CHEMISTRY

BOOKS - G.R. BATHLA & SONS CHEMISTRY (HINGLISH)

ATOMIC STRUCTURE

Example

1. How many protons, electrons and neutrons are present in 0.18 g $.^{20}_{15}P$?

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2. Calculate the frequency and wave number of radiation with wavelength 480nm.

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3. Calculate the energy associated with photon of light having a wavelength 6000Ã.... [$h = 6.624 \times 10^{-27} erg - \text{sec.}$]

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4. Which has a higher energy, a photon of violet light with wavelength 4000Ã... or a photon of red light with wavelength 7000Ã...? [$h = 6.62 \times 10^{-34} Js$]

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5. What is the ratio between the energies of two radiations one with a wavelength of 6000Ã... and other with 2000Ã...?

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6. Calculate the wavelength, wave number and frequency of photon having an energy to three electron volt.

$(h = 6.62 \times 10^{-27} erg - \sec)$.

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7. Calculate the energy in kilocalorie per mol of the photons of an electromagnetic radiation of wavelength 7600Ã....

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8. An Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise a sodium atom .Calculate the ionisation energy of sodium in $KJmol^{-1}$.

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9. The photons of light having a wavelength 4000Å are necessary to provide $1.00J$ of energy are.

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10. Find the number of quanta of radiations of frequency $4.67 \times 10^{13} s^{-1}$, that must be absorbed in order to melt 5 g of ice. The energy required to melt 1 g of ice is 333J.

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11. The wavelength of the spectral line when the electron is the hydrogen atom undergoes a transition from the energy level 4 to energy level 2 is.

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12. A blube emits light of $\lambda = 4500\text{Å}$. The bulb is rated as 150 watt and 8% of the energy is emitted as light. Number of photons emitted by bulb per second is : $[\text{Take} hc = 12400 eV\text{Å}]$

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13. A near U.V. photon of 300 nm is absorbe by a gas is red then remitted as two photons. One photon is red with wavelength 760 nm. Hence wavelength of the second photon is

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14. Calculate the wavelength of the radiation that would cause photo dissociation of chlorine molecule if the $Cl - Cl$ bond energy is $243 kJ/mol$.

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15. How many moles of photon would contain sufficient energy to raise the temperature of 225 g of water $21^{\circ}C$ to $96^{\circ}C$? Specific heat of water is $4.18 Jg^{-1}K^{-1}$ and frequency of light radiation used is $2.45 \times 10^{9} s^{-1}$.

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16. During photosynthesis, chlorophyll absorbs light of wavelength 440 nm and emits light of wavelength 670 nm. What is the energy available for photosynthesis from the absorption-emission of a mole of photons?

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17. Photochromic sunglasses, which darken when exposed to light, contain a small amount of colourless AgCl(s) embedded in the glass. When irradiated with light, metallic silver atoms are produced and the lass darkens.

$AgCl(s) \rightarrow Ag(s) + Cl$

Escape of chlorine atoms is prevented by the rigid structure of the glass and the reaction therefore, reverses as soon as the light is removed. if 310 kJ/mol of energy is required to make the reaction proceed, what wavelength of light is necessary.?

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18. Calculate the wavelength and energy of radiation emitted for the electron transition from infinite (∞) to first stationary state of the hydrogen atom.

$R = 1.0967 \times 10^7 m^{-1}, h = 6.6256 \times 10^{-34} Js$ and $c = 2.979 \times 10^8 ms^{-1}$

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19. Calculate the velocity of an electron present in third orbit of H atom. Also calculate number of revolutions per second round the nucleus.

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20. The electron energy in hydrogen atom is given by $E_n = \left(-2.18 \times 10^{-18}\right) / n^2 J$. Calculate the energy required to remove an electron completely from the $n = 2$ orbit. What is the longest wavelength of light in cm that can be used to cause this transition?

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21. Calculate the shortest and longest wavelength I hydrogen spectrum of Lyman series.

or Calculate the wavelength of the first line and the series limit for the Lyman series of hydrogen. $\left(R_H = 109678 cm^{-1}\right)$.

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22. The balmer series occurs between the wavelength of $\left[R = 1.0968 \times 10^7 m^{-1}\right]$.

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23. Light of wavelength 12818Ã… is emitted when the electron of a hydrogen atom drops from 5th to 3rd orbit. Find the wavelength of the photon emitted when the electron falls from 3rd to 2nd orbit.

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24. The ionisation energy of H atom is 13.6 eV. What will be the ionisation energy of $He^{\oplus}$ and Li^{2+} ions ?

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25. The energy difference between two electronic states is $46.12\text{kcal}/\text{mol}$. What will be the freqency of the light emitted when an electron drops from the higher to the lower energy state ? (Planck' constant $= 9.52 \times 10^{-14} kcal \sec mol^{-1}$)

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26. According to Bohr's theory, the electronic energy of an electron in the n^{th} orbit is given by $E_n = (-2.17 \times 10^{-18}) \times \frac{z^2}{n^2} J$

Calculate the longest wavelength of light that will be needed in remove an electron from the third Bohr orbit of $He^{\oplus}$

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27. The ratio of the velocity of light and the velocity of electron in the first orbit of a hydrogen atom.

$[Given\ h = 6.624 \times 10^{-27} erg - \sec, m = 9.108 \times 10^{-28} g, r = 0.529 \times 10$

.

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28. The wavelength of a vertain line in Balmer series is observed to be 4341Ã.... To what valu of 'n' does this correspond? $(R_H = 109678 cm^{-1})$.

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29. Estimate the difference in energy between the first and second Bohr's orbit for a hydrogen atom. At what minimum atomic number , a transition from $n = 2$ to $n = 1$ energy level would result in the emission of X -rays with $\lambda = 3.0 \times 10^{-8} m$? Which hydogen -like species does this atomic number correspond to ?

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30. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ to $n = 2$ of He^{+} spectrum ?

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31. Calculate the energy emitted when electron of 1.0 gm atom of Hydrogen undergo transition giving the spectrtal lines of lowest energy is visible region of its atomic spectra. Given that, R_H=$1.1 \times 10^{7} m^{-1}$, $c = 3 \times 10^{8} m / \sec$,$h = 6.625 \times 10^{-34} J \sec$.

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32. How many times does the electron go round the first Bohr's orbit of hydrogen in one second ?

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33. Calculate the wavelength of radiation emitted producing a line in the Lyman series ,when an electron falls from fourth stationary level in hydrogen atom $\left(R_H = 1.1 \times 10^7 m^{-1}\right)$

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34. What is the maximum degeneracy of a level of H-atom, where e^- has energy, $E_n = -\frac{R}{9}$?

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35. Calculate the angular frequency of revolution of an electron occupying the second Bohr orbit of He^{+} ion.

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Illustrations of Objective Question

1. The frequency of the rations having wave number $10m^{-1}$ is:

A. $10s^{-1}$

B. $3 \times 10^{7}s^{-1}$

C. $3 \times 10^{11}s^{-1}$

D. $3 \times 10^{9}s^{-1}$

Answer: D

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2. The energy of a photon of radiation having wavelength 300 nm is,

A. $6.63 \times 10^{29} J$

B. $6.63 \times 10^{-19} J$

C. $6.63 \times 10^{-28} J$

D. $6.63 \times 10^{-17} J$

Answer: B

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3. The maximum kinetic energy of the photoelectrons is found to be $6.63 \times 10^{-19} J$, when the metal is irradiated with a radiation of frequency 2×10^{15} Hz. The threshold frequency of the metal is about:

A. $1 \times 10^{15} s^{-1}$

B. $2 \times 10^{15} s^{-1}$

C. $3 \times 10^{15} s^{-1}$

D. $1.5 \times 10^{15} s^{-1}$

Answer: A

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4. The number of photons of light having wavelength 100 nm which can provide 1 J energy is nearly:

A. 10^7 photons

B. 5×10^{18} photons

C. 5×10^{17} photons

D. 5×10^7 photons

Answer: C

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5. The atomic transition gives rise to the radiation of frequency $(10^4 HMz)$. The change in energy per mole of atoms taking place wiould be:

A. $3.99 \times 10^{-6} J$

B. $3.99 J$

C. $6.62 \times 10^{-24} J$

D. $6.62 \times 10^{-30} J$

Answer: B

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6. The maximum kinetic energy of photoelectrons ejected from a metal, when it is irradiated with radiation of frequency $2 \times 10^{14} s^{-1}$ is 6.63×10^{-20}J. the threshold frequency of the metal is:

A. $2 \times 10^{14} s^{-1}$

B. $3 \times 10^{14} s^{-1}$

C. $2 \times 10^{-14} s^{-1}$

D. $1 \times 10^{14} s^{-1}$

Answer: D

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7. If λ_o and λ be the threshold wavelength and wavelength of incident light , the velocity of photoelectron ejected from the metal surface is :

A. $\sqrt{\frac{2h}{m}(\lambda_0 - \lambda)}$

B. $\sqrt{\frac{2hc}{m}(\lambda_0 - \lambda)}$

C. $\sqrt{\frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)}$

D. $\sqrt{\frac{2h}{m}\left(\frac{1}{\lambda_0} - \frac{1}{\lambda}\right)}$

Answer: C

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8. A radiation of wavelength λ illuminates a metal and ejects photoelectrons of maximum kinetic energy of 1eV. Aother radiation of wavelength $\frac{\lambda}{3}$, ejects photoelectrons of maximum kinetic energy of 4eV. What will be the work function of metal?

A. 1eV

B. 2eV

C. 0.5eV

D. 3eV

Answer: C

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9. The ratio of slopes of $K_{\max}$ vs. V and V_0 vs. v curves in the photoelectric effect gives (v= freqency. $K_{\max}$ = maximum kinetic energy, V_0 =stopping potential) :

A. charge of electron

B. planck's constant

C. work function

D. threshold frequency

Answer: A

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10. Ground state energy of H-atom is $(-E_1)$,t he velocity of photoelectrons emitted when photon of energy E_2 strikes stationary Li^{2+} ion in ground state will be:

A. $v = \sqrt{\frac{2(E_2 - E_1)}{m}}$

B. $v = \sqrt{\frac{2(E_2 + 9E_1)}{m}}$

C. $v = \sqrt{\frac{2(E_2 - 9E_1)}{m}}$

D. $v = \sqrt{\frac{2(E_2 - 3E_1)}{m}}$

Answer: C

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11. The work functions (W_0) of K, Na, Li, Mg and Cu are 2.25,2.30,2.42,3.70 and 4.80 eV respectively. How many of these metals do not undergo photoelectric effect when a radiation of wavelength 450 nm is allowed to fall on them? $\left(1eV = 1.602 \times 10^{-19} J\right)$

A. 2

B. 1

C. 3

D. 5

Answer: A

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12. If the speed of electron in first Bohr orbit of hydrogen be 'x' then speed of the electron in second orbit of He^{+} is

A. x/2

B. 2x

C. x

D. 4x

Answer: C

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13. If first ionisation energy of hydrogen be E, then the ionisation energy of He^{+} would be :

A. E

B. 2E

C. 0.5E

D. 4E

Answer: D

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14. The number of spectral lines that are possible when electrons in 7th shell in different hydrogen atoms return to the 2nd shell is:

A. 12

B. 15

C. 14

D. 10

Answer: B

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15. The ratio of radii of first orbits of H, He^{+} and Li^{2+} is:

A. $1:2:3$

B. $6:3:2$

C. $1:4:9$

D. $9:4:1$

Answer: B

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16. The energy of second orbit of hydrogen is equal to the energy of ,

A. fourth orbit of He^{+}

B. fourth orbit of Li^{2+}

C. Second orbit of He^{+}

D. second orbit of Li^{2+}.

Answer: A

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17. What is the energy in eV requried to excite the electron from n=1 to n=2 state in hydrogen atom? (n=principal quantum number)

A. 13.6

B. 3.4

C. 17

D. 10.2

Answer: D

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18. An electron in an atom jumps in such a way that its kinetic energy changes from x to $\frac{x}{4}$. The change in potential energy will be:

A. $+\frac{3}{2}x$

B. $-\frac{3}{8}x$

C. $+\frac{3}{4}x$

D. $-\frac{3}{4}x$

Answer: A

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19. If the kinetic energy of an electron is increased 4 times, the wavelength of the de Broglie wave associated with it would becomes:

A. 4 times

B. 2 times

C. $\frac{1}{2}$ times

D. $\frac{1}{4}$ times

Answer: C

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20. The mass of photon having wavelength $1nm$ is :

A. $2.21 \times 10^{-35} kg$

B. $2.21 \times 10^{-33} g$

C. $2.21 \times 10^{-33} kg$

D. $2.21 \times 10^{-26} kg$

Answer: C

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21. The de Broglie wavelenth of $1mg$ grain of sand blown by a $20ms^{-1}$ wind is :

A. $3.3 \times 10^{-29} m$

B. $3.3 \times 10^{-21} m$

C. $3.3 \times 10^{-49} m$

D. $3.3 \times 10^{-42} m$

Answer: A

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22. In an atom, an electron is moving with a speed of $600 m / s$ with an accuracy of 0.005% . Certainty with which the position of the electron can be localized is :

$(h = 6.6 \times 10^{-34} kgm^2 s^{-1}$,

mass of electron $(e_m) = 9.1 \times 10^{-31} kg)$.

A. $1.52 \times 10^{-4} m$

B. $5.1 \times 10^{-3} m$

C. $1.92 \times 10^{-3} m$

D. $3.84 \times 10^{-3} m$

Answer: C

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23. Velocity of de Broglie wave is given by :

A. $\frac{c^2}{v}$

B. $\frac{hv}{mc}$

C. $\frac{mc^2}{h}$

D. $v\lambda$

Answer: B

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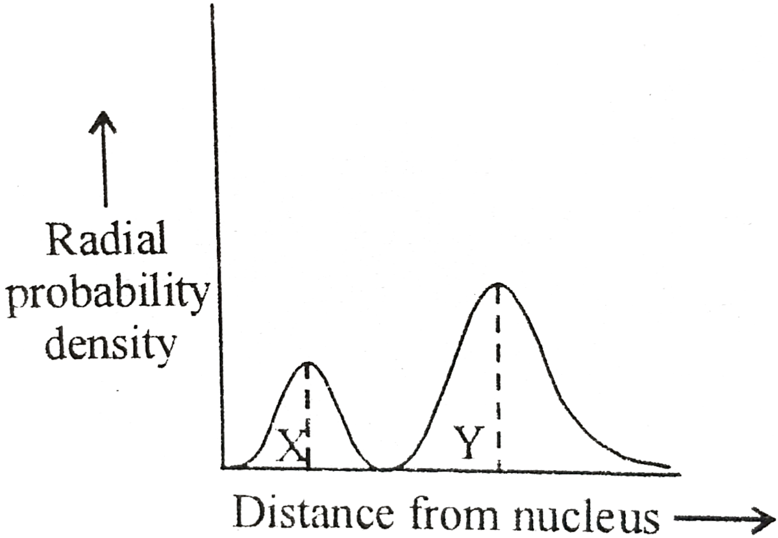

24.

If the above radial probaility curve indicates '2s' orbital, the distance between the peak points X& Y

is

A. 2.07Ã...

B. 1.59Ã...

C. 0.53Ã...

D. 2.12Ã...

Answer: A

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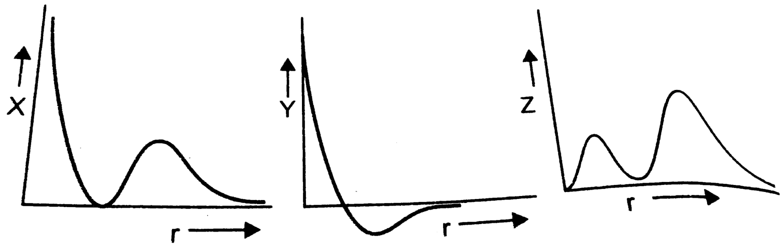
25. 

Plots for 2s orbital are

X, Y and Z respectively.

A. R, R^2 and $4\pi r^2 R^2$

B. R^2, R and $4\pi r^2 R^2$

C. $4\pi r^2 R^2, R^2$ and R

D. $R^2, 4\pi r^2 R^2$ and R.

Answer: B

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26. The Wave function (Psi) of 2s is given by:

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{1/2}\left\{2 - \frac{r}{a^0}\right\}e^{-r/2a_0}$$

At $r = r_0$, radial node is formed . Thus for 2s , r_0, in terms of a_0 is-

A. $r_0 = a_0$

B. $r_0 = 2a_0$

C. $r_0 = a_0/2$

D. $r_0 = 4a_0$

Answer: B

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27. The wave function for 1s orbital of hydrogen atom is given by:

$$\Psi_{1s} = \frac{\pi}{\sqrt{2}}e^{-r/a_0}$$

Where, a_0= Radius of first Bohar orbit

r= Distance from the nucleus (Probability of finding the ekectron varies with respect to it)

What will be the ratio of probability of finding rhe electron at the nucleus to first Bohr's orbit a_0?

