choose the one that best describes the two statements.

Statement-1 : A metallic surface is irradiated by a monochromatic light of frequency $\nu > \nu_0$ (the threshold frequency). If the incident frequency is now doubled, the photocurrent and the maximum kinetic energy are also doubled.

Statement-2 : The maximum kinetic energy of photoelectrons emitted from a surface is linearly dependent on the frequency of the incident light. The photocurrent depends only on the intensity of the incident light. **[AIEEE-2012 (Online)]**

(1) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true and Statement-2 is not the correct explanation of statement-1.
(3) Statement-1 is true, Statement-2 is false.
(4) Statement-1 is false, Statement-2 is true.

7. Photons of an electromagnetic radiation has an energy 11 keV each. To which region of electromagnetic spectrum does it belong ?

[JEE(Main)-2013 (Online)]

(1) Ultra violet region

(2) Infrared region

(3) visible region

(4) X- ray region

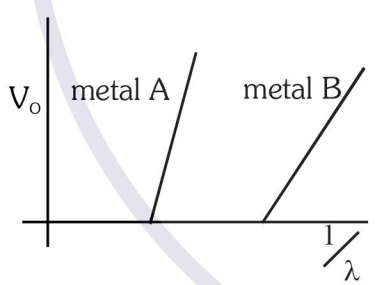
8. A copper ball of radius 1 cm and work function 4.47eV is irradiated with ultraviolet radiation of wavelength 2500 Å. The effect of irradiation results in the emission of electrons from the ball. Further the ball will acquire charge and due to this there will be a finite value of the potential on the ball. The charge acquired by the ball is :

[JEE(Main)-2013 (Online)]

(1) 2.5×10^{-11} C (2) 4.5×10^{-12} C

(3) 7.5×10^{-13}C (4) 5.5×10^{-13} C

9. In an experiment on photoelectric effect a student plots stopping potential V_0 against reciprocal of the wavelength λ of the incident light for two different metals A and B. These are shown in the figure.



Looking at the graphs, you can most appropriately say that : **[JEE(Main)-2013 (Online)]**

(1) Work function of metal B is greater than that of metal A

(2) Students data is not correct

(3) For light certain wavelength falling on both metals, maximum kinetic energy of electrons emitted from A will be greater than those emitted from B

(4) Work function of metal A is greater than that of metal B

10. The work functions of Silver and sodium are 4.6 and 2.3 eV, repetitively. The ratio of the slope of the stopping potential versus frequency plot for Silver to that of Sodium is. **[JEE Advanced 2013]**

(1) 1 (2) 2

(3) 3 (4) 4

11. The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of 3×10^{-4}T. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to :- **[JEE(Main) - 2014]**

(1) 0.8 eV (2) 1.6 eV

(3) 1.8 eV (4) 1.1 eV

12. A metal surface is illuminated by light of two different wavelength 248 nm and 310 nm. The maximum speeds of the photoelectrons corresponding to these wavelengths are u_1 and u_2, respectively. If the ratio $u_1 : u_2 = 2 : 1$ and hc = 1240 eV nm, the work function of the metal is nearly **[JEE Advanced 2014]**

(1) 3.7 eV (2) 3.2 eV

(3) 2.8 eV (4) 2.5 eV

13. Match List-I (Fundament Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list : **[JEE Main-2015]**

	List-I		**List-II**
(A)	Franck-Hertz Experiment.	(i)	Particle nature of light
(B)	Photo-electric experiment	(iii)	Discrete energy levels of atom
(C)	Davison-Germer Experiment	(iiii)	Wave nature of electroc
		(iv)	Structure of atom

(1) A-ii, B-i, C-iii (2) A-iv, B-iii, C-ii

(3) A-i, B-iv, C-iii (4) A-ii, B-iv, C-iii

14. Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed v. If the wavelength of changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be :- **[JEE(Main) - 2016]**

