1. The innermost orbit of the hydrogen atom has a diameter 1.06 Å. The diameter of tenth orbit is
(a) 5.3 Å (b) 10.6 Å (c) 53 Å (d) 106 Å

2. When hydrogen like atom in excited state make a transition from excited state to ground state, most energetic photons have energy E_{max} = 52.224 eV and least energetic photons haveenergyE_{min} = 1.224 eV. Find the atomic number –
(a) 4 (b) 6 (c) 2 (d) 8

3. What will be the angular momentum of an electron, if energy of this electron in H-atom is –1.5eV (in J sec) ?
(a) 1.05×10^{-34} (b) 2.1×10^{-34}
(c) 3.15×10^{-34} (d) -2.1×10^{-34}

4. The photon radiated from hydrogen corresponding to 2nd line of Lyman series is absorbed by a hydrogen-like atom 'X' in 2nd excited state. As a result Then, the hydrogen-like atom 'X' makes a transition of nth orbit -
(a) X = He^+, n = 4 (b) X = Li^{++}, n = 6
(c) X = He^+, n = 6 (d) X = Li^{++}, n = 9

5. Atoms of a hydrogen like gas are in a particular excited energy level. When these atoms deexcite they emit photons of different energies. Maximum and minimum energies of emitted photons are E_{max} = 52.224 eV and E_{min} = 1.224 eV respectively. Identify the gas i.e. value of atomic number –
(a) 2 (b) 4 (c) 6 (d) 3

6. The first excitation potential of the hydrogen atom in the gound state is -
(a) 13.6 volt (b) 10.2 volt (c) 3.4 volt (d) 1.89 volt

7. When a hydrogen atom emits a photon in going transition from n = 5 to n = 1, its recoil speed is almost -
(a) 10^{-4} m/s (b) 2×10^{-2} m/s
(c) 4 m/s (d) 8×10^{2} m/s

8. The potential energy of an electron in the fifth orbit of hydrogen atom is -
(a) 0.54 eV (b) – 0.54 eV (c) 1.08 eV (d) – 1.08 eV

9. The electron in a hydrogen atom makes a transition from n = n_1 to n = n_2 state. The time period of the electron in the initial state (n_1) is eight times that in final state (n_2). The possible values of n_1 and n_2 are-
(a) $n_1 = 8, n_2 = 1$ (b) $n_1 = 4, n_2 = 2$
(c) $n_1 = 2, n_2 = 4$ (d) $n_1 = 1, n_2 = 8$

10. The maximum energy of the electrons released in photocell is independent of

(a) Frequency of incident light.
(b) Intensity of incident light.
(c) Nature of cathode surface.
(d) None of these.

11. In photo-emissive cell, with exciting wavelength λ, the fastest electron has speed υ. If the exciting wavelength is changed to 3λ/4, the speed of the fastest emitted electron will be :

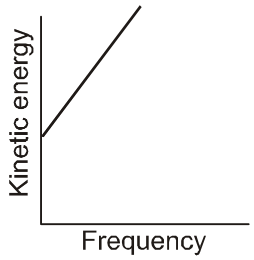
(a) $\upsilon\ (3/4)^{1/2}$ (b) $\upsilon\ (4/3)^{1/2}$
(c) less than $\upsilon\ (4/3)^{1/2}$ (d) greater than $\upsilon\ (4/3)^{1/2}$

12. photo-cell is illuminated by a source of light, which is placed at a distance d from the cell, If the distance become d/2, then number of electrons emitted per second will be :-

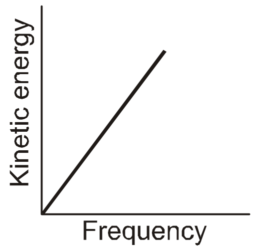
(a) Remain same (b) Four times

(c) Two times (d) One-fourth

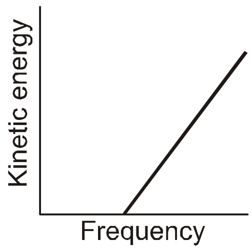
13. According to Eistein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is