A. e

B. e^2

C. $1/e^2$

D. zero

Answer: D

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28. The radial wave equation for hydrogen of radial nodes from nucleus are:

$$\Psi_{1s} = \frac{1}{16\sqrt{4}}\left(\frac{1}{a_0}\right)^{3/2}\left[(\mathrm{x}-1)\left(\mathrm{x}^2-8\mathrm{x}+12\right)\right]e^{-x/2}$$

where, $x = 2r/a_0$, a_0 = radius of first Bohr orbit

The minimum and maximum position of radial nodes from nucleus are:

A. $a_0, 3a_0$

B. $\frac{a_0}{2}, 3a_0$

C. $\frac{a_0}{2}, a_0$

D. $\frac{a_0}{2}, 4a_0$

Answer: B

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29. The orbital angular momentum of an electron in a d-orbital is:

A. $\sqrt{6}\frac{h}{2\pi}$

B. $\frac{\sqrt{h}}{2\pi}$

C. $\frac{h}{2}\pi$

D. $\frac{2h}{2\pi}$

Answer: A

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30. Which of the following sets of quantum numbers is correct for an electron in 4 f-orbital?

A. n=4,l=3,m=+4,s=$+1/2$

B. n=4,l=4,m=-4,s$-1/2$

C. n=4,l=3,m=+1, $s = +1/2$

D. n=3,l=2,m=-2,$s = +1/2$

Answer: C

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31. Match the List -I and List-II and select the correct set from the following sets given below:

(A).	The number of sub-energy levels in an energy level	(1).	n^2
(B).	The number of orbitals in a sub-energy level	(2).	$3d$
(C).	The number of orbitals in an energy level	(3).	$2l+1$
(D).	n=3,l=2,m=0	(4).	n

A.

(A)	(B)	(C)	(D)
4	3	1	2

B. $\begin{matrix} (A) & (B) & (C) & (D) \\ 3 & 1 & 2 & 4 \end{matrix}$

C. $\begin{matrix} (A) & (B) & (C) & (D) \\ 1 & 2 & 3 & 4 \end{matrix}$

D. $\begin{matrix} (A) & (B) & (C) & (D) \\ 3 & 4 & 1 & 2 \end{matrix}$

Answer: A

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32. Which of the following is not possible?

A. n=2,l=1,m=0

B. n=2,l=0,m=-1

C. n=3,l=0,m=0

D. n=3,l=1,m=-1

Answer: B

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33. What is the maximum number of electron in an atom that can have the quantum numbers $n = 4, m_l = +1$?

A. 4

B. 15

C. 3

D. 6

Answer: D

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Solved Examples

1. The wavelength associated with an electron moving with a velocity of $10^{10} cm per \sec$.

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2. Calculate the uncertainty in the position of a particle when the uncertaintly in momentum it:

(a). $1 \times 10^{-3} g \quad \text{cm} \quad \text{sec}^{-1}$

(b) zero.

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3. Calculate the momentum of a particle which has a de Broglie wavelength of 2Å, $\left(h = 6.6 \times 10^{-34} kgm^2 s^{-1}\right)$

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4. What is the mass of a photon of sodium light with a wavelength of 5800Ã...?

$\left(h = 6.63 \times 10^{-27} erg - \text{sec}, c = 3 \times 10^{10} cm / \text{sec}\right)$

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5. The uncertainty in position and velocity of the particle are 0.1 nm and $5.27 \times 10^{-24} ms^{-1}$ respectively then find the approximate integral mass of the particle (in g) . $(h = 6.625 \times 10^{-34} Js)$

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6. Calculate the uncertainty in the velocity of a cricket ball of mass $150g$, if the uncertainty in its position in of the orer of $1Å$.

$(h = 6.6 \times 10^{-34} kg \quad m^2 s^{-1})$

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7. Find out the number of waves made by a Bohr's electron in one complete revolution in its $3rd$ orbit.

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8. An electron is moving with a kinetic energy of $4.55 \times 10^{-25} J$. What will be Broglie wavelength for this electron ?

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9. The Speeds of the fiat and ferrari racing cars are recorded to $\pm 4.5 \times 10^{-4} m \sec^{-1}$. Assuming the track distance to be known within $\pm 16m$, is the uncertainty principle violated for a 3500 kg car?

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10. Alveoli are tiny sacs in the lungs whose average diamter is $5 \times 10^{-5} m$. Consider an oxygen molecule $(5.3 \times 10^{-26} kg)$ trapped within a sac. Calculate uncertainty in the velocity of oxygen molecule.

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Some Solved Examples

1. The minimum energy requried to overcome the attractive forces between an electron and the surface of Ag metal is 5.52×10^{-19}J. what will be the maximum kinetic energy of electrons ejected out from Ag which is being exposed to UV light of $\lambda = 360$Ã...?

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2. Let a light of wavelength λ and intensity 'I' strikes a metal surface to emit x electrons per second. Average energy of each electron is 'y' unit. What will happen to 'x' and 'y' when (a). λ is halved (b) intensity I is doubled?

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3. how many orbits, orbitals and electrons are there in an atom having atomic mass 24 and atomic number 12?

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4. A neutral atom has 2K electrons, 8L electrons and 6M electrons. Predict from this:

(a). Its atomic number, (b() total number of s-electrons,

(c). Total number of p-electrons, (d) total number of d-electrons.

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5. Write down the values of quantum numbers of all the electrons present in the outermost orbit of argon (At. No. 18).

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6. (a) An electron is in 5f-orbital. What possible values of quantum numbers n,lm and s can it have?

(b). What designation is given to an orbital having

(i) n=2, l=1 and (ii). N=3,l=0?

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7. Atomic number of sodium is 11. Write down the four quantum numbers of the electron having highest energy.

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8. An element has 8 electrons in 4d-subshell. Show the distribution of 8 electrons in the d-orbitals of the element within small rectangles.

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9. How many elements would be in the third period of the periodic table if the spin quantum number m_s could have the value $-\frac{1}{2}, 0 \text{ and } +\frac{1}{2}$?

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10. The binding energy of $._{2}^{4}He$ is 28.57 MeV.

What shall be the binding energy per nucleon of this element?

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11. Calculate the binding energy of the oxygen isotope $._{8}^{16}O$. The mass of the isotope is 16.0 amu. (Given e=0.0005486 amu, p=1.00757 amu and n=1.00893 amu).

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12. There are four atoms which have mass numbers 9,10,11 and 12 respectively. Their binding energies are 54,70,66 and 78 MeV respectively. Which one of the atoms is most stable?

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Miscellaneous Numerical Examples

1. The Schrodinger wave equation for hydrogen atom is $\Psi_{2s} = \frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2 - \frac{r}{a_0}\right)e^{-r/a_0}$, where a_0 is Bohr's radius . If the radial node in 2s be at r_0 , then r_0 would be equal to :

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2. Consider the hydrogen atom to be a proton embedded in a cavity of radius a_0 (Bohr radius) whose charge is neutralised by the addition of an electron to the cavity in a vacuum, infinitiely slowly .Estimate the average total energy of an electron in its ground state in a hydrogen atom as the work done in the above neutralisation process .Also if the magnitude of the average kinetic energy is half the magnitude of the average potential energy, find the average potential energy.

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3. Hydrogen atoms are excited from ground state. Its spectrum contains wavelength 486 nm. Find , what transition does the line corresponds to. Also find from this information what other wavelengths will be present in the spectrum?

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4. If uncertainties in the measurement of position and momentum of an electrona re equal, calculate uncertainty in the measurement of velocity.

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5. How much energy will be released when a sodium ion and a chloride ion, originally at infinite distance are brought together to a distance of 2.76Ã… (the shortest distance of approach in a sodium chloride crystal)? Assume that ions act as point charges, each with a magnitude of $1.6 \times 10^{-19} C$.

Permittivity constant of the medium is $9 \times 10^{9} Nm^{2} C^{-2}$.

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6. The angular momentum of electron in a Bohr's orbit of H atom is $4.2178 \times 10^{-34} kgm^2 s^{-1}$. Calculate the wavelength of the spectral line when the electrton falls from this level to the next lower level.

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7. A negatively charged particle called Negatron was discovered. In the Millikan's oil-drop experiment, the charges of the oil-drops in five experimetns are reported as 3.2×10^{-19} coulomb, 4.8×10^{-19} coulomb, 6.4×10^{-19} coulomb 8×10^{-19} coulomb and 9.6×10^{-19} coulomb. Calculate the charge on the negatron.

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8. When a certain metal was irradiated with light of frequency $3.2 \times 10^{16} s^{-1}$ the photoelectrons emitted had twice the KE as did photoelectrons emitted when the same metal was irradiated with light of frequency $2.0 \times 10^{16} s^{-1}$. Calculate the thereshold frequency of the metal.

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9. An electron moves in an electric field with a kinetic energy of 2.5 eV. What is the associated de Broglie wavelength?

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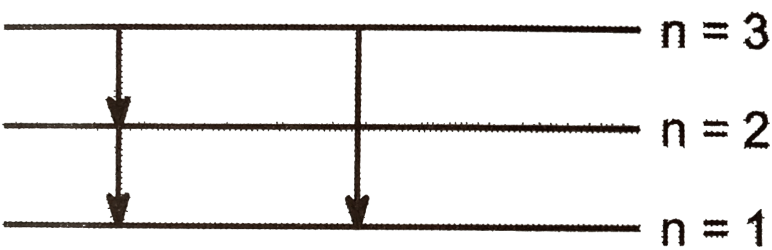
10. Consider the follwoing two elerctronic transition possibilites in a hydrogen atom as pictured below :



(1) The electron drops from third Bohr's orbit to second Bohr's obit

followed with the next transition from second to first Bohr's orbit .

(2) The electron drops from third Bohr's orbit to first Bohr's orbit directly

.

Show that :

(a) The sum of the enrgies for the transitions $n = 3$ to $n = 2$ and $n = 2$ to $n = 1$ is equal to the energy of transiton for $n = 3$ to $n = 1$.

(b) Are wavelengths and frequencies of the emitted spectrum also additive in the same way as their energies are ?

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11. If an electron is moving with velocity $500ms^{-1}$, which is accurate up to 0.005% then calculate uncertainty in its position. $\left[h = 6.63 \times 10^{-34} J - s\right.$, mass of electron $\left. = 9.1 \times 10^{-31} kg\right]$

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12. Applyig bohr's model when H-atom comes from n=4 to n=2, calcualte its wavelength. In this process, write whether energy is released or aborbed? Also write the range of radiation

$R_H = 2.18 \times 10^{-18} J, h = 6.63 \times 10^{-34} J - s$

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Practice Problems

1. An atom of an element contains 13 electrons. Its nucleus has 14 neutrons. Fid out its atomic number and approxiamte atomic mass. An isotope has atomic mass 2 units higher. What will be the number of protons, neutrons and electrons in the isotope?

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2. From the following find out groups of isotopes, isobars and isotons.

$._8^{16} O, ^{39}_{19} K, ._6^{14} C, ._{92}^{239} U, ._7^{14} N, ._{20}^{40} Ca, ._{92}^{238} U, ._{32}^{77} Ge, ._{33}^{77} As, ._8^{18} O, ._{32}^{76} Ge, ._{34}^{78}$

.

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3. An element has atomic number 30. Its cation has 2 units positive charge. How many protons and electrons are present in the cation?

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4. The total number of electrons present in $18mL$ of water is ......

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5. Find (i) the total number of neutrons and (ii) the total mass of neutrons in 7 mg of $.^{14}C$ (assuming that mass of neutron=mass of hydrogen atom).

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6. Calculate the wavelength of a photon in Angstrons having an energy of 1 electron-volt.

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7. A photon of light with wavelength 6000Ã… has an energy E. calculate the wavelength of photon of a light which cooresponds to an energy equal to 2E.

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8. Calculate ther energy in kilocalorie per mol of the photons of an electromagnetic radiation of wavelength 5700Ã…

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9. Light of what frequency and wavelength is needed to ionise sodium tom. The ionisation potential of sodium is $8.2 \times 10^{-19} J$.

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10. Determine the energy of 1 mole photons of radiations whose frequency is $5 \times 10^{10} s^{-1} \quad \left(h = 6.62 \times 10^{-34} J - s\right)$.

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11. Find e/m for He^{2+} ion and compare with that for electron.

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12. A ball of mass 100 g is moving with a velocity of 100 $m \sec^{-1}$. Find its wavelength.

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13. Calculate the wavelength of radiation and energy per mol necessary to ionize a hydrogen atom in the ground state.

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14. Bond energy of F_2 is 150 kJ mol^{-1}. Calculate the minimum frequency of photon to break this bond.

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15. If an Einstein (E) is the total energy absorbed by 1 mole of a substance and each molecule absorbs one quantum of energy, then calculate the value of 'E' in terms of λ in cm.

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16. How many chlorine atoms can you ionize in the process $Cl \rightarrow Cl^{+} + e$, by the energy liberated from the following process ?

$Cl + e^{- \rightarrow} Cl^{-} f \text{ or } 6 \times 10^{23} \text{atoms}$

Given electron affinity ofm $Cl = 3.61 eV$, and IP of $Cl = 17.422 eV$.

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17. a.Calculate the velocity of an electron in the first Bohr's orbit of hydrogen atom (given $r = a_0$).

b. Find de Broglie's wavelength of the electron in the first Bohr's orbit.

c. Find the orbital angular momentum of $2p$ orbital in terms of $h/2\pi$ units.

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18. The energy of an α-particle is $6.8 \times 10^{-18} J$. What will be the wavelength associated with it?

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19. The number of revolutions made by electron in Bohr's 2nd orbit of hydrogen atom is

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20. What is the speed of an electron whose de Broglie wavelength is 0.1 nm? By what potential difference, must have such an electron accelerated from an initial speed zero?

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21. A green ball weighs $75g$ and comes travelling towards you at $400cm/\text{sec}$. A photon of light emitted form green ball has wavelength of 5×10^{-5} cm . Assuming that the error in the position of ball is the same as the wavelength of itself calculate the error in momentum of the green ball .

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22. What is the relationship betwee the eV and the wavelength in metre of the energetically equivalent photons?

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23. In first Bohr orbit of hydrogen atom, the velocity of electron would be (given that radius of first Bohr orbit is $0.53 \times 10^{-10} m$)

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24. In a hydrogen atom, an electron jumps from the third orbit to the first orbit. Find out the frequency and wavelength of the spectral line. $\left(R_H = 1.09678 \times 10^7 m^{-1}\right)$.

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25. The energy of the electron in the second and third Bohr's orbitals of the hydrogen atom is $-5.42 \times 10^{-12} erg$ and $-2.42 \times 10^{-12} erg$ respectively ,Calculate the wavelength of the emitted radiation when the electron drops from the third to the second orbit.

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26. Calculate the wavelength in Angstroms of the photon that is emitted when an electron in the Bohr's orbit $n = 2$, returns to the orbit $n = 1$, in the hydrogen atom .The ionisation potential of the ground state hydrogen atom is 2.17×10^{-11} ergs per atom

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27. Calculate the wave number for the shortest wavelength transition in the Balmer series of atomic hydrogen.

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28. The wavelength of the first member of the balmer series of hydrogen is $6563 \times 10^{-10} m$. Calculate the wavelength of its second member.

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29. According to Bohr theory, the electronic energy of hydrogen atom in the nth Bohr orbit is given by

$$E_n = -\frac{21.76 \times 10^{-19}}{n^2} J.$$

Calculate the longest wavelength of light that will be needed to remove an electron from the 2nd orbit of Li^{2+} ions.

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30. Calculate frequency, energy and wavelength of the radiation corresponding to the speciral line of the lowest frequency in lyman series in the spectrum of a hydrogen atom .Also calculate the energy for the coresponding line in the spectrum of Li^{2+}. $\left(R_H = 109677 cm^{-1}, c = 3 \times 10^8 ms^{-1}, Z = 3\right)$

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31. Calculate the ratio of the velocity of light and the velocity of electron in the 2nd orbit of a hydrogen atom. (given

$h = 6.624 \times 10^{-27} erg - \sec, m = 9.108 \times 10^{-28} g, r = 2.11 \times 10^{-8} cm$

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32. What hydrogen-like ion has the wavelength difference between the first lines of the Balmer Lyman series equal to $59.3 nm$?

