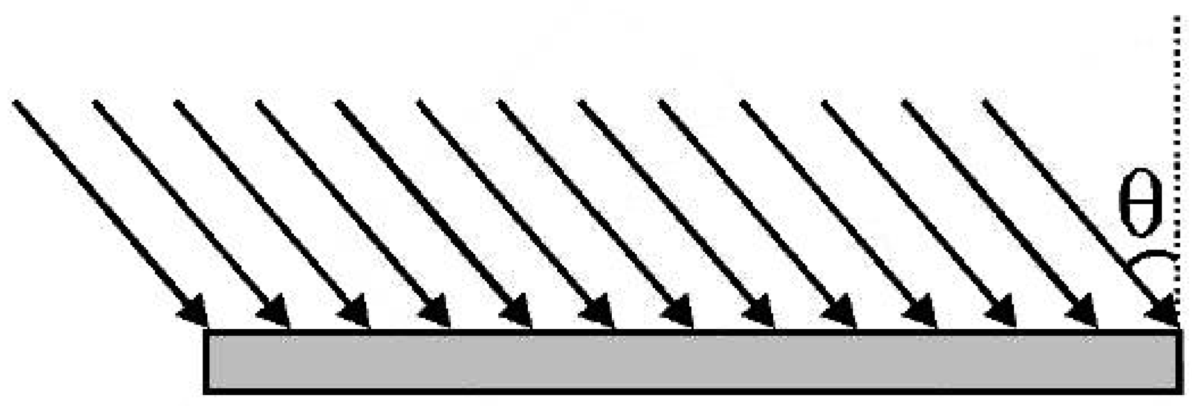
GUIDED REVISION

PHOTOELECTRIC EFFECT

1. A beam of light has two wavelengths 3100 Å and 4133 Å with a total intensity of 12.8 W/m^2 equally distributed between the two wavelengths. The beam falls normally on an area of a clean metallic surface of work function 3.1 eV. Assume that there is no loss of energy by reflection and that each energetically capable photon ejects one electron. How many electrons will emit per second from the face area ?

(A) 2×10^{19}
(B) 10^{19}
(C) 10^{18}
(D) 2×10^{18}

2. The radiation of intensity I is falling obliquely on a surface. Area of surface exposed to radiation is A. Select correct alternative



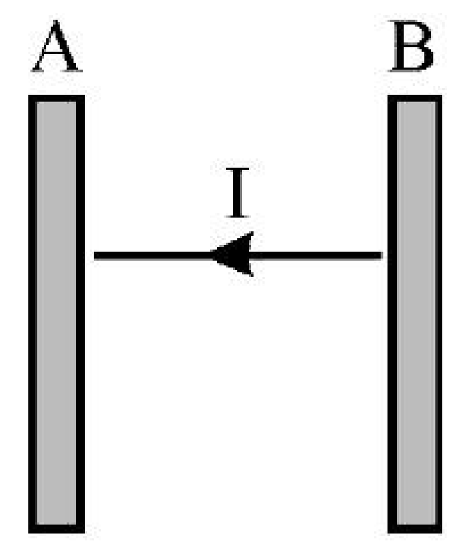
(A) If surface is perfectly reflecting surface then force experienced due to radiation is $\frac{IA\cos^2\theta}{c}$

(B) If surface is perfectly absorbing surface then force experienced due to radiation is $\frac{IA\cos^2\theta}{c}$

(C) If surface is perfectly absorbing surface then force experienced due to radiation is $\frac{IA\cos\theta}{c}$

(D) If surface is partially reflecting surface then force experienced due to radiation is $\frac{\beta IA\cos^2\theta}{c}$ where β is a constant and depends upon nature of surface.

3. A parallel beam of light of intensity I is incident normally on a plane surface A which absorbs 50% of the incident light. The reflected light falls on B which is perfect reflector, the light reflected by B is again partly reflected and partly absorbed and this process continues. For all absorption by A, asborption coefficient is 0.5. The pressure experienced by A due to light is :-



(A) $\frac{1.5\,I}{c}$
(B) $\frac{I}{c}$
(C) $\frac{3I}{4c}$
(D) $\frac{3I}{c}$

4. When photons of energy 4.25 eV strike the surface of a metal "A", the ejected photoelectrons have maximum kinetic energy, T_A expressed in eV and de Broglie wavelength λ. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50 \text{ eV})$. If the de Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then :

