REVISION ASSIGNMENT # 14

CHEMISTRY

SECTION–I : (i) Only One option correct Type

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. **3(–1)**

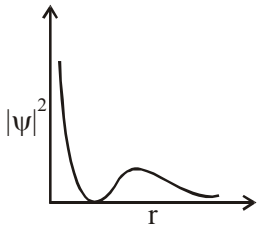
1. If the kinetic energy of an electron is increased four times, the wavelength of the de-Broglie wave associated with it would become :- **[JEE-Main(online) 2012]**

(A) Two times (B) Half (C) One fourth (D) Four times

2. The electron in the hydrogen atom undergoes transition from higher orbitals to orbital of radius 211.6 pm. This transition is associated with:- **[JEE-Main(online) 2017]**

(A) Brackett series (B) Balmer series (C) Lyman series (D) Paschen series

3. The graph betweeen $|\psi|^2$ and r(radial distance) is shown below. This represents :-

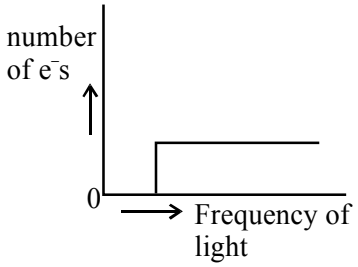


(A) 3s orbital (B) 1s orbital **[JEE-Main(online) 2019]**

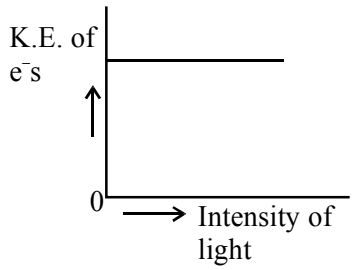
(C) 2p orbital (D) 2s orbital

4. Which of the graphs shown below does not represent the relationship between incident light and the electron ejected form metal surface ? **[JEE-Main(online) 2019]**

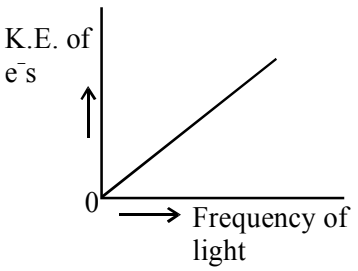
(A)



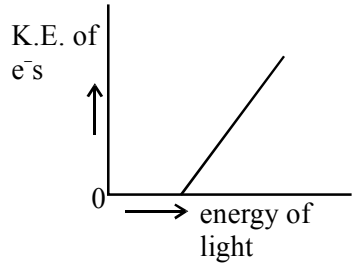
(B)



(C)



(D)



(ii) One or more options correct Type

This section contains **1 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct. **4(–1)**

5 Given ΔH for the process $Li(g) \longrightarrow Li^{+3}(g) + 3e^-$ is 19800 kJ/mole & IE_1 for Li is 520 then IE_2 & IE_3 of Li are respectively (approx, value)

(A) 7505 , 11775 (B) 520 , 19280 (C) 11775 , 19280 (D) Data insufficient

(iii) Paragraph Type

This section contains **1 paragraphs** , describing theory, experiment, data etc. **3 questions** relate to one paragraphs with two questions. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D). **3(0)**

Paragraph for questions 6 to 8

The hydrogen-like species Li^{2+} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom. **[JEE 2010]**

6. The state S_1 is :-

(A) 1s (B) 2s (C) 2p (D) 3s

6. Ans. (B)

7. Energy of the state S_1 in units of the hydrogen atom ground state energy is :-

(A) 0.75 (B) 1.50 (C) 2.25 (D) 4.50

7. Ans. (C)

8. The orbital angular momentum quantum number of the state S_2 is :-

(A) 0 (B) 1 (C) 2 (D) 3

8. Ans. (B)

SECTION-III : (Integer Value Correct Type)

This section contains **13 questions**. The answer to each question is **a single digit Integer**, ranging from **0 to 9** (both inclusive) **4(–1)**