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33. The velocity of electron in a certain Bohr orbit of H bears the ratio $1 : 275$ to the velocity of light M

a. What is the quantum number (n) of orbit ?

b. Calculate the wave number of the radiation emitted whemn the electron jumps from $(n + 1)$ state to the ground state $(R = 1.0987 \times 10^5 cm^{-1})$

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34. Find out the wavelength of the next line in the series having lines of spectrum of H-atom of wavelength 6565Ã..., 4863Ã..., 4342Ã... and 4103Ã....

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35. Which jump is responsible for the wave number of emitted radiations equal to $9.490 \times 10^6 m^{-1}$ in Lyman series of hydrogen spectrum? $(R = 1.09678 \times 10^7 m^{-1})$.

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36. Calculate the ionisation energy of the hyddrogen atom. How much energy will be required to ionise 1 mole of hydrogen atoms? Given, that the Rydberg constant is $1.0974 \times 10^7 m^{-1}$.

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37. Calculate the IE of (a) one Li^{2+} ion (b) one mole of Li^{2+} ions. Given Rydberg constant $= 1.0974 \times 10^7 m^{-1}$

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38. A series of lines in the spectrum of atomic hydrogen lies at 656.46 n, 486.27 nm, 439.17 nm and 410.29 nm. What is the wavelength of the next line in this series? What is the ionisation energy of the atom when it is ini the lower state of transition?

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39. A certain line of the Lyman series of hydrogen and a certain line of the Balmer series of He^{+} ion have nearly the same wavelength to what transition do they belong? Small differences between their Rydberg constant may be neglected. Differences between their Rydberg constant may be neglected.

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40. What element has a hydrogen-like spectrum whose lines have wavelength four times shorter than those of atomic hydrogen?

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41. The binding energy of the electron in the ground state of He atom is equal to $E_0 = 24.6 eV$. Find the energy required to remove both the electrons from the atom.

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42. What is the ratio of the speeds of an electron in the first and second orbits of a hydrogen atom?

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43. Find out the number of waves made by a Bohr's electron in one complete revolution in its third orbit.

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44. The wave number of first line in Balmer series of Hydrogen is $15, 200cm^{-1}$ the wave number of first line in Balmer series of Be^{3+}

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45. An electron in H-atom in its ground state absorbs 1.5 times as much energy as the minimum required for its escape (i. e., 13 . 6 eV) from the atom . Calculate the wavelength of emitted electron.

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46. The radius of the an orbit of hydrogen atom is 0.85nm . Calculate the velocity of electron in this orbit.

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47. An electron jumps from an outer orbit to an inner orbit with the energy difference of 3.0 eV. What will be the wvelength of the line and in what region does the emission take place?

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48. The first ionisation energy of a certain atom took plaec with an absorption of radiation of frequency 1.5×10^{18} cycle per second calculate its ionisation energy in calorie per gram atom.

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49. Find the wavelength associated with an electron which has mass $9.1 \times 10^{-28} g$ and is moving with a velocity of 10^5 cm $\sec^{-1}$. (Given , $h = 6.625 \times 10^{-27}$ erg-sec)

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50. Calculate the momentum of the particle which has de Broglie wavelength $1\tilde{A}...(10^{-10} m)$ and $h = 6.6 \times 10^{-34} J - \sec.$

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51. The uncertainty of a particle in momentum is 3.3×10^{-2} kg ms^{-1}. Calculate the uncertainty in its position.

$(h = 6.6 \times 10^{-34} J - \sec)$.

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52. Calculate the product of the uncertainty of the displacement and velocity of a electron having mass $9.1 \times 10^{-28} g$

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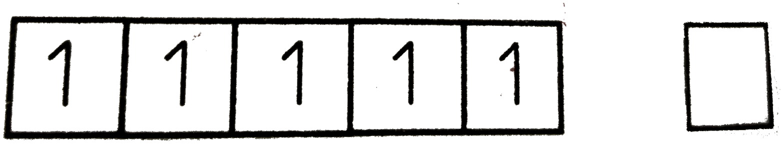
53. (a). A transition metal cation x^{3+} has magnetic momen $\sqrt{35}$ BM. What is the atomic number of x^{3+}?

(b). Select the coloured ion and the ion having maximum



Magnetic moment (i). Fe^{2+}

(ii). Cu^{+}

(iii). Sc^{3+} and (iv) Mn^{2+}.

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54. A photon of wavelength 4000Ã… A strikes a metal surface, then work function of the metal being 2.13 eV. Calculate (i) energy photoelectron and (iii) velocity of the photoelectron.

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55. Calculate the ratio between the wavelength of an electron and a proton, if the proton is moving at half the velocity of the electron (mass of the proton $= 1.67 \times 10^{-27} kg$, mass of the electron $= 9.11 \times 10^{-2} m$.

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56. A moving electro has 2.8×10^{-25} J of kinetic energy calculate its wavelength

(Mass of electron $= 9.2 \times 10^{-31} kg$)

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57. Calculate the mass defect and binding energy per nucleon for an alpha particle (containing two protons and two neutrons) whose actual mass is 4.0028 amu (mass of proton = 1.00759 amu, mass of nuetron = 1.00898 amu).

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58. Calculate the mass defect and binding energy per nucleon of $._8^{16}O$ which has a mass 15.99491 amu.

Mass of neutron=1.008655 amu

Mass of proton =1.007277 amu

Mass of electron=0.005486 amu

1amu=931.5 MeV

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59. The circumference of the second Bohr orbit of an electron in a hydrogen atom is $600nm$. Calculate the potential difference to which the electron has to be accelerated to get de Broglie wavelength corresponding to this circumference.

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60. The velocity of an electron of mass 9.1×10^{-31} kg moving round the nucleus in the Bohr orbit (diameter of the orbit is 1.058Ã...) is $2.2 \times 10^{-6} m \sec^{-1}$. If momentum can be measured within the accuracy of 1%, then calculate uncertainty in position (Δx) of the electron

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61. An electron wave has wavelength 1Ã.... Calculat the potential with which the electron is accelerated.

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62. Calculate the de Broglie wavelength associated with an α-particle having an energy of $7.7 \times 10^{-13} J$ and a mass of $6.6 \times 10^{-24} g$. $(h = 6.6 \times 10^{-34} J - s)$.

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63. An electron has mass $9.1 \times 10^{-28} g$ and is moving with a velocity of $10^5 cm / \sec$. Calculate its kinetic energy and wavelength when $h = 6.626 \times 10^{-27} erg - \sec$

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64. Calculate the de Broglie wavelength of an electron, proton and uranium atom, all having the same kinetic energy $100 eV$.

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65. Work function of sodium is 2.5 eV. Predict whether the wavelength 6500Ã... is suitable for a photoelectron or not?

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66. Calculate the de Broglie wavelength associated with a helium atom in a helium gas sample at 27° C and 1 atm pressure.

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67. The threshold frequency for a certain metal is 3.3×10^{14} cycle/sec, calculate the cut-off potential for the photoelectron.

View Text Solution

68. Can you locate the electro within 0.005 nm?

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69. The photoelectric cut off voltage in a certain experiment is 1.5V. What is the maximum kinetic energy of photoelectrons emitted? $e = 1.6 \times 10^{-19} C$.

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70. 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 uncertainty in position?

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71. In a photoelectric effect experiment irradiation of a metal with light of frequency $5.2 \times 10^{14} s^{-1}$ yields electrons with maximum kinetic energy $1.3 \times 10^{-19} J$. Calculate the threshold frequency (v_0) for the metal.

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72. Calculate the wavelength of a CO_2 molecule moving with a velocity of 440 m $\sec^{-1}$

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73. The predominant yellow line in the spectrum of a sodium vapour lamp has a wavelength of 590 nm. What minimum accelerating potential is needed to excite this line in an electron tube having sodium vapours?

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74. Find out the wavelength of a track star running a 100 metre dash I 10.1 sec, if its weight is 75 kg.

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75. At what velocity ratio are the wavelengths of an electron and a proton equal?

$(m_e = 9.1 \times 10^{-28} g$ and $m_p = 1.6725 \times 10^{-24} g$

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76. Through what potential difference must an electron pass to have a wavelength of $500 A^{\circ}$.

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77. Calculate the velocity of an α-particle which begins to reverse its direction at a distance of 2×10^{-14} m from a scattering gold nucleus (Z=79)

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78. Two hydrogen atom collide Collide head on and end up with zero kinetic energy. Each atom then emit a photon of wavelength $121.6nm$. Which transition leads to the wavelength? How fast were the hydrogen atoms travelling before collision?

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79. Show that the wavelength of electrons moving at a velocity very small compared to that of light and with a kinetic energy of V electron volt can be written as

$$\lambda = \frac{12.268}{\sqrt{V}} \times 10^{-8} cm$$

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80. What is the distance of closest approach to the nucleus of an αpartile which undergoes scattering by 180° is geiger-marsden experiment?

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81. Photo electrons are liberated by ultraviolet light of wavelength 3000Å from a metalic surface for which the photoelectric threshold wavelength is 4000Å. Calculate the de Broglie wavelength of electrons emitted with maximum kinetic energy.

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82. Show that de Broglie wavelength of electrons accelerated V volt is very nearly given by:

$$\lambda(\text{in Ã}...) = \left(\frac{150}{V}\right)^{1/2}$$

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83. A 1 MeV proton is sent against a gold leaf $(Z = 79)$. Calculate the distance of closest approach for head-on collision.

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84. What is the energy, momentum and wavelength of the photon emitted by a hydrogen atom when an electron makes a transition from n=2 to n=1? Given that ionization potential is 13.6 eV

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85. Calculate the orbital angular momentum of the following orbitals:

(a). 3p

(b). 3d

(c). 3s.

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86. A single electron system has ionization energy 11180 kJ mol^{-1}. Find the number of protons in the nucleus of the system.

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87. Suppose $10^{-17}J$ of light energy is needed by the interior of the human eye to see an object. How many photons of green light $(\lambda = 550nm)$ are needed to generate this minimum amount of energy?

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88. How many hydrogen atoms in the ground state are exited by means of monochromatic radiation of wavelength 970.6 Ã.... How many different lines are possible in the resulting emission spectrum? Find the longest wavelength among these .

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Questions with single correct Answer

1. The ratio e/m i.e. specific , for a cathode ray

A. varies with a gas in a discharge tube

B. is fixed

C. varies with different electrodes

D. is maximum if hydrogen is taken

Answer: B

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2. Which of the following statements is wrong about athode rays?

A. They travel in straight lines towards cathode.

B. They produce heating effect.

C. They carry negative charge.

D. They produce X-rays when strike with material having high atomic masses.

Answer: A

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3. Cathode rays are

A. electromagnetic waves

B. Strem of α-particles

C. stream of electrons

D. radiations

Answer: C

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4. Cathode rays have:

A. mass only

B. charge only

C. no mass and no charge

D. mass and charge both

Answer: D

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5. Which is correct statement about proton?

A. It is a nucleus of deuterium.

B. It is an ionised hydrogen molecule.

C. It is an ionised hydrogen atom.

D. It is an α-partile.

Answer: C

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6. Neutron was discovered by ....

A. J.J. Thomsono

B. Chadwick

C. Rutherford

D. Priestley.

Answer: B

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7. The discovery of neutron becomes very late because.

A. it is present in nucleus

B. it is a fundamental particle.

C. It does move

D. it does not carry any charge.

Answer: D

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8. The fundamental particles present in equal numbers in neutral atoms (atomic number 71) are

A. protons and electrons

B. neutrons and electrons

C. Protons and neutrons

D. protons and positrons

Answer: A

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9. The nucleus of the atom consists of:

A. protons and neutrons

B. protons and electrons

C. neutrons and electrons

D. protons, neutrons and electrons.

Answer: A

Watch Video Solution

10. The charge on electron was discovered by

A. J.J. Thomsono

B. R.A. Millikan

C. Rutherford

D. Chadwick

Answer: B

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11. Atomic number of an element represents:

A. number of neutrons in the nucleus

B. atomic mass of an element

C. valency of an element

D. number of protons in the nucleus.

Answer: D

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12. Rutherford's experiment on the scattering of α particle showed for the first time that the atom has

A. electrons

B. protons

C. neutrons

D. nucleus

Answer: D

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13. Rutherford's scattering experiment is related to the size of the

A. nucleus

B. atom

C. electron

D. neutron

Answer: A

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14. When alpha particles are sent through a thin metal foil, most of them go straight through the foil because:

A. alpha particles are much heavier than electrons

B. alpha particles are positively charged

C. most part of the atom is empty space

D. alpha particles move with very high velocity.

Answer: C

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15. The radius of an atomic nucleus is of the order of

A. $10^{-10} cm$

B. $10^{-13} cm$

C. $10^{-15} cm$

D. $10^{-8} cm$

Answer: B

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16. The size of atomic nucleus is of the order of............ m and size of the atom is of the order of........... .

A. $10^{-8} cm$

B. $10^{-10} cm$

C. $10^{-13} cm$

D. $10^{-6} cm$

Answer: A

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17. Atom consist of electrons , protons and neutrons . If the mass attributed to neutron were halved and that attributed to the electrons were doubled , the atomic mass of $6C^{12}$ would be approximately :

A. approximately the same

B. doubled

C. reduced approx. 25%

D. approx. halved.

Answer: C

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18. A light whose frequency is equal to $6 \times 10^{14} Hz$ is incident on a metal whose work function is $2eV \left(h = 6.63 \times 10^{-34} Js, 1eV = 1.6 \times 10^{-19} J\right)$. The maximum energy of electrons emitted will be:

A. 2.49 eV

B. 4.49 eV

C. 0.49 eV

D. 5.49eV

Answer: C

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19. The nuclear size is measured in units of

A. amu

B. angstrom

C. cm

D. fermi

Answer: D

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20. The highest value of e/m of anode rays has been observed when the discharge tube is filled with:

A. nitrogen

B. oxygen

C. hydrogen

D. helium

Answer: C

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21. Which of the following atoms contains the least number of neutrons?

A. $._{92}^{235}U$

B. $._{92}^{238}U$

C. $._{93}^{239}Np$

D. $._{93}^{240}Np$

Answer: A

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22. Which of the following properties of an element is a whole number ?

A. Atomic mass

B. Atomic number

C. Atomic radius

D. Atomic volume

Answer: B

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23. The increasing order (lowest first) for the values of e/m (charge//mass) for electron (e), proton (p), neutron (n), and alpha particle (α) is

A. e,p,n,α

B. n,p,e, α

C. n,p,α,e

D. n,α,p,e

Answer: D

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24. The mass of the neutron is of the order of

A. $10^{-27} kg$

B. $10^{-26} kg$

C. $10^{-25} kg$

D. $10^{-24} kg$

Answer: A

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25. The atoms of various isotopes of a particular element differ from each other in the number of:

A. electrons in the outer shell only

B. protons in the nucleus

C. electrons in the inner shell only

D. neutrons in the nucleus.

Answer: D

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26. Which of the following conditions is incorrect for a well behaved wave function (Φ)?

A. Φ must be finite

B. Φ must be single valued

C. Φ must be infinite

D. Φ must be continuous.

Answer: C

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27. Atomic mass of an element is not necessarily a whole number because

A. it contians electrons, protons and neutrons

B. it contains isotopes

C. it contains allotropes

D. all of the above

Answer: B

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28. Nucleons are:

A. Protons and neutrons

B. neutrons and electrons

C. protons and electrons

D. proton, neutrons and electrons.

Answer: A

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29. Isotopes of an element have

A. different chemical and physical properties.

B. similar chemical and physical properties.

C. similar chemical but different physical properties.

D. similar physical and different chemical properties.

Answer: C

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30. Isotopes are identified by:

A. Postiive ray analysis

B. Astons' mass spectrograph

C. Dempster's mass spectrograph

D. all of the above

Answer: D

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31. Mass spectrograph helps in the detection of isotopes because they:

A. hae different atomic masses

B. have same number of electrons

C. have sae atomic number

D. have same atomic masses.

Answer: A

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32. Discovery of the nucleus of an atom was due to the experiment carried out by:

A. Bohr

B. Rutherrford

C. Moseley

D. Thomson

Answer: B

Watch Video Solution

33. Isobars are the atoms of:

A. same elements having same atomic number

B. same elements having same atomic mass

C. different elements having same atomic mass

D. none of the above

Answer: C

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34. Which of the following pairs represents isobars?