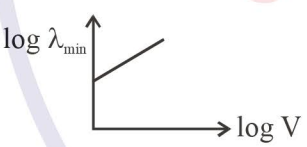
(1) $= v\left(\frac{3}{5}\right)^{1/2}$

(2) $> v\left(\frac{4}{3}\right)^{1/2}$

(3) $< v\left(\frac{4}{3}\right)^{1/2}$

(4) $= v\left(\frac{4}{3}\right)^{1/2}$

15. An electron beam is accelerated by a potential difference V to hit a metallic target to produce X-rays. It produces continuous as well as characteristic X-rays.If λ_{min} is the smallest possible wavelength of X-ray in the spectrum, the variation of log λ_{min} with log V is correctly represented in : **[JEE Main-2017]**

(1)


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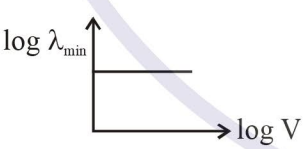

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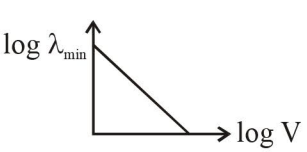

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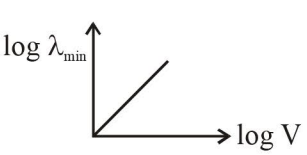


MATTER WAVE

16. A proton has kinetic energy E = 100 keV which is equal to that of a photon. The wavelength of photon is λ_2 and that of proton is λ_1. The ratio of λ_1 / λ_2 is proportional to **[JEE-2004 (Scr.)]**

(1) E^2 (2) $E^{1/2}$

(3) E^{-1} (4) $E^{-1/2}$

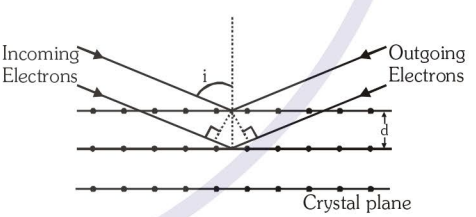
17. Electrons with de-Broglie wavelength λ fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-rays is **[JEE 2007]**

(1) $\lambda_0 = \frac{2mc\lambda^2}{h}$ (2) $\lambda_0 = \frac{2h}{mc}$

(3) $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$ (4) $\lambda_0 = \lambda$

Directions : Questions No. 18, 19 and 20 are based on the following paragraph.

Wave property of electrons implies that they will show diffraction effects. Davission and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see figure)



18. If a strong diffraction peak is observed when electrons are incident at an angle 'i' from the normal to the crystal planes with distance 'd' between them (see figure), de-Broglie wavelength λ_{dB} of electrons can be calculated by the relationship (n is an integer): **[AIEEE - 2008]**

(1) d sin i = n λ_{dB}

(2) 2d cos i = n λ_{dB}

(3) 2d sin i = n λ_{dB}

(4) d cos i = n λ_{dB}

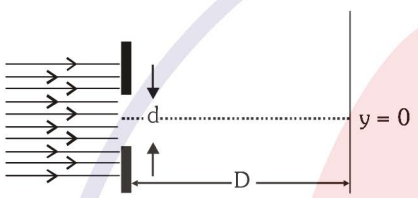
19. Electrons accelerated by potential V are diffracted from a crystal. If d = 1Å and i = 30° V should be about (h = 6.6×10^{-34} Js, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C) :

[AIEEE - 2008]

(1) 2000 V (2) 50 V

(3) 500 V (4) 1000 V

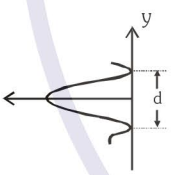
20. In an experiment, electrons are made to pass through a narrow slit of width 'd' comparable to their de-Broglie wavelength. They are detected on a screen at a distance 'D' from the slit (see figure).

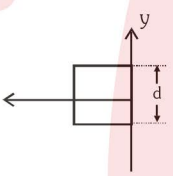


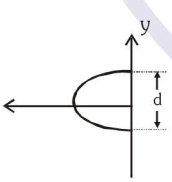
Which of the following graphs can be expected to represent the number of electrons 'N' detected as a function of the detector position 'y'

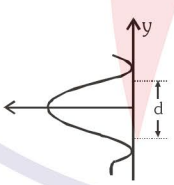
(y = 0 corresponds to the middle of the slit) ?