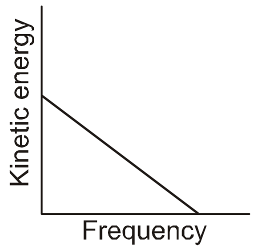
(a)



(b)



(c)



(d)

14. A radiation of energy E falls normally on a perfecting reflecting surface. The momentum transferred to the surface is

(a) E/c (b) 2E/c
(c) Ec (d) E/c^2

15. If the energy of a photon corresponding to a wavelength of 6000 A° is 3.32×10^{-19} joule, the photon energy (in joule) for a wavelength of 4000 A° will be

(a) 1.11×10^{-19} (b) 2.22×10^{-19}
(c) 4.44×10^{-19} (d) 4.98×10^{-19}

16. The work functions for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5eV According to Einsten's's equation, the metals which will emit photo electrons for a radiation of wavelength 4100 Å is /are :-

(a) None (b) A only
(c) A and B only (d) All the three metals

17. Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW. The number of photons arriving per second on the average at a target irradiated by this beam is

(a) 9×10^{17} (b) 3×10^{16}
(c) 9×10^{15} (d) 9×10^{19}

18. Two particles have identical charges. If they are accelerated through identical potential differences, then the ratio of their deBroglie wavelength would be

(a) $\lambda_1 : \lambda_2 = 1 : 1$
(b) $\lambda_1 : \lambda_2 = m_2 : m_1$
(c) $\lambda_1 : \lambda_2 = \sqrt{m_2} : \sqrt{m_1}$
(d) $\lambda_1 : \lambda_2 = \sqrt{m_1} : \sqrt{m_2}$

19. What voltage must be applied to an electron microscope to produce electrons of λ. = 1.0 Å

(a) 190 volt (b) 180 volt
(c) 160 volt (d) 150 volt

20. The accelerating voltage of an electron gun is 50,000 volt. De-Broglie wavelength of the electron will be-
(a) 0.55 Å (b) 0.055 Å
(c) 0.077 Å (d) 0.095 Å

21. The energy of electron with de-Broglie wavelength of 10^{-10} meter, in [ev] is -

(a) 13.6 (b) 12.27
(c) 1.27 (d) 150.6

22. The energy required to knock out the electron in the third orbit of a hydrogen atom is equal to

(a) 13.6 eV (b) $+\frac{13.6}{9}$ eV
(c) $-\frac{13.6}{3}$ eV (d) $-\frac{3}{13.6}$ eV

23. The relation between λ_1: wavelength of series limit of Lyman series, λ_2: the wavelength of the series limit of Balmer series & λ_3: the wavelength of first line of Lyman series is :
(a) $\lambda_1 = \lambda_2 + \lambda_3$ (b) $\lambda_3 = \lambda_1 + \lambda_2$
(c) $\lambda_2 = \lambda_3 - \lambda_1$ (d) none of these

24. The energy of a hydrogen-like atom in its ground state is – 54.4 eV. It may be

(a) hydrogen (b) deuterium
(c) helium (d) lithium

25. An electron makes a transition from orbit n = 4 to the orbit n = 2 of a hydrogen atom. The wave number of the emitted radiation (R = Rydberg's constant) will be
(a) 16/3R (b) 2R/16
(c) 3R/16 (d) 4R/16

26. Which of the following transitions in hydrogen atoms emit photons of highest frequency ?

(a) n = 2 to n = 6 (b) n = 6 to n = 2
(c) n = 2 to n = 1 (d) n = 1 to n = 2

27. Three photons coming from excited atomic-hydrogen sample are picked up. Their energies are 12.1eV, 10.2eV and 1.9eV. These photons must come from

(a) a single atom
(b) two atoms
(c) three atom
(d) either two atoms or more than two atoms

28. The minimum wavelength λ_{min} in the continuous spectrum of X-rays is

(a) Proportional to the potential difference V between the cathode and anode.
(b) Inversely proportional to potential difference V between the cathode and anode.
(c) Proportional to the square root of the potential difference V between the cathode and the anode.
(d) Inversely proportional to the square root of the potential difference V between the cathode and the anode.