A. $._2^3 He$ and $._2^4 He$

B. $._{12}^{24} Mg$ and $._{12}^{25} Mg$

C. $._{19}^{40} K$ and $._{20}^{40} Ca$

D. $._{19}^{40} K$ and $._{19}^{39} K$

Answer: C

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35. The triad of nuclei that is isotonic is

A. $._{6}^{14}C, ._{7}^{14}N, ._{9}^{19}F$

B. $._{6}^{12}C, ._{7}^{14}N, ._{9}^{19}F$

C. $._{6}^{14}C, ._{7}^{14}N, ._{9}^{17}F$

D. $._{6}^{14}C, ._{7}^{15}N, ._{9}^{17}F$

Answer: D

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36. Sodium atoms and sodium ions:

A. are chemically similary

B. Both react vigorously with waer

C. have same umber of electrons

D. have same number of protons.

Answer: D

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37. In $._{17}^{35}Cl$ and $._{17}^{37}Cl$, which of the following is false?

A. Both have 17 protons

B. Both have 17 electrons

C. Both have 18 neutrons

D. Both show same chemical properties.

Answer: C

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38. Neutrino has:

A. charge +1, mass 1

B. charge 0, mass 0

C. charge -1, mass 1

D. charge 0, mass 1

Answer: B

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39. " Positronium " is the name given to an aotm like combination formed between :

A. a positron and a proton

B. a positron and a neutron

C. a positron and an α-particle

D. a positron and an electron.

Answer: D

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40. An isotone of $._{32}^{76}Ge$ is-

(a) $._{32}^{77}Ge$

(b).$_{33}^{77}As$

(c).$_{34}^{77}Se$

(d).$_{34}^{78}Se$

A. $._{32}^{77}Ge$

B. $._{33}^{78}As$

C. $._{34}^{77}Se$

D. $._{34}^{78}Se$

Answer: D

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41. Which of the following does not characteristic X -rays ?

A. The radiations can ionise gases.

B. It causes ZnS to fluorescence.

C. Deflected by electric and magnetic fields.

D. Have wavelengths shorter than ultraviolet rays.

Answer: C

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42. X-rays are produced when a stream of electrons in an X-ray tube:

A. Hits the glass wall of the tube

B. strikes the metal target

C. passes through a strong magnetic field

D. none of the above

Answer: B

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43. Number of completely filled orbitals in xenon atom (Xe) is:

A. 17

B. 18

C. 27

D. 28

Answer: C

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44. The nature of positive rays produced in a vacuum discharge tue depends upon:

A. the nature of the gas filled

B. nature of the material of cathode.

C. nature of the material of anode

D. the potential applied across the electrodes.

Answer: A

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45. Electromagnetic radiation with maximum wavelengths is :

A. ultraviolet

B. radiowaves

C. X-rays

D. infrared

Answer: B

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46. What is the ratio of volume of atom of the volume of nucleus?

A. 10^{10}

B. 10^{12}

C. 10^{15}

D. 10^{20}

Answer: C

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47. Which of the followign statements is incorrect?

A. The frequency of radiation is inversely proportional to its wavelength.

B. Energy of radiation increases with increase in frequency.

C. Energy of radiation decreases with increase in wavelength.

D. the frequency of radiation is directly proportional to its wavelength.

Answer: D

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48. Visible light consists of rays with wavelengths in the approximate range of:

A. 4000 Ã... to 7500 Ã...

B. $4 \times 10^{-3} cm$ to $7.5 \times 10^{-4} cm$

C. 4000 nm to 7500 nm

D. $4 \times 10^{-5} m$ to $7.5 \times 10^{-6} m$

Answer: A

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49. Which of the following statements concerning light is false?

A. it is a part of the electromagnetic spectrum.

B. It travels with same velocity i.e., $3 \times 10^{10} cm / s$.

C. It cannot be deflected by a magnet.

D. It consists of photons of same energy.

Answer: D

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50. A 600 W mercury lamp emits monochromatic radiation of wave length 313.3 nm. How many photons are emitted from the lamp per second ? ($h = 6.626 \times 10^{-34} Js$, velocity of light $= 3 \times 10^8 ms^{-1}$)

A. 1×10^{19}

B. 1×10^{20}

C. 1×10^{21}

D. 1×10^{23}

Answer: C

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51. Arrange the following electromagnetic radiations per quantum in the order of increasing energy:

A: Blue light

B: Yellow light

C: X-ray

D: Radiowave

A. D,B,A,C

B. A,B,D,C

C. C,A,B,D

D. B,A,D,C

Answer: A

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52. The wave number which corresponds to electromagnetic radiations of 600 nm is equal to:

A. $1.6 \times 10^4 cm^{-1}$

B. $0.16 \times 10^4 cm^{-1}$

C. $16 \times 10^4 cm^{-1}$

D. $160 \times 10^4 cm^{-1}$

Answer: A

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53. Which of the following is not acharacteristic of plack's quentum theory of radiation ?

A. The energy is not absorbed or emitted in whose number multiple of quantum.

B. Radiation is associated with energy.

C. Radiation energy is not emitted or absorbed continuously but in the form of small packets called quanta.

D. This magnitude of energy associated with a quantum is proportional to the frequency.

Answer: A

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54. Which of the followng among the visible colours has the minimum wavelength?

A. Red

B. Blue

C. Green

D. Violet

Answer: D

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55. According to classical theory if an electron is moving in a circular orbit around the nucleus:

A. it will contuinue to do so for something

B. its orbit will continuously shrink

C. its orbit will continuously enlarge

D. it will continue to do so for all the time.

Answer: B

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56. Bohr advanced the idea of :

A. Stationary electrons

B. statioinary nucleus

C. statioary orbits

D. elliptical orbits

Answer: C

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57. In Bohr's stationary orbits:

A. Electrons do not move

B. electrons move emitting radiations

C. energy of the electron remains constant

D. angular momentum of the electron is $\frac{h}{2i}$.

Answer: C

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58. If Paschen series of hydrogen spectrum has 4 lines then number of lines in Balmar sereis will be:

A. 3

B. 5

C. 6

D. 2

Answer: B

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59. Which of the following statement does not form part of Bohr's model of the hydrogen atomn?

A. Energy of the electrons in the orbit is quantised.

B. The electron in the orbit nearest to the nucleus has the lowest energy.

C. Electrons revolve in different orbits around the nucleus.

D. The position and velocity of the electrons in the orbit cannot be determined silultaneously.

Answer: D

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60. The radius of the first orbit of H-atom is r. then the radius of the first orbit of Li^{2+} will be:

A. $\frac{r}{9}$

B. $\frac{r}{3}$

C. $3r$

D. 9r

Answer: B

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61. The energy liberated when an excited electron returns to its ground state can have:

A. any value from zero to infinity

B. only negative values

C. only specified positive values

D. None of the above

Answer: C

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62. The total energy of an electron in the second excited state of the hydrogen atom is about -1.5 eV. The kinetic energy and potential energy of the electron in this state are:

A. 1.5 eV and -3 eV

B. $-1.5eV$ and -1.5eV

C. 3eV and -4.5 eV

D. -0.75 eV and $-0.75eV$

Answer: A

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63. The radius ratio of Bohr's first orbit of hydrogen like species He^{+}, Li^{2+}, Be^{3+} is

A. $3:4:6$

B. $2:3:4$

C. $6:4:3$

D. $4:3:2$

Answer: C

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64. Which point does not pertain to Bohr's model of atom?

A. Angular momentum is an integral multiple of $h/(2\pi)$

B. the path of the electron is circular.

C. Force of attraction towards nucleus=centrifugal force.

D. The energy changes are taking place continuously.

Answer: D

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65. According to Boohr's theory the angular momentum of an electron in 5th orbit is :

A. $5h / \pi$

B. $2.5h / \pi$

C. $5\pi / h$

D. $25h / \pi$

Answer: B

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66. A gas absorbs a photon of $355nm$ and emits at two wavelengths . If one of the emission is at 680 nm , the other is at :

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67. If $n = 6$, the correct sequence for filling of electrons will be.

A. $ns \rightarrow np \rightarrow (n-1)dto(n-2)f$

B. $ns \rightarrow (n-2)f \rightarrow (n-1)dtonp$

C. $ns \rightarrow (n-1)dto(n-2)f \rightarrow np$

D. $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$

Answer: B

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68. Which of the following electron transitions in a hydrogen atom will require the largest amount of energy?

A. From n=1 to n=2

B. From n=2 to n=3

C. From n $= \infty$ to n=1

D. From n=4 to n=5

Answer: A

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69. For a hydrogen atom, the energies that an electron can have are given by the expression, $E = -13.58/n^2 eV$, where n is an integer. The smallest amount of energy that a hydrogen atom in the ground state can absorb is:

A. 1.00 eV

B. 3.39 eV

C. 6.79 eV

D. 10.19 eV

Answer: B

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70. The energy of a hydrogen atom in its ground state is $-13.6eV$. The energy of the level corresponding to the quantum number n=5 is

A. $-0.54eV$

B. $-5.40eV$

C. $-0.85eV$

D. $-2.72eV$

Answer: A

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71. $E_n = -313.6/n^2$ kcal/mol. If the value of $E = -34.84$ kcal/mol, to which value does 'n' correspond?

A. 4

B. 3

C. 2

D. 1

Answer: B

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72. The ratio of the difference between 1 st and 2nd Bohr orbits energy to that between 2nd and 3rd orbits energy is:

A. $1/2$

B. $1/3$

C. $27/5$

D. $5/27$

Answer: C

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73. The energy difference between two electronic states is 43.56 kcal/mo. The frequency of light emitted when the electron drops from higher orbit to lower orbit, is

(Planck's constant $= 9.52 \times 10^{-14} kcal/mol$)

A. 9.14×10^{14}cycle/sec

B. 45.7×10^{14} cycle/sec

C. 91.4×10^{14} cycle/sec

D. 4.57×10^{14} cycle/sec

Answer: D

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74. Which of the following transitions of an electron in hydrogen atom emits radiation of the lowest wavelength?

A. $n_2 = \infty$ to $n_1 = 2$

B. $n_2 = 4$ to $n_1 = 3$

C. $n_2 = 2$ to $n_1 = 1$

D. $n_2 = 5$ to $n_1 = 3$

Answer: A

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75. The value of $(n_2 + n_1)$ and $\left(n_2^2 - n_1^2\right)$ for He^+ ion in atomic spectrum are 4 and 8 reaspectively . The wave length of emitted photon whwn electron jump from n_2 to n_1 is

A. $\frac{32}{9R_H}$

B. $\frac{9}{32R_H}$

C. $\frac{32}{9}R_H$

D. $\frac{9}{32}R_H$

Answer: B

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76. Number of possible spectral lines which may be emitted in brackett series in H-atom, if electrons in 8th excited state returns to ground state are:

A. 5

B. 45

C. 6

D. 21

Answer: C

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77. Which electronic level would allow the hydrogen atom to absorbs a photon but not to emit a photon

A. 1s

B. 2s

C. 3s

D. 4s

Answer: A

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78. The spectral lines corresponding to the radiation emitted by an electron jumping from 6th, 5 th and 4th orbits to second orbit belong to:

A. Lyman series

B. Balmer series

C. Paschen series

D. Pfund series.

Answer: B

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79. The spectral lines corresponding to the radiatio emitted by an electron jumping from higher orbits to first orbit belong to

A. Paschen series

B. Balmer series

C. Lyman series

D. none of these

Answer: C

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80. In hydrogen atom, the transition takes place from $n = 3$ to $n = 2$. If Rydberg's constant is 1.09×10 per metre, the wavelength of the limit emitted is

A. 6564Ã...

B. 6064Ã...

C. 6664Ã...

D. 5664Ã...

Answer: A

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81. The speed of the electron in the 1st orbit of the hydrogen atom in the ground state is (c is the veloicty of light)

A. $\frac{c}{1.37}$

B. $\frac{c}{1370}$

C. $\frac{c}{13.7}$

D. $\frac{c}{137}$

Answer: D

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82. Find the value of wave number $\left(\bar{v}\right)$ in terms of Rydberg's constant, when transition of electron takes place between two lvels of He^{+} ion whose sum is 4 and difference is 2.

A. $\frac{8R}{9}$

B. $\frac{32R}{9}$

C. $\frac{3R}{4}$

D. None of these

Answer: B

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83. The wave number of the first line of Balmer series of hydrogen is $15200cm^{-1}$ The wave number of the first Balmer line of Li^{2+} ion is

A. $15, 200cm^{-1}$

B. $60, 800cm^{-1}$

C. $76, 000cm^{-1}$

D. $1, 36, 800cm^{-1}$

Answer: D

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84. If the magnetic quantum number of a given atom is represented by -3, then what will be its principal quantum number?

A. 2

B. 3

C. 4

D. 5

Answer: C

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85. Which of the following relates to photons both as wave motion and as a stream of particles?

A. Interference

B. Diffraction

C. E=hv

D. $E = mc^2$.

Answer: C

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86. Which of the following best explains light both as a stream of particles and wave motion ?

A. Diffraction

B. $\lambda = h/p$

C. Interference

D. Photoelectric effect

Answer: B

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87. A body of mass x kg is moving with a velocity of $100 ms^{-1}$. Its de-Broglie wavelength is $6.62 \times 10^{-35} m$. Hence x is $\left(h = 6.62 \times 10^{-34} Js\right)$

A. 0.25 kg

B. 0.15 kg

C. 0.2 kg

D. 0.1 kg

Answer: D

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88. A $200g$ cricket ball is thrown with a speed of $3.0 \times 10^3 cm \sec^{-1}$. What will be its de Broglie's wavelength ?

$\left[h = 6.6 \times 10^{-27} gcm^2 \sec^{-1}\right]$.

A. $1.1 \times 10^{-32} cm$

B. $2.2 \times 10^{-32} cm$

C. $0.55 \times 10^{-32} cm$

D. $11.0 \times 10^{-32} cm$

Answer: A

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89. The frequency of radiations emitted when electron falls from $n = 4$ to $n = 1$ in $H -$ atom would be (Given E_1 for $H = 2.18 \times 10^{-18} J\text{atom}^{-1}$ and $h = 6.625 \times 10^{-34} Js$.)

A. $1.54 \times 10^{15} s^{-1}$

B. $1.03 \times 10^{15} s^{-1}$

C. $3.08 \times 10^{15} s^{-1}$

D. $2 \times 10^{15} s^{-1}$.

Answer: C

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90. in a multi- electron atom ,which of the following orbitals described by the three quantum numbers, which of the following will have nearly same energy?

$$\begin{array}{llll} (P) & n=1, l=0, m=0 & (q) & n=2, l=0, m=0 \\ (r) & n=2, l=1, m=1, & (S) & n=3, l=2, m=1 \\ (t) & n=3, l=2, m=0 & ,, & \end{array}$$

A. (i) and (ii)

B. (ii) and (iii)

C. (iii) and (iv)

D. (iv) and (v)

Answer: D

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91. For a one-electron atom, the set of allowed quantum number is -

A. $n=1, l=0, m_l=0, m_s= +\frac{1}{2}$

B. $n=1, l=1, m_l=0, m_s+\frac{1}{2}$

C. $n=1, l=0, m_l= -1, m_s= -\frac{1}{2}$

D. $n=1, l=1, m_l=1, m_s= -\frac{1}{2}$.

Answer: A

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92. The longest wavelength of He^{+} in paschen series is "m", then shortest wavelenght of Be^{+3} in Pacchen series is(in terms of m):

A. $\frac{7}{64}m$

B. $\frac{5}{36}m$

C. m

D. $\frac{53}{8}m$

Answer: A

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93. The magnetic quantum is a number related to:

A. Size

B. Shape

C. Orientation

D. Spin

Answer: C

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94. Consider the following parameters with regard to hydrogen like atoms:

(1). Energy of the atom

(2). Radius of electron orbit

(3) Spin of the electron

Which of the above are same for all hydrogen-like atoms and ions in n=1 state?

A. 1 only

B. 2 only

C. 3 only

D. 1 and 2

Answer: D

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95. The quantum number not obtained from the schrodinger's wave equation is

A. n

B. l

C. m

D. s

Answer: D

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96. The atomic orbital is:

A. The circular path of the electron

B. elliptical shaped orbit

C. three-dimensional field around nucleus

D. The region in which there is maximum probability of finding an electron.

Answer: D

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97. The ionization potential for hydrogen atom is $13.6 eV$, the ionization potential for He^{+} is

A. 13.6 eV

B. 6.8 eV

C. 54.4 eV

D. 72.2 eV

Answer: C

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98. Principal azimuthal , and magnetic quantum numbers are respetively related to

A. size, shape and orientation

B. shape, size and orientation

C. size, orientation and shape

D. none of the above

Answer: A

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99. In H-atom energy of electron is datermined by :

A. only n

B. both n and l

C. n,l and m

D. all the four quantum numbers.

Answer: A

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100. Any p arbital can accommodate up to

A. 4 electrons

B. 2 electrons with parallel spins

C. 6 electrons

D. 2 electrons with opposite spins

Answer: C

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101. The electrons present in K-shell of the atom will differ in

A. Principal quantum number

B. spin quantum number

C. azimuthal quantum number

D. magnetic quantum number

Answer: B

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102. Two electrons have the following quantum numbers :

P=3, 2, -2, +1/2 , Q=3, 0, 0, +1/2

Which of the following statements is true ?