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1. In the Bohr's model, for unielectronic species following symbols are used

$r_{n,z} \longrightarrow$ Radius of n^{th} orbit with atomic number "z"

$U_{n,z} \longrightarrow$ Potential energy of electron in n^{th} orbit with atomic number "z"

$K_{n,z} \longrightarrow$ Kinetic energy of electron in n^{th} orbit with atomic number "z"

$v_{n,z} \longrightarrow$ Velocity of electron in n^{th} orbit with atomic number "z"

$T_{n,z} \longrightarrow$ Time period of revolution of electron in n^{th} orbit with atomic number "z"

Calculate z in all in cases.

(i) $U_{1,2} : K_{1,z} = -8 : 1$ (ii) $r_{1,z} : r_{2,1} = 1 : 8$

(iii) $v_{1,z} : v_{3,1} = 9 : 1$ (iv) $T_{1,2} : T_{2,z} = 9 : 32$

2. The atomic masses of He and Ne are 4 and 20 a.m.u. respectively. The value of the de Broglie wavelength of He gas at –73 ºC is "M" times that of the de Broglie wavelength of Ne at 727 ºC. M is.

[JEE 2013]

3. A H-like ion is observed to emit six different wavelengths originating from all possible transitions between a group of levels. These levels have energies between –0.85 eV (Min) and –0.544 eV (Max).

(a) Find atomic number (z) of element

(b) Find quantum numbers of levels between which transitions occur.

(c) Calculate largest wavelength emitted in transitons between the levels.

4. Photon having wavelength 12.4 nm was allowed to strike a metal plate having work function 25 eV. Calculate the

(a) Maximum kinetic energy (in eV) of photoelectrons emitted in eV.

(b) Wavelength (in Å) of electron with maximum kinetic energy in Å.

(c) Calculate the uncertainity in wavelength (in m) of emitted electron if the uncertainity in the momentum is 6.62×10^{-28} Kg m/sec.

5. The vapours of Hg absorb some electrons accelerated by a potential diff. of 4.5 volt as a result of which light is emitted. If the full energy of single incident e^- is supposed to be converted into light emitted by single Hg atom, find the wave no. (in m^{-1}) of the light.

6. A certain dye absorbs 4000 Å and fluoresces at 5000 Å these being wavelengths of maximum absorption that under given conditions 40% of the absorbed energy is emitted. Calculate the ratio of the number of quanta emitted to the number absorbed.

7. The reaction between H_2 and Br_2 to form HBr in presence of light is initiated by the photo decomposition of Br_2 into free Br atoms (free radicals) by absorption of light. The bond dissociation energy of Br_2 is 192 KJ/mole. What is the longest wavelength (in Å) of the photon that would initiate the reaction.
$\left(1\frac{eV}{atom} = 96kJ/mol\ ;\ hc = 1240\ ev \times nm\right)$

8. The velocity of e^- in a certain Bohr orbit of the hydrogen atom bears the ratio 1:275 to the velocity of light. What is the quantum no. "n" of the orbit and the wave no. of the radiation emitted for the transition from the quatum state (n+1) to the ground state.

9 A hydrogen like atom with atomic number 'Z' is in higher excited state of quantum number 'n'.This xcited state atom can make a transition to the first excited state by successively emitting two photons of energies 10 eV and 68.2 eV respectivley. Alternatively, the atom from the same excited state can make a transition to the 2nd excited state by emitting two photons of energies 4.25 eV and 5.95 eV respectively. Calculate the value of 'Z'.

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11. deBroglie wavelength associated with an electron in 4^{th} orbit of hydrogen atom is $a \times (\pi r_0)$ where r_0 is radius of 1^{st} orbit of hydrogen atom, find value of 'a'.