29. For hard X-rays.

(a) the wavelength is higher
(b) the intensity is higher
(c) the frequency is higher
(d) the photon energy is lower

30. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to 1/8. The thickness of lead, which will reduce the intensity to 1/2 will be :

(a) 6 mm (b) 9 mm
(c) 18 mm (d) 12 mm

1. (d)

Using $r \propto n^2 \Rightarrow \frac{r_2}{r_1} = \left(\frac{n_2}{n_1}\right)^2$ or $\frac{d_2}{d_1} = \left(\frac{n_2}{n_1}\right)^2$

$\Rightarrow \frac{d_2}{1.06} = \left(\frac{10}{1}\right)^2 \Rightarrow d = 106\ \AA$

2. (c)

Maximum energy is liberated for transition

$E_n \to 1$ and minimum energy for $E_n \to E_{n-1}$

Hence , $\frac{E_1}{n^2} - E_1 = 52.224$ eV … (1)

$\frac{E_1}{n^2} - \frac{E_1}{(n-1)^2} = 1.224$ eV … (2)

Solving (1) and (2) $E_1 = -54.4$ eV

$E_1 = -\frac{13.6Z^2}{1^2}$

Z = 2

3. (c)

–1.5eV energy is of n = 3

$L = \frac{nh}{2\pi} = \frac{3h}{2\pi} = \frac{3 \times 6.6 \times 10^{-34}}{2 \times 3.14} = 3.15 \times 10^{-34}$

4. (d)

Energy of nth orbit in H-atom is same as energy of 3n[th] state in Li^{++}

$\therefore 3 \to 1$ transition in H-atom would give same energy as the $3 \times 3 \to 1 \times 3 = 9 \to 3$ transition in Li^{++}

5. (a)

$E_{max} = E_n - E_1 = 52.224$

$E_{min} = E_n - E_{(n-1)} = 1.224$ eV

energy of n^{th} level $= E_n = \frac{E_1}{n^2}$

$\frac{E_1}{n^2} - E_1 = 52.224$…(1)

$\frac{E_1}{n^2} - \frac{E_1}{(n-1)^2} = 1.224$ …(2)

Solve for E_1 and n

$E_1 = -54.4$ eV n = 5s

6. (b)

First excitation potential

7. (c)

$\frac{1}{\lambda} = R\left[1 - \frac{1}{25}\right] = \frac{24R}{25}$

$\therefore P = \frac{h}{\lambda} = \frac{24Rh}{25} = 6.9 \times 10^{-27}$ kg-m/sec.

$\therefore v = \frac{P}{m} = \frac{6.9 \times 10^{-27}}{1.6 \times 10^{-27}} \approx 4$ m/ss

8. (d)

$V = -27.2eV\frac{Z^2}{n^2} = -27.2eV\frac{1^2}{5^2}$

$= -\frac{27.2}{25}\,eV = -1.08\,eV$

9. (b)

$T_1 = 8T_2\ (T \propto n^3) \Rightarrow n_1 = 2n_2 \Rightarrow n_1 : n_2 = 2 : 1$

10. (b)As maximum energy does not depend on the intensity of light.

11. (d) Einstein's photoelectric equation is given by

$E_k = E - w$

but $E_k = \frac{1}{2}mv^2$ and $E = \frac{ch}{\lambda}$

$\therefore\ \frac{1}{2}mv^2 = \frac{ch}{(3\lambda/4)} - w$

or $\frac{1}{2}mv^2 = \frac{4}{3}\frac{hc}{\lambda} - w$ … (ii)

Dividing Eq. (ii) by Eq. (i), we get

$$\frac{v^2}{v^2} = \frac{\frac{4}{3}\frac{ch}{\lambda} - w}{\frac{ch}{\lambda} - w} = \frac{\frac{4}{3}\frac{ch}{\lambda} - \frac{4}{3}w + \frac{1}{3}}{\frac{ch}{\lambda} - w} = \frac{4}{3} + \frac{w}{3\left(\frac{ch}{\lambda} - w\right)} > \frac{4}{3}$$

$\therefore\ \frac{v^2}{v^2} > \sqrt{\frac{4}{3}}$ or $v' > \sqrt{\frac{4}{3}}\,v$