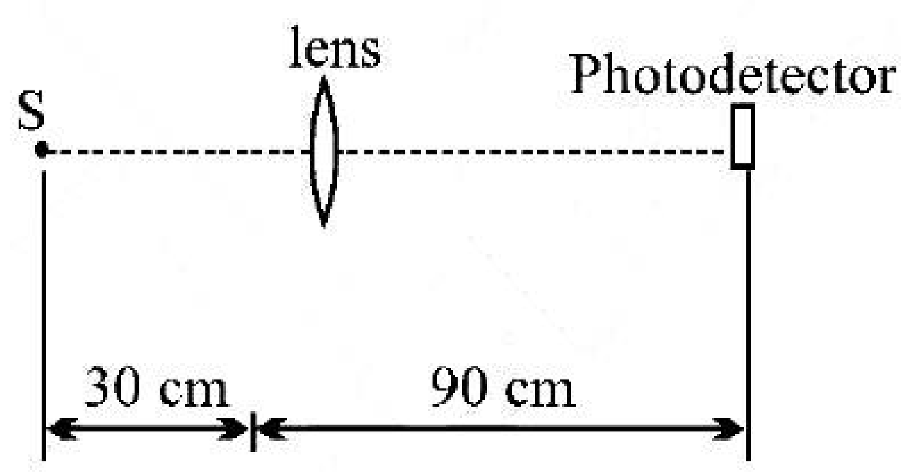
(A) the work function of A is 2.25 eV
(B) the work function of B is 4.20 eV
(C) $T_A = 2.00$ eV
(D) $T_B = 2.75$ eV

5. Photons of wavelength 248 nm fall on a metal surface whose work function is 2.2 eV. Assume that each photoelectron inside the metal lattice may come out of the surface or collide with the lattice before coming out. In each collision with the lattice, it loses 20% of its existing energy. Which of the following can be a kinetic energy of an ejected photoelectron?

(A) 2.8 eV
(B) 2.24 eV
(C) 1.8 eV
(D) 1 eV

6. An isolated copper ball of radius 9 mm having work function 4.47 eV is illuminated by electromagnetic radiation of wavelength 1243 Å. Find the maximum charge on the ball.

7. A disc shaped photoelectric detector of area 0.5 cm^2 generates current when light of frequency > that of yellow light falls on it. The photoelectron generation efficiency is 20%. In the arrangement shown, S is an isotropic 100 watt point monochromatic light source with $\lambda = 4000$ Å. The focal of the lens is 20 cm and its circular area is 4 cm^2. Find the photocurrent in the detector assuming all rays to be paraxial w.r.t. lens.



BOHR'S THEORY

8. Lyman alpha, the n=1 to n=2 transition in atomic hydrogen occurs at 1215 Å.

(A) Radiation of wavelength longer than 911 Å can photo–ionize hydrogen atom in ground state.

(B) Radiation of wavelength longer than 3645 Å can photo–ionize hydrogen atom in first excited state.

(C) Radiation of wavelength longer than 228 Å can photo–ionize He^+ ion in ground state.

(D) Radiation of wavelength longer than 1215 Å can photo–ionize He^+ ion atom in first excited state.

9. The total energy of a hydrogen atom in its ground state is -13.6eV. If the potential energy in the first excited state is taken as zero then the total energy in the ground state will be :

(A) –3.4eV
(B) 3.4 eV
(C) – 6.8eV
(D) 6.8eV

10. A positronium atom is a system that consist of a positron and an electron that orbit each other. Choose the wrong statement.

(A) The Rydberg constant for positronium is half as large as it is for ordinary hydrogen atom.

(B) Wavelength in the positronium spectral lines are all twice of those corresponding in the hydrogen spectrum

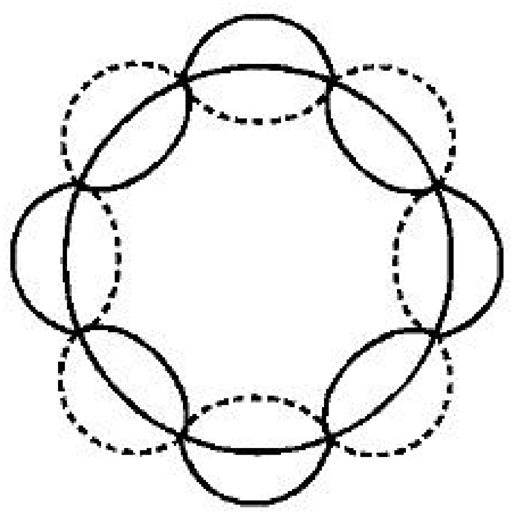
(C) In positronium electron and positron rotate about common centre of mass

(D) Wavelengths in the positronium spectral lines are all half of those corresponding in the hydrogen spectrum.