A. P has lesser energy than Q

B. P and Q have same energy

C. P and Q represent same electron

D. P has greater energy than Q

Answer: D

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103. Which one of the following sets of quantum numbers represents an impossible arrangement ?

A. $\begin{matrix} n & l & m & s \\ 3 & 2 & -2 & 1/2 \end{matrix}$

B. $\begin{matrix} n & l & m & s \\ 4 & 0 & 0 & 1/2 \end{matrix}$

C. $(n, l, m, s), (3, 2, -3/2)$

D. $\begin{matrix} n & l & m & s \\ 5 & 3 & -0 & 1/2 \end{matrix}$

Answer: C

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104. Which of the following sets of quantum numbers is correct for an electron in 4f-orbtial ?

A. n=4,l=3,m=+4,s=+1/2

B. n=4,l=4,m=-4,s=-1/2

C. n=4,l=3,m=+1,s=+1/2

D. n=3,l=2,m=-2,s=+1/2

Answer: C

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105. In any subshell, the maimum number of electrons having same value of spin quantum number is :

A. $\sqrt{l(l+1)}$

B. $l+2$

C. $2l+1$

D. $4l+2$

Answer: C

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106. Values of magnetic orbital quantum for an electron of M-shell can be:

A. 0,1,2

B. $-2, \ -1, 0, \ +1, \ +2$

C. $0, 1, 2, 3$

D. $-1, 0, +1$

Answer: B

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107. The correct set of quantum number for the unpaired electron of a chlorine atom is

A. $2, 0, 0, +1/2$

B. $2, 1, -1, +1/2$

C. $3, 1, 1, +1/2$

D. $3, 0, 0, +1/2$

Answer: C

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108. In hydrogen atom, the electron is at a distance of 4.768Ã... from the nucleus. The angular momentum of the electron is:

A. $\frac{3h}{2\pi}$

B. $\frac{h}{2\pi}$

C. $\frac{h}{\pi}$

D. $\frac{3h}{\pi}$

Answer: A

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109. The total number of m values for $n = 4$ is

A. 8

B. 16

C. 12

D. 20

Answer: B

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110. The subshell that rises after f subshell is called g subshell

What is the total number of orbitals in the shell in which the g subshell first occur?

A. 9

B. 16

C. 25

D. 36

Answer: C

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111. In Bohr's model, if the atomic radius of the first orbit is r_0, then the radius of the fourth orbit is

A. $4r_1$

B. $6r_1$

C. $16r_1$

D. $\frac{r_1}{16}$

Answer: C

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112. The electrons identified by quantum numbers n and l :-

(a) n=4, l=1 (b) n=4, l=0 (c) n=3, l=2 (d) n=3, l=1

Can be placed in order of increasing energy as

A. AltCltBltD

B. CltDltBltA

C. DltBltCltA

D. BltDltAltC

Answer: C

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113. The angular momentum of an electron depends on:

A. principal quantum number

B. azimuthal quantum number

C. magnetic quantum number

D. all of the above

Answer: B

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114. The correct set of quantum number for the unpaired electron of a chlorine atom is

A. 2,0,0,$+\frac{1}{2}$

B. $2, 1, -1, +\frac{1}{2}$

C. $3, 1, -1, \pm\frac{1}{2}$

D. $3, 0, 0, \pm\frac{1}{2}$

Answer: C

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115. The shape of the orbital is determined by

A. spin quantum number

B. magnetic quantum number

C. azimuthal quantum number

D. principal qunatum number

Answer: C

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116. The energy of an electron of $2p_y$ orbital is

A. greater than $2p_x$ orbital

B. less than $2p_z$ orbital

C. equal to 2s orbital

D. same as that of $2p_x$ and $2p_z$ orbital

Answer: D

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117. Two electrons occupying the same orbital are distinguished by :

A. Principal quantum number

B. azimuthal quantum number

C. magnetic quantum number

D. spin quantum number

Answer: D

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118. The maximum number of electrons in a subshell is given by the expression

A. $4l+2$

B. $4l-2$

C. $2l+1$

D. $2n^2$

Answer: A

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119. The electronic configuration of an atom/ion can be defined by the following

A. Aufbau principal

B. Pauli's exclusion principle

C. Hund's rule of maximum multiplicity

D. All of the above

Answer: D

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120. If an electron has spin quantum number of $-\frac{1}{2}$ and magnetic quantum number of -1 it cannot be present in:

A. d-orbital

B. f-orbital

C. s-orbital

D. p-orbital

Answer: C

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121. For the energy level is an atom which one of the following statement is correct ?

A. The 4s sub-energy level is at a higher energy than the 3d sub-energy level.

B. The M-energy level can have maximum of 32 electrons.

C. The second principal energy level can have four orbital and contain a maximum of 8 electrons.

D. The 5th main energy level can have maximum of 50 electrons.

Answer: C

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122. A new electron enters the orbital when:

A. (n+l) is minimum

B. (n+l) is maximum

C. (n+m) is minimum

D. (n+m) is maximum

Answer: A

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123. For a given value of n (principal quantum number), the energy of different subshells an be arranged in the order of:

A. $f > d > p > s$

B. $s > p > d > f$

C. $f > p > d > s$

D. $s > f > p > d$

Answer: A

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124. After filling the 4d-orbitals, an electron will enter in:

A. 4p

B. 4s

C. 5p

D. 4f

Answer: C

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125. According to aufbau principle, the correct order of energy of 3d,4s and 4p-orbitals is

A. $4p < 3d < 4s$

B. $4s < 4p < 3d$

C. $4s < 3d < 4p$

D. $3d < 4s < 4p$

Answer: C

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126. How many unpaired electrons are there in Ni^{2+}?

A. Zero

B. 8

C. 2

D. 4

Answer: C

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127. The electronic configuration of chromium (Z=24) is:

A. $[Ne]3s^2 3p^6 3d^4 4s^2$

B. $[Ne]3s^2 3p^6 3d^5 4s^1$

C. $[Ne]3s^2 3p^6 3d^5 4s^1$

D. $[Ne]3s^2 3p^6 3d^1 4s^2$

Answer: B

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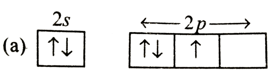
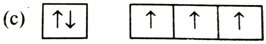
128. The orbital diagram in which the Aufbau principle is violated is

A. 

B. 

C. 

D. 

Answer: B

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129. The managanese $(Z = 25)$ has the outer configuration.

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130. Which of the following sets of quantum numbers is correct for an electron in 3d-orbital?

A. $n = 3, l = 2, m = -3, s = +\frac{1}{2}$

B. $n = 3, l = 3, m + 3, s = -\frac{1}{2}$

C. $n = 3, l = 2, m = -2, s + \frac{1}{2}$

D. $n = 3, l = 2, m = -3, s = -\frac{1}{2}$

Answer: C

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131. The radial probability distribution curve obtined for an orbital wave function (Φ) has 3 peaks and 2 radial nodes. The valence electron of which one of the following metals does this wave function (Φ) correspond to.

A. Co

B. Li

C. K

D. Na

Answer: D

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132. Krypton (At. No 36) has the electronic configuraiton [Ar] $4s^2 3d^{10} 4p^6$.

The 37th electron will go into which one of the following sub-levels?

A. 4f

B. 4d

C. 3p

D. 5s

Answer: D

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133. Which of the following orbitals has the highest energy?

A. 5d

B. 5f

C. 6s

D. 6p

Answer: B

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134. Which of the following set of quantum numbers is not possible for an electron in the ground state of an atom with atomic number 19?

A. n=2,l=0,m=0

B. n=2,l=1,m=0

C. n=3,l=1,m=-1

D. n=3,l=2,m=± 2

Answer: D

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135. Helium nucleus is composed of two protons and two neutrons if the atomic mass is 4.00388, how much energy is released when the nucleus is constituted?

(Mass of proton =1.00757, mass of neturon=1.00893)

A. 283MeV

B. 28.3 mEv

C. 2830 MeV

D. 2.83 MeV

Answer: B

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136. Binding energy per nucleon of three nuclei A, B and C are 5.5, 8.5 and 7.5 respectively. Which one of the following nuclei is most stable?

A. A

B. B

C. C

D. Cannot be predicted

Answer: C

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137. The mass of a $._3^7 Li$ nucleus is $0.042u$ less than the sum of the masses of all its nucleons. The binding energy per nucleon of $._3^7 Li$ nucleus is nearly

A. 5.6 MeV

B. 56MeV

C. 0.56 MeV

D. 560 MeV

Answer: A

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138. Meson was discovered by:

A. Powell

B. Seaborg

C. Anderson

D. Yukawa

Answer: D

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139. The number of protons and neutrons for most stable elements is a)Even-odd b)Even-even c)Odd-odd d)Odd-Even

A. odd-odd

B. even-even

C. odd-even

D. even-odd

Answer: B

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140. Nuclear particles responsible for holding all nuclear composition of an atom would lead to a change in:

A. electrons

B. neutrons

C. positrons

D. mesons

Answer: D

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141. The introduction of a neutron into the nuclear composition of an atom would lead to a change in:

A. Its atomic mass

B. Its atomic number

C. the chemical nature of the atom

D. number of the electron also

Answer: A

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142. Which of the following has highest orbital angular momentum?

A. 4s

B. 4p

C. 4d

D. 4f

Answer: D

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143. In Millikan's oil drop experiment, we make use of:

A. Ohm's law

B. Ampere's law

C. Stoke's law

D. Faraday's law

Answer: C

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144. A strong argument for the particle nature of cathode rays is:

A. they can propagate in vacuum

B. they produce fluorescene

C. they cast shadoes

D. they are deflected by electric and magnetic fields

Answer: A

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145. As the speed of the electrons increases, the measured value of charge to mass ratio (in the relativistic units):

A. Increases

B. remains unchanged

C. decreases

D. first increases and then decreases.

Answer: A

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146. Which of the following are true for cathode ray?

A. It travels along a straght line.

B. It emits X-rays when strikes a metal.

C. It is an electromagnetic wave.

D. It is not deflected by magnetic field.

Answer: B

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147. Three isotopes of an element have mass numbers (m), $(m+1)$ and $(M+2)$. If the mean mass number is (M + 0. 5) then which of the following ratios may be accepted for M, $(M+1)$ and $(M+2)$ in the order ?

A. $1:1:1$

B. $4:1:1$

C. $3:2:1$

D. $2:1:1$

Answer: B

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148. The radii of two of the first four Bohr's orbits of the hydrogen atom are in the ratio $1:4$. The energy difference between them may be :

A. either 12.09 eV or 3.4 eV

B. either 2.55 eV or 10.2 eV

C. either 13.6 eV or 3.4 eV

D. either 3.4 eV or 0.85 eV

Answer: B

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149. Photoelectric emission is observed from a surface for frequencies $v_1 \text{and} v_2$ of the incident radiation $(v_1 > v_2)$. If maximum kinetic energies of the photo electrons in the two cases are in the ratio $1 : K$, then the threshold frequency is given by:

A. $\frac{v_2 - v_1}{k - 1}$

B. $\frac{k \quad v_1 - v_2}{k - 1}$

C. $\frac{k \quad v_2 - v_1}{k - 1}$

D. $\frac{v_2 - v_1}{k}$

Answer: B

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150. The numer of waves made by a bohr electron in an orbit of maximum magnetic quantum number +2 is:

A. 3

B. 4

C. 2

D. 1

Answer: A

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151. Which of the following statements is correct?

A. The shape of an atomic orbital depends on the azimuthal quantum number.

B. The orientation of an atomic orbital depends on the magnetic quantum number.

C. The energy of an electron in an atomic orbital of multielectron atom depends on the principal quantum number.

D. The number of degenerate atomic orbitals of one type depends on the values of azimuthal and magnetic quantum numbers.

Answer: C

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152. Gases begin to conduct electricity at low pressure because

A. at low pressures gases turn to plasma

B. colliding electrons can acquire higher kinetic energy due to increased mean free path leading to ionisation of atoms

C. atoms break up into electrons and protons

D. the electrons in atoms can move freely at low pressure.

Answer: B

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153. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. The final speed of the electron will be

A. $\sqrt{(eV/m)}$

B. $2eV/m$

C. $\sqrt{(eV/2m)}$

D. $\sqrt{(2eV/m)}$

Answer: A

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154. The difference in angular momentum associated with the electron in two successive orbits of hydrogen atoms is

A. h/π

B. $h/2\pi$

C. $h/2$

D. $(n-1)h/2\pi$

Answer: A

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155. Photo electric effect can be explained only by assuming that light

A. is a form of transverse waves

B. is a form of longitudinal waves

C. can be polarised

D. consists of quanta

Answer: D

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156. Photoelectric effect supports quantum nature of light because

(a) there is a minimum frequency of light below which no photo electrons are emitted

(b) the maximum kinetic energy of photo electrons depends only on the frequency of light and not on its intensity

(c) even when the metal surface is faintly illuminated, the photo electrons leave the surface immediately

(d) electric charge of the photo electrons is quantised

A. there is a minimum frequency of light below which no photoelectrons are emitted

B. the maximum kientic energy of photoelectrons depends only on the frequency of light and not on its intensity.

C. even when metal surface is faintly illuminated the photoelectrons leave the surfaec immediately

D. electric charge of photoelectrons is quantised.

Answer: A

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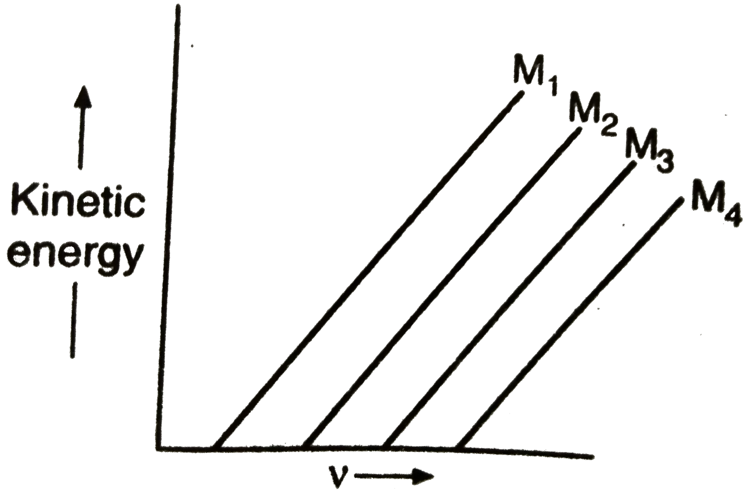
157. A plot of the kinetic energy $\left(\frac{1}{2}mv^2\right)$ of ejected electrons as a function of the frequency (v) of incident radiation for four alkali metals (M_1, M_2, M_3, M_4) is given below:



The alkali metals M_1, M_2, M_3, M_4 are respectively:

A. Li,Na,K and Rb

B. Rb,K,Na and Li

C. Na, K, Li and Rb

D. Rb, Li, Na and K

Answer: B

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158. Momentum of a photon of wavelength λ is

A. h / λ

B. zero

C. $h\lambda / c^2$

D. $h\lambda / c$

Answer: A

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159. When X-rays pass through air they:

A. produce light track in the air

B. ionise the gas

C. produce fumes in the air

D. accelerate gas atoms

Answer: A

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160. X-rays

A. are deflected in a magnetic field

B. are deflected in an electric field

C. remain undeflected by both the field

D. are deflected in both the field.

Answer: C

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161. The energy of an electron in the first Bohr orbit of H atom is $-13.6eV$ The potential energy value (s) of excited state(s) for the electron in the Bohr orbit of hydrogen is(are)

A. $-3.4eV$

B. $-4.2eV$

C. $-6.8eV$

D. $+6.8eV$

Answer: A

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162. The electrons identified by the following quantum numbers n and l: $(i)n = 4, l = 1, (ii)n = 4, l = 0, (iii)n = 3, l = 2,$ and (iv) $n = 3, l = 1$ can be placed in the order of increasing enegry from the lowest to the highest as

A. ivltiiltiiilti

B. iiltivltiltiii

C. iltiiiltiiltiv

D. iiiltiltivltii

Answer: A

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163. The wavelength of the radiation emitted when an electron falls from Bohr 's orbit 4 to 2 in H atom is

A. 243 nm

B. 972 nm

C. 486 nm

D. 182 nm

Answer: B

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164. The energy of the electron in the first orbit of He^{+} is $-871.6 \times 10^{-20} J$. The energy of the electron in the first orbit of hydrogen would be.