[AIEEE - 2008]

(1) 

(2) 

(3) 

(4) 

21. An α–particle and a proton are accelerated from rest by a potential difference of 100 V. After this, their de Broglie wavelengths are λ_α and λ_p respectively. The ratio $\frac{\lambda_p}{\lambda_\alpha}$, to the nearest integer, is

[JEE 2010]

(1) 1 (2) 2

(3) 3 (4) 4

22. After absorbing a slowly moving neutron of mass m_N (momentum ~0) a nucleus of mass M breaks into two nuclei of masses m_1 and $5m_1 (6m_1 = M + m_N)$, respectively. If the de Broglie wavelength of the nucleus with mass m_1 is λ, then de Broglie wavelength of the other nucleus will be :-

[AIEEE - 2011]

(1) 25 λ (2) 5λ

(3) $\frac{\lambda}{5}$ (4) λ

23. This question has Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1: Davisson-Germer experiment established the wave nature of electrons.

Statement-2 : If electrons have wave nature, they can interfere and show diffraction. **[AIEEE - 2012]**

(1) Statement-1 is true, Statement-2 is true and Statement-2 is not the correct explanation of Statement-1.

(2) Statement-1 is false, Statement-2 is true

(3) Statement-1 is true, Statement-2 is false

(4) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of statement-1.

24. The frequency of X-rays, γ-rays and ultraviolet rays are respectively a, b and c then :-

[AIEEE-2012 (Online)]

(1) a < b ; b > c

(2) a > b ; b > c

(3) a < b < c

(4) a = b = c

25. If the kinetic energy of an electron is increased four times, the wavelength of the de-Broglie wave associated with it would become :-

[AIEEE-2012 (Online)]

(1) Two times

(2) Half

(3) One fourth

(4) Four times

26. If the radius of first orbit of H atom is a_0, the de-Broglie wavelength of an electron in the third orbit is :- **[AIEEE-2012 (Online)]**

(1) $6\pi a_0$ (2) $8\pi a_0$

(3) $2\pi a_0$ (4) $4\pi a_0$

27. A proton is fired from very far away towards a nucleus with charge Q = 120 *e*, where *e* is the electronic charge. It makes a closest approach of 10 fm to the nucleus. The de Broglie wavelength (in units of fm) of the proton at its start is

(Take : The proton mass, $m_p = (5/3) \times 10^{-27}$ kg; $h/e = 4.2 \times 10^{-15}$ J.s/C; $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ m/F; 1 fm = 10^{-15} m) **[JEE 2012]**

(1) 7 (2) 8

(3) 9 (4) 10

28. Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de-Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the n^{th} orbital will therefore be proportional to : **[JEE(Main)-2013 (Online)]**

(1) n^2 (2) $n^{1/2}$

(3) $n^{1/4}$ (4) n

29. Electrons are accelerated through a potential difference V and protons are accelerated through a potential difference 4V. The de-Broglie wavelengths are λ_e and λ_p for electrons and protons respectively.

The ratio of $\frac{\lambda_e}{\lambda_p}$ is given by :

(Given m_e is mass of electron and m_p is mass of proton). **[JEE(Main)-2013 (Online)]**

(1) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m_p}}$ (2) $\frac{\lambda_e}{\lambda_p} = 2\sqrt{\frac{m_p}{m_e}}$

(3) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$ (4) $\frac{\lambda_e}{\lambda_p} = \frac{1}{2}\sqrt{\frac{m_e}{m_p}}$

30. A particle A of mass m and initial velocity v collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de–Broglie wavelengths λ_A to λ_B after the collision is: **[JEE Main-2017]**

(1) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$ (2) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

(3) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$ (4) $\frac{\lambda_A}{\lambda_B} = 2$

PREVIOUS YEARS QUESTIONS				ANSWER KEY						Exercise-II
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**1**	**4**	**1**	**1**	**2**	**4**	**4**	**4**	**1,2,3**	**1**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**4**	**1**	**1**	**2**	**3**	**2**	**1**	**2**	**2**	**4**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**4**	**4**	**1**	**2**	**1**	**1**	**2**	**2**	**4**