11. Applying Bohr's model choose the correct statement(s) :-
(A) K_β photon of aluminium will be more energetic than K_α photon of Lithium
(B) K_α photon of Beryllium will be more energetic than K_α photon of Lithium
(C) K_α photon of sodium will be more energetic than K_α photon of magnesium
(D) K_α photon of aluminium will be less energetic than K_β photon of aluminium

12. A particle of mass m moves along a circular orbit in a central potential field given by $U(r) \propto r^2$. Assuming Bohr's quantization conditions to be valid. Choose correct statement(s) regarding this.
(A) Ratio of radii of fourth Bohr orbit (n = 4) and ground state orbit is 4
(B) Ratio of radii of fourth Bohr orbit (n = 4) and ground state orbit is 2
(C) Energy levels are equally spaced
(D) Separation between successive energy levels increase as n increases.

13. Figure shows stationary orbit of an hydrogen atom upon the transition of electron from given excited state to ground state.



(A) Average change in angular momentum is $\frac{3h}{2\pi}$.
(B) The ratio of de-Broglie wavelengths in final state to initial state is 4.
(C) Energy of emitted photon is nearly 12.75 eV.
(D) Ratio of orbital time period in final state to initial state is 4^3.

14. A moving neutron collides with stationary H-atom in ground state. As a result it excites and then de excites. The corresponding radiation fall on a surface, having work function σ. The minimum value of required kinetic energy for neutron is E_0 and possible minimum value of de broglie wavelength of emitted photoelectrons is λ_0. If neutron hits stationary He^+ ion instead of stationary H atom, then minimum value of kinetic energy for neutron is E_1. Then

(A) The value of energy transferred from neutron to H-atom is $\frac{3E_0}{4}$.

(B) The value of λ_0 is $\frac{h}{\sqrt{m_e(E_0 - 2\sigma)}}$.

(C) The value of E_1 is $4E_0$

(D) The value of E_1 is $\frac{5E_0}{2}$

15. A hydrogen like atom (atomic number Z) is in higher excited state of quantum number n. This excited atom can make a transition to the first excited state by successively emitting two photons of energy 22.95eV and 5.15eV respectively. Alternatively, the atom from the same excited state can make transition to the second excited state by successively emitting two photons of energies 2.4eV and 8.7eV respectively. Find the values of n and Z.

X-RAYS

16. X-ray from a tube with a target A of atomic number Z shows strong K lines for target A and weak K lines for impurities. The wavelength of K_α lines is λ_z for target A and λ_1 and λ_2 for two impurities. If

$\frac{\lambda_z}{\lambda_1} = 4$ and $\frac{\lambda_z}{\lambda_2} = \frac{1}{4}$

Screening constant of K_α lines to be unity. Select the correct statement(s)

(A) The atomic number of first impurity is $2Z - 1$

(B) The atomic number of first impurity is $2Z + 1$

(C) The atomic number of second impurity is $\frac{(Z+1)}{2}$

(D) The atomic number of second impurity is $\frac{Z}{2} + 1$

17. An X-ray tube is operating at 50 kV and 10 mA. The target material of the tube has mass of 1 kg and specific heat 495 J kg^{-1} $°C^{-1}$. One percent of applied electric power is converted into X-rays and the remaining energy goes into heating the target. Then :

(A) a suitable target material must have high melting temperature

(B) a suitable target material must have low thermal conductivity

(C) the average rate of rise of temperature of the target would be 1°C/sec

(D) the minimum wavelength of X-rays emitted is about 0.25×10^{-10} m

MODERN PHYSICS-1				ANSWER KEY
ANSWER KEY				
1. Ans. (B)	**2. Ans. (C)**	**3. Ans. (D)**	**4. Ans. (A, B, C)**	**5. Ans. (A, C, D)**
6. Ans. 5.5×10^{-12} C		**7. Ans. $\frac{1}{279\pi}$ A**	**8. Ans. (A)**	**9. Ans. (C)**
10. Ans. (D)	**11. Ans. (A,B,D)**	**12. Ans. (B,C)**	**13. Ans. (A,C,D)**	**14. Ans. (A,B,D)**
15. Ans. z = 3, n = 7		**16. Ans. (A,C)**	**17. Ans. (A,C,D)**	