A. $-871.6 \times 10^{-20} J$

B. $-435 \times 10^{-20} J$

C. $-217.9 \times 10^{-20} J$

D. $-108.9 \times 10^{-20} J$

Answer: C

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165. The wavelength associated with a holf ball weighing 200 g and moving with a speed of 5km/h is of the order of :

A. $10^{-10} m$

B. $10^{-20} m$

C. $10^{-30} m$

D. $10^{-40} m$

Answer: C

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166. If uncertainty in momentum of electron is three times the uncertainty in position, then uncertainty in velocity of electron would be:

A. $\frac{1}{4m}\sqrt{\frac{h}{3\pi}}$

B. $\frac{1}{3m}\sqrt{\frac{h}{\pi}}$

C. $\frac{1}{3m}\sqrt{\frac{4\pi}{h}}$

D. $\frac{1}{2m}\sqrt{\frac{3h}{\pi}}$

Answer: D

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167. Threshold wavelength of a metal is λ_0. The de Broglie wavelength of photoelectron when the metal is irradiated with the radiation of wavelength λ is:

A. $\left[\frac{h\lambda\lambda_0}{2cm}\right]^{\frac{1}{2}}$

B. $\left[\frac{h(\lambda-\lambda_0)}{2cm\lambda\lambda_0}\right]^{1/2}$

C. $\left[\frac{h(\lambda_0-\lambda)}{2cm\lambda\lambda_0}\right]^{1/2}$

D. $\left[\frac{h\lambda\lambda_0}{2mc(\lambda_0-\lambda)}\right]^{1/2}$

Answer: D

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168. The number of nodal planes in p_x-obital is:

A. one

B. two

C. three

D. zero

Answer: A

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169. The angular momentum (L) of an electron in a Bohr orbit is gives as:

A. $L = \frac{nh}{2\pi}$

B. $L = \sqrt{l(l+1)\frac{h}{2\pi}}$

C. $L = \frac{mg}{2\pi}$

D. $L = \frac{h}{4\pi}$

Answer: A

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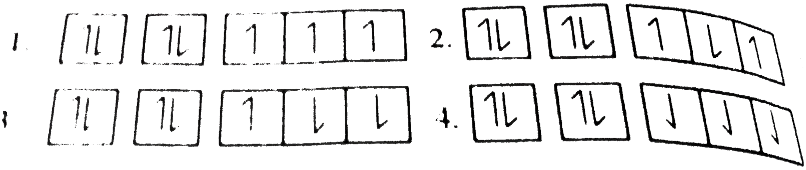
170. Ground state electronic configuration of nitrogen atom can be represented by:



A. 1 only

B. 1,2 only

C. 1,4 only

D. 2,3 only

Answer: C

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171. Which of the following statement(s) are correct?

1. Electronic configuration of Cr is $[Ar]3d^5 4s^1$ (At. No of Cr=24)

2. The magnetic quantum number may have negative value.

3. In silver atom, 23 electron have a spin of one type and 24 of the

opposite type (At. No. of Ag=47)

4. The oxidation state of nitrogen in HN_3 is -3.

A. 1,2,3

B. 2,3,4

C. 3,4

D. 1,2,4

Answer: A

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172. The electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ .This represents its

A. excited state

B. ground state

C. cationic state

D. anionic state

Answer: B

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173. The quantum number $+1/2$ and $-1/2$ for the electron spin represent

A. rotation of the electron in clockwise and anticlockwise directions respectively

B. rotation of the electron in anticlockwise and clockwise direction respectively.

C. magnetic momentum of electron pointing up and down respectively

D. two quantum mechanical spin states which have no classical anologues.

Answer: D

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174. Rutherford's scattering experiment, which established the nuclear model of the atom, used a beam of

A. $B\eta -$ particles, which impinged on a metal foil and got absorbed.

B. γ-rays, which impinged on a metal foil and ejected electrons

C. helium atojms, which impinged on a metal foil and got scattered

D. helium nuclei, which impinged on a metal foil and got scattered

Answer: D

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175. How many moles of electrons weigh one kilogram?

(Mass of electron $= 9.108 \times 10^{-31}$ kg, Avogadro's number

$= 6.023 \times 10^{23})$

A. 6.023×10^{23}

B. $\frac{1}{9.108} \times 10^{31}$

C. $\frac{6.023}{9.108} \times 10^{54}$

D. $\frac{1}{9.108 \times 6.023} \times 10^{8}$

Answer: D

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176. If the electronic configuration of nitrogen had $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 2p^3$ because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed because it vilates:

A. Heisenberg uncertainty principle

B. Hund's rule

C. Pauli's exclusion principle

D. Bohr postulates of stationary orbits

Answer: C

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177. The orbital angular momentum of an electron in $2s$-orbital is

A. $+\frac{1}{2}\frac{h}{2\pi}$

B. zero

C. $\frac{h}{2\pi}$

D. $\sqrt{2}\frac{h}{2\pi}$

Answer: B

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178. Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^3 ms^{-1}$(Mass proton $= 1.67 \times 10^{-27} kg$ and $h = 6.63 \times 10^{-34} Js$):-

A. 0.032 nm

B. 0.40 nm

C. 2.5 nm

D. 14 nm

Answer: B

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179. The value of Planck's constant is $6.63 \times 10^{-34} Js$. The velocity of light is $3 \times 10^8 m/\text{sec}$. Which value is closest to the wavelength of quantum of light with frequency of $8 \times 10^{15} \text{sec}^{-1}$?

A. 5×10^{-18}

B. 4×10^{1}

C. 3×10^{7}

D. 2×10^{-25}

Answer: B

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180. Which of the following statement is correct in relation to the hydrogen atom :

A. 3s-orbital is lower in energy than 3p-orbital

B. 3p-orbital is lower in energy than 3d-orbital

C. 3s-and 3p-orbital are of lower energy than 3-orbital.

D. 3s,3p-and 3d-orbitals all hae the same energy.

Answer: D

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181. The number of d electrons in Ni (at.no $= 28$) is equal to that of the

A. s and p-electrons in F^{-}

B. p-electrons in Ar (At. No=18)

C. d-electron in Ni^{2+}

D. total number of electron in N (At No.=7)

Answer: C

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182. The number of radial nods of 4p-orbital is:

A. 4

B. 3

C. 2

D. 1

Answer: C

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183. Which of the following is not permissible?

A. $n = 4, l = 3, m = 0$

B. $n = 4, l = 2, m = 1$

C. $n = 4, l = 4, m = 1$

D. $n = 4, l = 0, m = 0$

Answer: C

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184. According to Boohr's theory the angular momentum of an electron in 5th orbit is :

A. $25\frac{h}{\pi}$

B. $1\frac{h}{\pi}$

C. $10\frac{h}{\pi}$

D. $2.5\frac{h}{\pi}$

Answer: D

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185. Which of the following sets of quantum numbers represents the highest energy of an atom?

A. $n = 3, l = 0, m = 0, s = +1/2$

B. $n = 3, l = 1, m = 1, s = +1/2$

C. $n = 3, l = 2, m = 1, s = +1/2$

D. $n = 4, l = 0, m = 0, s = +1/2$

Answer: C

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186. How many d-electrons in $Cu^{+}(At. No = 29)$ can have the spin quantum $\left(-\frac{1}{2}\right)$?

A. 3

B. 7

C. 5

D. 9

Answer: C

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187. The measurement of the electron position is associated with an uncertainty in momentum, which is equal to $1 \times 10^{-18} gcms^{-1}$. The uncertainty in electron velocity is (mass of an electron is $9 \times 10^{-28} g$)

A. $1 \times 10^5 \text{cm ss}^{-1}$

B. $1 \times 10^{-11} \text{ cm s}^{-1}$

C. $1 \times 10^9 \text{ cm } s^{-1}$

D. $1 \times 10^6 \text{ cm } s^{-1}$

Answer: C

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188. The ionization enthalpy of hydrogen atom is $1.312 \times 10^6 Jmol^{-1}$. The energy required to excite the electron in the atom from $n = 1$ to $n = 2$ is :

A. $9.84 \times 10^5 J \text{ mol}^{-1}$

B. $8.51 \times 10^5 \text{J } mol^{-1}$

C. $6.56 \times 10^5 \text{ J } mol^{-1}$

D. $7.56 \times 10^5 J \text{ } mol^{-1}$

Answer: A

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189. The wavelengths of electron waves in two orbits is 3:5. The ratio of kinetic energy of electrons will be

A. $25 : 9$

B. $5 : 3$

C. $9 : 25$

D. $3 : 5$

Answer: A

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190. Electrons with a kinetici energy of $6.023 \times 10^4 J / mol$ are evolved from the surface of a metal, when it is exposed to radiation of wavelength of 600 nm. The minimum amount of energy required to remove an electron fro the metal atom is:

A. $2.3125 \times 10^{-19} J$

B. $3 \times 10^{-19} J$

C. $6.02 \times 10^{-19} J$

D. $6.62 \times 10^{-34} J$

Answer: A

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191. For the Paschen series thr values of n_1 and n_2 in the expression $\Delta E = R_H c \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ are

A. $n_1 = 1, n_2 = 2, 3, 4 \ldots$

B. $n_1 = 2, n_2 = 3, 4, 5 \ldots$

C. $n_1 = 3, n_2 = 4, 5, 6 \ldots$

D. $n_1 = 4, n_2 = 5, 6, 7 ..$

Answer: C

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192. Ionisation energy of He^{+} is $19.6 \times 10^{-18} J \text{atom}^{-1}$. The energy of the first stationary state $(n = 1)$ of Li^{2+} is.

A. -2.2×10^{-15}J $a \rightarrow m^{-1}$

B. 8.82×10^{-17} J atom^{-1}

C. 4.41×10^{-16} J atom^{-1}

D. -4.41×10^{-17} J atom^{-1}

Answer: D

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193. The energy required to break one mole of $Cl - Cl$ bonds in Cl_2 is $242 kJ mol^{-1}$. The longest wavelength of light capable of breaking a since $Cl - Cl$ bond is

A. 700 nm

B. 494 nm

C. 564 nm

D. 640 nm

Answer: B

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194. In Sommerfeld's modification of Bohr's theory, the trajectory of an electron in a hydrogen atom is:

A. Perfect ellipse

B. a closed ellipse like curve, narrower at the perihelion position and flatter at the aphelion positron

C. a closed loop on spherical surface

D. a rosette

Answer: C

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195. The highest energy in Balmer series, ini the emission spectra of hydrogen is represented by:

$(R_H = 109737 cm^{-1})$

A. $4389.48 cm^{-1}$

B. $2194.74 cm^{-1}$

C. $5486.85 cm^{-1}$

D. $27434.25 cm^{-1}$

Answer: D

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196. A photon with initial frquency 10^{11}Hz scatters off an electron at rest. Its final frequency is $0.9 \times 10^{11} Hz$. The speed of scattered electron is close to :

$\left(h = 6.63 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31} kg\right)$

A. $4 \times 10^3 ms^{-1}$

B. $3 \times 10^2 ms^{-1}$

C. $2 \times 10^6 ms^{-1}$

D. $30 ms^{-1}$

Answer: A

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197. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is [a_0 is Bohr radius] :

A. $\dfrac{h^2}{4\pi m a_{0^2}}$

B. $\dfrac{h^2}{16\pi^2 m a_0^2}$

C. $\dfrac{h^2}{32\pi^2 m a_0^2}$

D. $\dfrac{h^2}{64\pi^2 m a_0^2}$

Answer: C

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198. Energy of an electron is givem by $E = -2.178 \times 10^{-18} J\left(\dfrac{Z^2}{n^2}\right)$. Wavelength of light required to excited an electron in an hydrogen atom from level $n = 1$ to $n = 2$ will be

$(h = 6.62 \times 10^{-34} Js$ and $c = 3.0 \times 10^8 ms^{-1})$.

A. $6.500 \times 10^{-7} m$

B. $8.500 \times 10^{-7} m$

C. $1.214 \times 10^{-7} m$

D. $2.816 \times 10^{-7} m.$

Answer: C

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199. The correct set of four quantum numbers for valence electrons of rubidium atom (Z=37) is

A. $5, 1, 1, +\frac{1}{2}$

B. $5, 0, 1, +\frac{1}{2}$

C. $5, 0, 0, +\frac{1}{2}$

D. $5, 1, 0, +\frac{1}{2}$

Answer: C

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200. Which of the following is the energy of a possible excited state of hydrogen?

A. $+6.8eV$

B. $+13.6eV$

C. $-6.8eV$

D. $-3.4eV$

Answer: D

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201. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If c and m are charge and mass of an electron repectively, then the value of h/λ (where λ is wavelength associated with electron wave) is given by :

A. meV

B. 2meV

C. $\sqrt{meV}$

D. $\sqrt{2meV}$

Answer: D

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202. The mass number of two elements X and Z are 52 and 75 respectively. X contains 16.6% more neutrons compared to protons. Z contains 27.3% more neutrons compared to protons. X and Z are respectively:

A. $.(24)Cr, ._{33}As$

B. $._{24}Cr, ._{34}Zn$

C. $._{19}K, ._{33}As$

D. $._{29}Cu, ._{30}Zn$

Answer: A

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203. If the kinetic energy of an electron of mass 9.0×10^{-31} kg is $8 \times 10^{-25} J$,t he wavelength of this electro in nm is:

A. 1104.1

B. 276.2

C. 552.2

D. 828.2

Answer: C

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Set-2

1. Correct order of radius of the first orbit of $H, He^{+}, Li^{2+}, Be^{3+}$ is :

A. $H > He^{+} > Li^{2+} > Be^{3+}$

B. $Be^{3+} > Li^{2+} > He^{+} > H$

C. $He^{+} > Be^{3+} > Li^{2+} > H$

D. $He^{+} > H > Li^{2+} > Be^{3+}$

Answer: A

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2. Which is the correct relationship?

(a). E_1 of $H = 1/2E_2$ of $He^{+} = 1/3E_3$of $Li^{2+} = 1/4E_4$of Be^{3+}

(b). $E_1(H) = E_2(He^{+}) = E_3(Li^{2+}) = E_4(Be^{3+})$

(c). $E_1(H) = 2E_2(He^{+}) = 3E_3(Li^{2+}) = 4E_4(Be^{3+})$

(d). No relation

A. E_1 of $H = 1/2$ E_2 of $He^+ = 1/3$ E_3 of $Li^{2+} = 1/4$ E_4 of Be^{3+}

B. $E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$

C. $E_1(H) = 2E_2(He^+) = 3E_3(Li^{2+}) = 4E_4(Be^{3+})$

D. No relation

Answer: B

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3. Which is correct for any kind of species?

A. $(E_2 - E_1) > (E_3 - E_2) > (E_4 - E_3)$

B. $(E_2 - E_1) > (E_3 - E_2) < (E_4 - E_3)$

C. $(E_2 - E_1) = (E_3 - E_2) = (E_4 - E_3)$

D. $(E_2 - E_1) = 1/4(E_3 - E_2) = 1/9(E_4 - E_3)$

Answer: A

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4. Number of visible lines when an electron returns from 5th orbit to ground state in H spectrum :

A. 5

B. 4

C. 3

D. 10

Answer: C

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5. Quantum numbers l=2 and m=0 represent which orbital?

A. d_{xy}

B. $d_{x^2-y^2}$

C. d_{z^2}

D. d_{zx}

Answer: C

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6. If n and l are respectively the principal and azimuthal quantum numbers , then the expression for calculating the total number of electrons in any energy level is :

A. $\sum_{l=0}^{l=n} 2(2l+1)$

B. $\sum_{l=1}^{l=n-1} 2(2l+1)$

C. $\overset{l=n+1}{\underset{l=0}{2}}(2l+1)$

D. $\sum_{l=0}^{l=n-1} 2(2l+1)$

Answer: D

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7. Order of no. of revolutions/sec $\gamma_1, \gamma_2, \gamma_3$ and γ_4 for I, II, III and IV orbits is:

A. $\gamma_1 > \gamma_2 > \gamma_3 > \gamma_4$

B. $\gamma_4 > \gamma_3 > \gamma_2 > \gamma_1$

C. $\gamma_1 > \gamma_2 > \gamma_4 > \gamma_3$

D. $\gamma_2 > \gamma_3 > \gamma_4 > \gamma_1$

Answer: A

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8. Consider the following statements:

(a) Electron density in the XY plane in $3d_{x^2-y^2}$ orbital is zero

(b) Electron density in the XY plane in $3d_{z^2}$ orbital is zero.