12. If uncertainities in measurement of position and momentum of an electron are equal, then the uncertainity in measurement of its velocity is $x \times 10^{12}$. The value of x (the closest whole number value) is $m_e = 9.1 \times 10^{-31}$ kg, and $h = 6.625 \times 10^{-34}$ Js.

13. A light source of wavelength λ illuminates a metal and ejects photo electron with $(KE)_{max} = 1$ eV. Another light source of wave length $\frac{\lambda}{3}$, ejects photoelectrons from same metal with $(KE)_{max}$=5eV. Find the value of work function (eV) of metal.

SECTION-IV : (SUBJECTIVE)

1. A proton is accelerated to one- tenth of the velocity of light. If its velocity can be measured with a precision $\pm$ 1%. What must be its uncertainity in position (in m). (Use : $\frac{h}{4\pi} = 5.2 \times 10^{-35}$)

2 Calculate the distance of spherical nodes for '3s' orbital from nucleus?

$$R_{3s} = \frac{1}{9\sqrt{3}a_0^{3/2}} (6 - 6\sigma + \sigma^2)\, e^{-\frac{\sigma}{2}} \qquad \text{where } \sigma = \frac{2r}{na_0}$$

3. For an orbital in B^{+4} radial function is :

$$R(r) = \frac{1}{9\sqrt{6}}\left(\frac{z}{a_0}\right)^{\frac{3}{4}} (4-\sigma)\sigma\, e^{-\sigma/2}$$

where $\sigma = \frac{Zr}{a_0}$ and $a_0 = 0.529$ Å ; Z = atomic number, r = radial distance from nucleus.

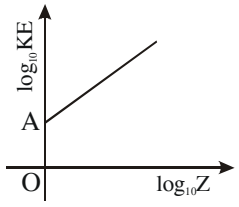
The radial node of orbital is at distance from nucleus.

4. To what effective potential (in volt) a proton beam be subjected to give its protons a wavelength of 1 $\times 10^{-10}$ m.

5. If shortest wavelength of H-atom in Balmer series is X then.
   (i) What is the shortest wave length in Lyman series.
   (ii) What is the longest wave length in Paschen series.

6. The energy of the second stationary state in Li^{+2} ion is -11.025×10^{-18} J. Find ionization energy (in J/mole) for He^+ ions in its ground state :

7 In a H-like atom for an electron revolving in n^{th} orbit, the variation of $\mathbf{\log_{10} KE}$ versus $\mathbf{\log_{10} Z}$ is plotted as following -



where Z is atomic number & KE is kinetic energy of electron (in eV). If OA = $\log_{10}$ 3.4 then find the value of principle quantum number of the electron.

8. If the average life time of an excited state of H atom is of order 10^{-8} sec, estimate how many orbits an e^- makes when it is in the state n = 2 and before it suffers a transition to n =1 state.

9. If the mass of electron is doubled, then find the new radius (in Å) of 1st orbit of H-atom ?

10. Specific charges of two particles A and B are in ratio 2 : 3. If their mass ratio $m_A : m_B$ is 2 : 3, then find ratio of their charges $\left(\frac{q_A}{q_B}\right)$?

11. The ratio of distances of closest approach of a proton and an α-particle projected towards the same nucleus with the same initial kinetic energy is.

12. The wave numbers of two electromagnetic radiations are 4×10^6 m^{-1} and 2×10^5 cm^{-1}. The ratio of their frequencies is.

13. The eyes of certain member of the reptile family pass a single visual signal to the brain when the visual receptors are struck by photons of wavelength 662 nm . If a total energy of 3.0×10^{-14} J is required to trip the signal, what is the minimum number of photons that must strike the receptor.
($h = 6.62 \times 10^{-34}$ J $\times$ s)

14. The dissociation energy of H_2 is 482.5 KJ/mol. If H_2 is exposed to radiant energy of wavelength 124 nm, what % of radiant energy will be converted into K.E. ($1\frac{ev}{atom} = 96.5$ kJ/mol.)