12. (b)
13. (c)
14. (b)Initial momentum of surface

$p_i = \frac{E}{C}$

where c = velocity of light (constant). Since, the surface is perfectly reflecting so, the same momentum will be reflected completely

Final momentum

$p_f = \frac{E}{C}$ (negative value)

$\therefore$ Change in momentum

$\Delta_p = p_f - p_i = -\frac{E}{C} - \frac{E}{C} = -\frac{2E}{C}$

Thus, momentum transferred to the surface is

$\Delta_{p'} = |\Delta_p| = \frac{2E}{C}$

15. (b) $E \propto \frac{1}{\lambda}$

16. (c)

17. (b) Here $\lambda = 667 \times 10^{-9}$ m, $P = 9 \times 10^{-3}$ W

$$\text{Power} = \frac{\text{energy}}{\text{time}} = \frac{nhc}{\lambda t} = \frac{Nhc}{\lambda}$$

where N is number of photons emitted per sec.

$\Rightarrow N = \frac{P \times \lambda}{hc} = \frac{9 \times 10^{-3} \times 667 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^{8}} = 3 \times 10^{16}$ per sec.

18. (c)= $\frac{\lambda}{mV} = \frac{h}{\sqrt{2km}}$

$\lambda = \frac{h}{\sqrt{2qVm}} \Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1}}$

as q and Volume (V) are same.

19. (d)= 1.0 Å = $\frac{h}{p}$

$1 \times 10^{-10} = \frac{6.6 \times 10^{-34}}{\sqrt{2 \times m_e \times e \times v}}$

$v = \frac{\left(6.6 \times 10^{-34}\right)^2 \lambda}{2\lambda m_e \times e}$ = 150 volt.

20. (b)

21. (d) $\lambda = \frac{h}{P} = \frac{h}{\sqrt{2mk}}$

K.E = $\frac{h^2}{2m\lambda^2} = \frac{(6.6 \times 1^{-34})^2}{2 \;\; m_e \times (10^{-10})^2}$ Jule

K.E = $\frac{(6.6 \times 10^{-34})^2}{2m_e \;\; 10^{-20} \times e}$ eV

= 150.6 (eV)

22. (b)

23. (d) $\frac{K}{\lambda_1} = E_\infty - E_1 \Rightarrow \frac{K}{\lambda_2} = E_\infty - E_2$

$\frac{K}{\lambda_3} = E_2 - E_7 \Rightarrow \frac{1}{\lambda_1} - \frac{1}{\lambda_2} = \frac{1}{\lambda_3}$

24. (c)Energy of H-like atoms,

$$E_n = -\frac{Z^2 Rhc}{n^2} = -\frac{Z^2 \times 13.6 \;\; eV}{n^2}$$

For ground state

n = 1

E_1 = – 54.4 eV (given)

∴ $-54.4\text{ eV} = \frac{Z^2 \times 13.6}{(1)^2}$ eV

⇒ $Z^2 = 4$ or $Z = 2$

Z = 2 is for helium.

25. (c)

26. (c)For highest frequency in emission spectra the difference of energy between two states involved should be maximum

$\Delta eV_{2-4} = 10.2$ eV, $\Delta E_{\infty-1} = 13.6$ eV

$\Delta E_{\infty-1} = 3.4$ eV, $\Delta E_{6-2} < \Delta E_{\infty-2}$, $\Delta E_{6-2} < \Delta E_{2-1}$

So photons of highest frequency will be emitted for n = 2 to n = 1.

27. (d)12.1 = E(n = 3) – E (n = 1)

10.2 = E(n = 2) – E (n = 1)

1.9 = E(n = 3) – E (n = 2)

At least two atoms must be enveloped as there connot be two transition from same level from same atom.

28. (b)

29. (c)

30. (d) $I' = Ie^{-\mu x}$

$-\mu x = \log \frac{I'}{I}$

$-\mu .36 = \log \frac{I}{8\ \ I}$ .... (i)

$-\mu x' = \log \frac{I}{2I}$ .... (ii)

From Eq. (i) and (ii) ,

$$\frac{36}{x} = \frac{3\log\left(\frac{1}{2}\right)}{\log\frac{1}{2}}$$

∴ x' = 12 mm