(c) $2s$ orbital has one nodel surface

(d) for $2p_z$ orbital, XY is the nodal plane.

Which of these are incorrect statements :

A. A and C

B. B and C

C. Only B

D. A,B,C and D

Answer: A

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9. The first emission line in the H-atom spectrum in the Balmer series appears at:

A. $\frac{5R}{36}cm^{-1}$

B. $\frac{3R}{4}cm^{-1}$

C. $\frac{7R}{144}cm^{-1}$

D. $\frac{9R}{400}m^{-1}$

Answer: A

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10. 1 BM is equal to:

A. $\frac{hc}{m\pi e^4}$

B. $\frac{hc}{4\pi m}$

C. $\frac{e^2hc}{4m}$

D. $\frac{ehc}{\pi m}$

Answer: A

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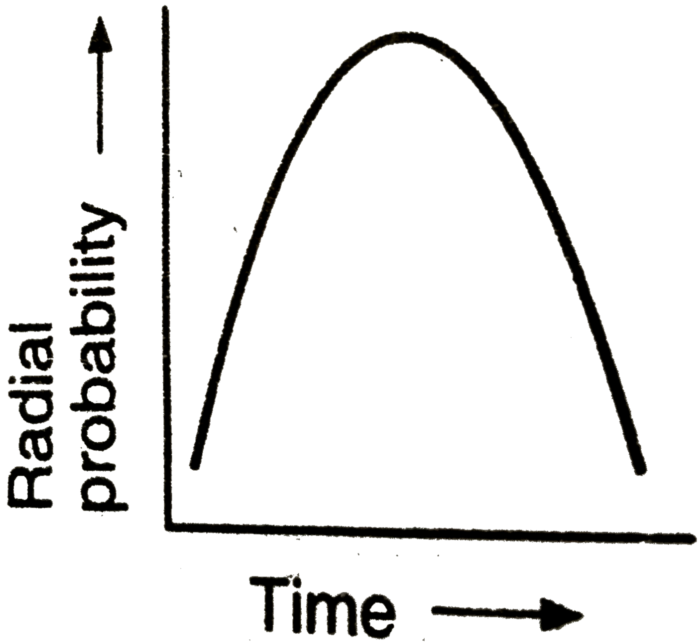

11.

Radial probability distribution curve is shown for s-orbital. The curve is:

A. 1s

B. 2s

C. 3s

D. 4s

Answer: A

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12. dz^2 orbital has:

A. a lobe along z-axis and a ring along xy-plane

B. a lobe along z-axis and a lobe along xy-plane

C. a lobe along z-axis and a ring along yz-plane

D. a lobe and ring along z-axis

Answer: A

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13. When a light of frequency v_1 is incident on a metal surface the photoelectrons emitted have twice the kinetic energy as did the photoelectron emitted when the same metal has irradiated with light of frequency v_2. What will be the value of threshold frequency?

A. $v_0 = v_1 - v_2$

B. $v_0 = v_1 - 2v_2$

C. $v_0 = 2v_1 - v_2$

D. $v_0 = v_1 + v_2$.

Answer: C

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14. Heisenberg's uncertainty principle is not valid for:

A. moving electrons

B. motor car

C. stationary particles

D. all of these

Answer: B::C

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15. Consider these electronic configurations for neutral atoms:

(i) $1s^2 2s^2 2p^6 3s^1$

(ii). $1s^2 2s^2 2p^6 4s^1$ ltbr Which of the following statements is/are false?

A. Energy is required to change (i) to (ii).

B. (i) represents 'Na' atom.

C. (i) and (ii) represent different elements.

D. More energy is required to remove one electron from (i) than (ii).

Answer: C::D

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16. For the energy levels in an ato which one of the following statements is/are correct?

A. There are seven principal electron energy levels.

B. The second principal energy level can have 4 subnergy levels and contain a maximum of 8 electrons.

C. The M energy level can have a maximum of 32 electrons.

D. The 4s subenergy level is at a lower energy than the 3d subenergy level.

Answer: A::D

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17. Which of the following statements are correct for an electron that has $n = 4$ and $m = -2$?

A. The electron may be in a d-orbital

B. The electron is in the fourth principal electronic shell.

C. The electron may be in a p-orbital

D. the electron must have the spin quantum number =+1/2.

Answer: B::C

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18. The angular momentum of electron can have the value (s) :

A. $\frac{h}{2\pi}$

B. $\frac{h}{\pi}$

C. $\frac{2h}{\pi}$

D. $\frac{5}{2}\frac{h}{2\pi}$

Answer: A::B::C

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19. Which of the following statements is/are wrong?

A. If the value of l=0, the electron distribution is spherical.

B. The shape of the orbital is given by magnetic quantum no.

C. Angular moment of 1s,2s,3s electrons are equal.

D. In an atom, all electrons travel with the same velocity.

Answer: C

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20. Consider the following sets of quantum numbers.

(i) $\begin{matrix} n & l & m & s \\ 3 & 0 & 0 & +1/2 \end{matrix}$

(ii) $\begin{matrix} n & l & m & s \\ 2 & 2 & 1 & +1/2 \end{matrix}$

(iii) $\begin{matrix} n & l & m & s \\ 4 & 3 & -2 & -1/2 \end{matrix}$

(iv) $\begin{matrix} n & l & m & s \\ 1 & 0 & -1 & -1/2 \end{matrix}$

(v) $\begin{matrix} n & l & m & s \\ 3 & 2 & 3 & +1/2 \end{matrix}$

Which of the following sets of quantum number is not possible ?

A. A,B,C and D

B. B,D and E

C. A and C

D. B,C and D

Answer: B

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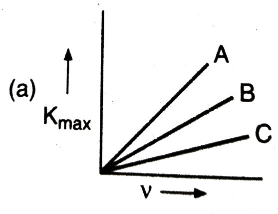
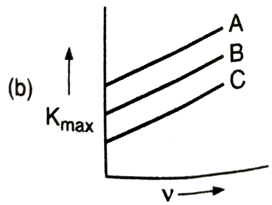
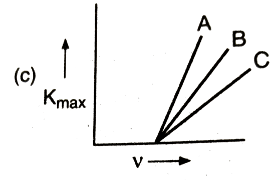
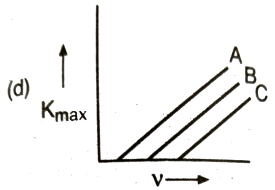
21. For three different metals A,B,C photoemission is observed one by one. The graph of maximum kinetic energy versus frequency f incident radiation are sketched as:

A. 

B. 

C. 

D. 

Answer: D

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22. for which of the following species, the expression for the energy of electron in the n^{th} $\left[E_n = \frac{13.6Z^2}{n^2} eV \ \ \text{atom}^{-1}\right]$ has the validity?

A. Tritium

B. Li^{2+}

C. Deuterium

D. He^{2+}

Answer: A::B::C

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23. For balmer series in the spectrum of atomic hydrogen the wave number of each line is given by $\overline{V} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ where R_H is a constant and n_1 and n_2 are integers. Which of the following statements (s), is (are correct)

1. As wave length decreases the lines in the series converge

2. The integer n_1 is equal to 2.

3. The ionisation energy of hydrogen can be calculated from the wave numbers of three lines.

4. The line of shortest wavelength corresponds to = 3.

A. 1,2 and 3

B. 2,3 and 4

C. 1,2 and 4

D. 2 and 4

Answer: C

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24. The radius of the second Bohr orbit for hydrogen atom is:

(Planck's const. $h = 6.6262 \times 10^{-34}$Js, mass of electron $= 9.1091 \times 10^{-31} kg$, charge of electron $e = 1.60210 \times 10^{-19}$C, permittivity of vacuum $\in_0 = 8.854185 \times 10^{-12} kgm^{-3} A^2$)

A. 1.65A

B. 4.76A

C. 0.529A

D. 2.12A

Answer: D

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25. Choose the wrong one on the basis of Bohr 's theory :-

A. velocity of electron $\propto \frac{1}{n}$

B. frequency of revolution $\propto \frac{1}{n^3}$

C. radius of orbit $\propto n^2 Z$

D. force on electron $\propto \frac{1}{n^4}$

Answer: A::B::D

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26. Bohr theory is applicable to

A. He

B. Li^{2+}

C. He^{2+}

D. $H-$ atom

Answer: A::C

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27. The magnitude of the spin angular momentum corresponding to an electron in Balmer transition inside a hydrogen atom cam be:

A. $S = \sqrt{s(s+1)}\frac{h}{2\pi}$

B. $S = s\frac{h}{2\pi}$

C. $S = \sqrt{\frac{3}{2}} \times \frac{h}{2\pi}$

D. $S = \pm\frac{1}{2} \times \frac{h}{2\pi}$

Answer: A::C

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28. Select the correct configurations among the following:

A. $Cr(Z = 24) : [Ar]3d^5, 4s^1$

B. $Cu(Z = 29) : [Ar]3d^{10}, 4s^1$

C. $Pd(Z = 46) : [Kr]4d^{10}, 5s^0$

D. $Pt(Z = 78) : \{Xe]4d^{10}4s^2$

Answer: A::B::C

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29. Which amog the followng statements is/are correct?

A. Φ^2 represents the atomic orbitals

B. The number of peaks in radial distribution is $(n - l)$

C. Radial probability density $\rho_{nl}(r) = 4\pi r^2 R^2_{nl}(r)$

D. A node is point in space where the wave function (Φ) has zero amplitude.

Answer: A::B::C::D

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30. Select the correct statement(s) among the following

(i) Total number of orbitals in a shell with principal quantum number 'n' is n^2

(ii). Total number of subshells in the n th energy level is n

(iii). The maximum number of electrons in a subshell is given by the expression (4l+2)

A. m=l+2 where la nd ma re azimuthal and magnetic quantum numbers.

B. (i),(iii) and (iv) are correct

C. (i),(ii) and (iii) are correct

D. (ii),(iii) and (iv) are correct

Answer: B

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31. Which among the following are correct about angular momentum of electron?

A. $2h$

B. $1.5\frac{h}{\pi}$

C. $2.5h$

D. $0.5\frac{h}{\pi}$

Answer: A::B::D

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32. Which of the following is/are incorrect for the Humphrey lines of hydrongen spectrum?

A. $n_2 = 7 \rightarrow n_1 = 2$

B. $n_2 = 10 \rightarrow n_1 = 6$

C. $n_2 = 5 \rightarrow n_1 = 1$

D. $n_2 = 11 \rightarrow n_1 = 3.$

Answer: A::C::D

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33. In Bohr's model of the hydrogen atom:

A. the radius of n th orbit is proportional to n^2

B. The toal energy of the electron in the n th orbit is inversely proportional to 'n'

C. the angular momentum of the electron is integral multiple of $h / 2\pi$

D. the magnitude of potential energy of an electron in an orbit is greater than kinetic energy.

Answer: A::C::D

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34. Which among the folloiwing series is obtained in both absorption and emission spectrums?

A. Lyman series

B. Balmer series

C. Paschen series

D. Brackett series

Answer: A

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35. The maximum kinetic energy of photoelectrons is directly proportional to . . . Of the incident radiation. The missing word can be:

A. intenstiy

B. wavelength

C. wave number

D. frequency.

Answer: C::D

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36. Rutherford's experiment established that

A. inside the atom there is a heavy positive centre.

B. nucleus contains protons and neutrons.

C. most of the space in an atom is empty

D. size of nucleus is ery small

Answer: A::C::D

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37. Which of the following orbital(s) lie in the xy-plane?

A. $d_{x^2-y^2}$

B. d_{xy}

C. d_{xz}

D. d_{yz}

Answer: A::B

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38. In which of the following sets of orbitals, electrons have equal orbital angular momentum?

A. 1s and 2s

B. 2s and 2p

C. 2p and 3p

D. 3p and 3d

Answer: A::C

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39. Which of the following orbitals have no spherical nodes?

A. 1s

B. 2s

C. 2p

D. 3p

Answer: A::C

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40. For a shell of principal quantum number n=4, there are:

A. 16orbitals

B. 4 subshells

C. 32 electrons (maximum)

D. 4 electrons with l=3

Answer: A::B::C

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41. The isotopes contain the same number of :

A. neutrons

B. protons

C. protons+neutrons

D. electron

Answer: B::D

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42. Which of the followig sepcies has less number of protons than the number of neutrons?

A. $._{6}^{12}C$

B. $._{9}^{19}F$

C. $._{11}^{23}Na$

D. $._{12}^{24}Mg$

Answer: B::C

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43. The angular part of the wave function depends on the quantum numbers are:

A. n

B. l

C. m

D. s

Answer: B::C

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44. Which of the following species are expected to have spectrum similar to hydrogen?

A. He^{+}

B. He^{2+}

C. Li^{2+}

D. Li^{+}

Answer: A::C

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45. Which of the following statements (regarding an atom of H) are correct?

A. Kinetic energy of the electron is maximum in the first orbit

B. potential energy of the electron is maximum in the first orbit

C. radius of the second orbit is four times the radius of the first orbit

D. Various energy levels are equally spaces.

Answer: A::C

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46. Highly excited state for hydrogen - like atom (also called rydberg states) with nuclear charge Ze are defined by their principal quantum number n, where $n > > 1$ Which of the following statement is (are) true?

A. Relative change in the radii of two consecutive orbitals does not depend on Z

B. Relative change in the radii of two consecutive orbitals varies as 1/n

C. Relative change in the energy of two consecutive orbitals varies as $1/n^3$

D. Relative change in the angular momenta of two consecutive orbitals varies as $1/n$.

Answer: A

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Objective Question Level-B

1. The configuration of Cr atom is $3d^5 4s^1$ but not $3d^4 4s^2$ due to reason R_1 and the configuration of Cu atom is $3d^{10} 4s^1$ but not $3d^9 4s^2$ due to reason R_2. R_1 and R_2 are:

A. $R_1:$ The exchange energy of $3d^5 4s^1$: is greater than that of $3d^4 4s^2$

$R_2:$ The exchange energy of $3d^{10} 4s^1$ is greater than that of $3d^9 4s^2$.

B. R_1: $3d^5 4s^1$ and $3d^4 4s^2$ have same exhange energy but $3d^5 4s^1$ is spheriaclly symmetrical.

R_2: $3d^{10} 4s^1$ is also shpherically symmetrical.

C. R_1: $3d^5 4s^1$ has grater exhange energy than $3d^4 4s^2$.

$R_2 : 3d^{10} 4s^1$ has spherical symmetry.

D. $R_1 : 3d^5 4s^1$ has greater energy than $3d^4 4s^2$.

$R_2 : 3d^{10} 4s^1$ has greater energy than $3d^9 4s^2$.

Answer: C

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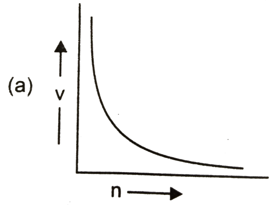
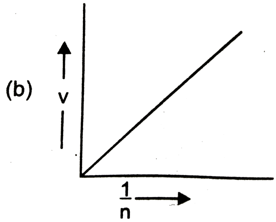
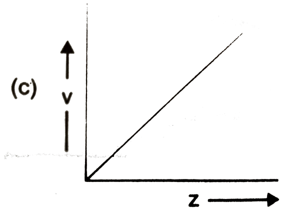
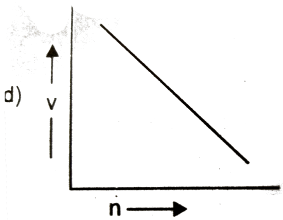
2. Which of the following graphs is incorrect?

A. 

B. 

C. 

D. 

Answer: D

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3. Which among the following is correct of $._5\ B$ in normal state?

	2s	2p				
(a)	↑↑		↑		:	Against Hund's rule
(b)	↑	↑	↑		:	Against aufbau principle as well as Hund's rule
(c)	↑↑	↑			:	Violation of Pauli's exclusion principle and not Hund's rule
(d)	↑↓	↑			:	Against aufbau principle

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4. Maximum value $(n + l + m)$ for unpaired electrons in second excited state of chlorine $._{17}\ Cl$ is:

A. 28

B. 25

C. 20

D. none of these

Answer: B

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5. Which of the following is correctly matched?

A. Momentum of H-atom when electrons return from n=2 to n=1, $\frac{3Rh}{4}$

B. Momentum of photon, Independent of wavelength of light

C. e/m ratio of anode rays, Independent of gas in the discharg tube

D. Radius of nucleus :$(\text{Mass no.})^{1/2}$

Answer: A

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6. In Bohr series of lines of hydrogen spectrum, third line from the red end corresponds to which one of the following inner orbit jumps of electron for Bohr orbit in atom in hydrogen :

A. $4 \to 1$

B. $2 \rightarrow 5$

C. $3 \rightarrow 2$

D. $5 \rightarrow 2$

Answer: D

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7. In which of the following pairs is the probability of finding the electron in xy-plane zero both orbitals?

A. $3d_{yz}, 4d_{x^2-y^2}$

B. $2p_z, d_{z^2}$

C. $4d_{zx}, 3p_z$

D. none of these

Answer: D

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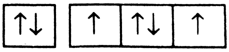
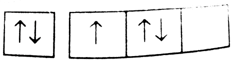
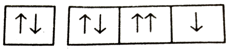
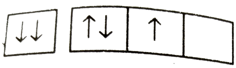
8. The orbital diagram in which both the Pauli's exlusion principle and Hund's rule violated is

A. (a) 

B. (b) 

C. (c) 

D. (d) 

Answer: D

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9. The distance between 3rd and 2nd bohr orbits of hydrogen atom:

A. $0.529 \times 10^{-8} cm$

B. $2.645 \times 10^{-8} cm$

C. $2.116 \times 10^{-8} cm$

D. $1.058 \times 10^{-8} cm$

Answer: B

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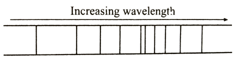
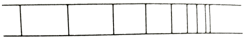
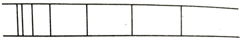
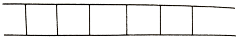
10. Which diagram best represnts the apperance of the line spectrum of atomic hydorgen in the visible region?

$\overrightarrow{Increa\sin g\lambda}$

A. (a) 

B. (b) 

C. (c) 

D. (d) 

Answer: C

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11. The 'm' vlaue for an electron in an atom is equal to the number of m values for l=1. the electron may be present in

A. $3d_{x^2-y^2}$

B. $5f_{x(x^2-y^2)}$

C. $4f_{x^3/z}$

D. None of these

Answer: B

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12. For a sub-shell with azimuthal quantum number 'l', the total values of magnetic quantum number m can be related to l as

A. $m = l + 2$

B. $m = 2l^2 + 1$

C. $l = \frac{m-1}{2}$

D. $l = 2m + 1$

Answer: C

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13. What are the values of the orbital angular momentum of an electron in the orbitals $1s$, $3s$, $3d$ and $2p$:-

(a). $0, 0\sqrt{6h}, \sqrt{2h}$

(b). $1, 1\sqrt{4h}, \sqrt{2h}$

(c). $0, 1\sqrt{6h}, \sqrt{3h}$

(d). $0, 0\sqrt{20h}, \sqrt{6}$

A. $0.0, \sqrt{6}h, \sqrt{2}h$

B. $1, 1, \sqrt{4}h, \sqrt{2}h$

C. $0, 1, \sqrt{6}h, \sqrt{3}h$

D. $0, 0, \sqrt{20}h, \sqrt{6}h$

Answer: A

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14. After np orbitals are filled, the next orbital filled will be :-

(a). $(n+1)s$

(b). $(n+2)p$

(c). $(n+1)d$

(d). $(n+2)s$

A. $(n+1)s$

B. $(n+2)p$

C. $(n+1)d$

D. $(n+2)s$

Answer: A

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15. The ratio of $(E_2 - E_1)$ to $(E_4 - E_3)$ for He^+ ion is approximately equal to (where E_n is the energy of nth orbit):

A. 10

B. 15

C. 17

D. 12

Answer: B

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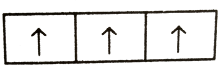
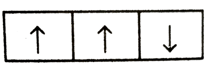
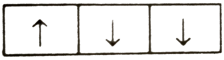
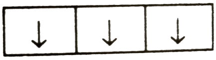
16. Which of the following electronic configurations has zero spin multiplicity?

A. (a) 

B. (b) 

C. (c) 

D. (d) 

Answer: C

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17. The energy required for removal of electron fro 3s,3p,3d subshells of hydrogen atom will lie in followig sequence:

$E_1 = (3s \rightarrow \infty) \quad E_2 = (3p \rightarrow \infty) \quad E_3 = (3d to \infty)$

A. $E_1 > E_2 > E_3$

B. $E_1 < E_2 < E_3$

C. $E_1 = E_2 = E_3$

D. None of these

Answer: D

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18. Which of the following electronic configuration have the highest exchange energy?

(A) 3d: [↑][↑][↑][ ][ ] 4s: [↑]

(B) 3d: [↑][↑][↑][↑][↑] 4s: [↑]

(C) 3d: [↑↓][↑↓][↑↓][↑↓][↑] 4s: [↑]

(D) 3d: [↑↓][↑↓][↑↓][↑↓][↑↓] 4s: [↑]

A. (a) 3d: [↑][↑][↑][ ][ ] 4s: [↑]

B. (b) [↑][↑][↑][↑][↑] [↑]

C. (c) [↑↓][↑↓][↑↓][↑↓][↑] [↑]

D. (d) [↑↓][↑↓][↑↓][↑↓][↑↓] [↑]

Answer: B

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19. In a historical experiment to dtermine Planck's constant, a metal surface was irradiated with light of different wavelengths. The emitted photoelectron energies were measured by applying a stopping potential. The relevant data for wavelength (λ) of incident light and the corresponding stopping potential (V_0) are given below

$\lambda (\mu m)$	V_0 (Volt)
0.3	2.0
0.4	1.0
0.5	0.4

Given that $c = 3 \times 10^8 ms^{-1}$ and $e = 1.6 \times 10^{-19} C$, Planck's constant (in units of J s) found from such an experiment is:

A. 6.0×10^{-34}

B. 6.4×10^{-34}

C. 6.6×10^{-34}

D. 6.8×10^{-34}.

Answer: B

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20. Angular distribution functions of all orbitals have:

A. l nodal surfaces

B. (l-1) nodal surface

C. (n+l) nodal surfaces

D. (n-l-1) nodal surfaces.

Answer: A

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21. If uncertainty in position and momentum are equal then uncertainty in velocity is.

A. $\sqrt{\frac{h}{\pi}}$

B. $\frac{\sqrt{h}}{2\pi}$

C. $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$

D. $\frac{1}{m}\sqrt{\frac{h}{\pi}}$.

Answer: C

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22. The minimum number of waves made by an electron moving in an orbit having maximum magnetic quantum number $+3$ is.

A. 3

B. 4

C. 2

D. 1

Answer: B

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23. The number of elliptical orbits excluding circular orbits in the N-shell of an atom is:

A. 3

B. 4

C. 2

D. 1

Answer: A

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24. From the electronic configuration of the given elements K,L, M and N, which one has the highest ionization potential?

A. $M = [Ne]3s^2 3p^2$

B. $L = [Ne]3s^2 3p^3$

C. $K = [Ne]3s^2 3p^1$

D. $N = [Ar]3d^{10}, 4s^2 4p^3$

Answer: B

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25. Radiation of wavelength λ in indent on a photocell . The fastest emitted electron has speed v if the wavelength is changed to $\frac{3\lambda}{4}$, then speed of the fastest emitted electron will be

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

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

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

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

Answer: A

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26. Given set of quantum numbers for a multielectron atom is:

n	l	m	s
2	0	0	$+1/2$
2	0	0	$-1/2$

What is the next higher allowed set of 'n' and 'l' quantum numbers for this atom in the ground state?

A. n=2,l=0

B. n=2,l=1

C. n=3,=0

D. n=4,l=1

Answer: B

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27. In how many elements does the electron have the quantum number of n =4 and l = 1 ?

A. 4

B. 6

C. 8

D. 10

Answer: B

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28. If there are three possible values $(-1/2, 0, +1/2)$ for the spin quantum, then electronic configuration of K (19) will be:

A. $1s^3, 3s^3 2p^9, 3s^2 3p^1$

B. $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$

C. $1s^2, 2s^2 2p^9, 3s^2 3p^4$

D. none of these

Answer: A

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29. The radius of first Bohr orbit is x, then de-Broglie wavelength of electron in 3rd orbit is nearly

A. $2\pi x$

B. $6\pi x$

C. 9x

D. $\frac{x}{3}$

Answer: B

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30. How many times does light travel faster in vacuum than an electron in bohr first orbit of hydrogen atom?

A. 13.7 times

B. 67 times

C. 137 times

D. 97 times

Answer: C

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31. A compound of vanadium has a magnetic moment of 1.73 BM. The electronic configuration of vanadium ion in the compound is:

A. $[Ar]3d^2$

B. $[Ar]3d^1 4s^0$

C. $[Ar]3d^3$

D. $[Ar]3d^0 4s^1$

Answer: B

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32. The angular momentum of an electron revolving in a p-orbital is

A. Zero

B. $\frac{h}{\sqrt{2\pi}}$

C. $\frac{h}{2\pi}$

D. $\frac{1}{2}\frac{h}{2\pi}$

Answer: B

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33. If a hydrogen atom emit a photon of energy $12.1eV$, its orbital angular momentum changes by $\Delta L. then$Delta L` equals

A. $1.05 \times 10^{-34} J \quad \text{sec}$

B. $2.11 \times 10^{-34} J \quad \text{sec}$

C. $3.16 \times 10^{-34} J \quad \text{sec}$

D. $4.22 \times 10^{-34} J \quad \text{sec}$

Answer: B

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34. The total energy of the electron of H-atom in the second quantum state is $-E_2$. The total energy of the He^+ atom in the third quantum state is:

A. $-\left(\frac{3}{2}\right)E_2$

B. $-\left(\frac{2}{3}\right)E_2$

C. $-\left(\frac{4}{9}\right)E_2$

D. $-\left(\frac{16}{9}\right)E_2$

Answer: C

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35. What is the ratio of the Rydberg constant for helium to Hydrogen atom?

A. $1/2$

B. $1/4$

C. $1/8$

D. $1/16$

Answer: C

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36. If the kinetic energy of a particle is doubled, de Broglie wavelength becomes:

A. 2 times

B. 4 times

C. $\sqrt{2}$times

D. $\frac{1}{\sqrt{2}}$ times

Answer: D

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37. Imagine an atom made of a proton and a hypothetical particle of double the mass of the electron but having the same change as the electron. Apply the Bohr atom model and consider all possible transitions of this hypothetical particle of the first excited level. the longest wavelength photon that will be emitted has wavelength [given in terms of the Rydberg constant R for the hydrogen atom] equal to

A. $\frac{9}{5R}$

B. $\frac{36}{5R}$

C. $\frac{18}{5R}$

D. $\frac{4}{R}$

Answer: C

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38. What is the ratio of time periods (T_1/T_2) in second orbit of hydrogen atom to third orbit of He^+ ion?

A. $\frac{8}{27}$

B. $\frac{32}{27}$

C. $\frac{27}{32}$

D. $\frac{27}{8}$

Answer: B

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39. The de Broglie wavelength of an electron accelerated by an electric field of V volt is given by:

A. $\lambda = \frac{1.23}{\sqrt{m}}$

B. $\lambda = \frac{1.23m}{\sqrt{h}}$

C. $\frac{1.23}{\sqrt{V}}nm$

D. $\lambda = \frac{1.23}{V}.$

Answer: B

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40. An excited state of H atom emits a photon of wavelength λ and returns in the ground state. The principal quantum number of excited state is given by:

A. $\sqrt{\lambda R(\lambda R - 1)}$

B. $\sqrt{\frac{\lambda R}{(\lambda R - 1)}}$

C. $\frac{1}{\sqrt{\lambda R(\lambda R - 1)}}$

D. $\sqrt{\frac{(\lambda R - 1)}{\lambda R}}$

Answer: B

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41. A dye absorbs a photon of wavelength λ and re-emits the same energy into two photns of wavelength λ_1 and λ_2 respectively. The wavelength λ is related to λ_1 and λ_2 as :

A. $\lambda = \frac{\lambda_1 \lambda_2}{(\lambda_1 + \lambda_2)^2}$

B. $\lambda = \frac{\lambda_1 + \lambda_2}{\lambda_1 \lambda_2}$

C. $\lambda = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

D. $\frac{\lambda_1^2 + \lambda_2^2}{\lambda_1 + \lambda_2}$

Answer: C

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42. A metal is irradiated with light of wavelength 660 nm. Given that the work that the work function of the metal is $1.0eV$, the de Broglie wavelength of the ejected electron is close to-

A. $6.6 \times 10^{-7}m$

B. $8.9 \times 10^{-11}m$

C. $1.3 \times 10^{-9}m$

D. $6.6 \times 10^{-13}m$

Answer: C

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43. Hydrogen $\left(_- (1) H^1 \right)$ Deuterium $\left(_- (1) H^2 \right)$ singly omised helium $\left(_- (1) He^1 \right)$ and doubly ionised lithium $\left(_- (1) Li^6 \right)^{++}$ all have one electron around the nucleus Consider an electron transition from $n = 2 \rightarrow n = 1$ if the wavelength of emitted radiartion are $\lambda_1, \lambda_2, \lambda_3,$ and λ_4, repectivelly then approximetely which one of the following is correct ?

A. $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

B. $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

C. $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

D. $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

Answer: A

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44. If the radius of 3rd orbit of hydrogen atom is 'x' then the radius of 4th orbit of Li^{2+} ion would be:

A. $\frac{27}{16}x$

B. $\frac{16}{27}x$

C. $\frac{9}{16}x$

D. $\frac{16}{9}x$

Answer: B

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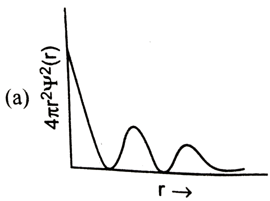
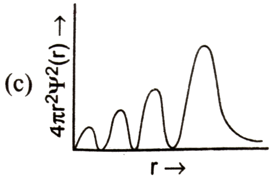
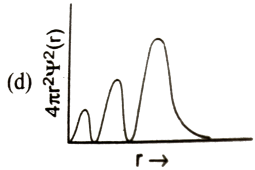
45. Which of the following graphs between radial probability distribution and radius of atom corresponding to 4s-orbital (n=4,l=0) is correct?

A. 

B.

C. 

D. 

Answer: C

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46. An electron in a hydrogen atom in its ground state absorbs energy equal to ionisation energy of Li^{+2}. The wavelength of the emitted electron is :-

(a). $3.32 \times 10^{10} m$

(b). 1.17Å

(c). $2.32 \times 10^{9} nm$

(d). 3.33pm

A. 3.32Ã...

B. 2.32nm

C. 1.14Ã…

D. 3.33 pm

Answer: C

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47. Which orbital has only positive value of wave function at all distances from the nucleus :

A. 1s

B. 2p

C. 2s

D. 3d

Answer: A

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48. A metal is irradiated with light of frequency $3.2 \times 10^{16} Hz$. The ejected photoelectron has kinetic energy $\frac{3}{4}$the of energy of absorbed photon. The threshold frequency orf the metal would be :

A. $1.6 \times 10^{15} Hz$

B. $8 \times 10^{15} Hz$

C. $2.4 \times 10^{25} Hz$

D. $2.4 \times 10^{18} Hz$

Answer: B

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49. Spin angular momentum of nitrogena to in ground state is:

A. $\frac{1}{2} \frac{h}{2\pi}$

B. zero

C. $\sqrt{\frac{3}{4}}\left(\frac{h}{2\pi}\right)$

D. $\sqrt{\frac{15}{4}}\left(\frac{h}{2\pi}\right)$

Answer: D

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50. A plot of kinetic energy of the emitted electron against frequency of the incident radiation yields a straight line.t he slope of the straight line is:

A. 0.66×10^{-35}

B. 0.66×10^{-33}

C. 0.33×10^{-33}

D. 3.33×10^{-35}

Answer: B

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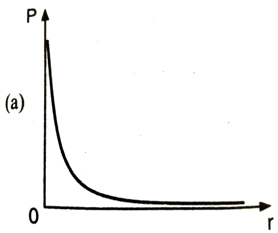
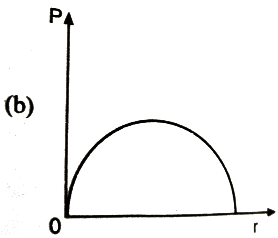
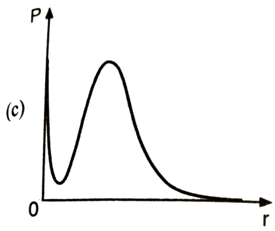
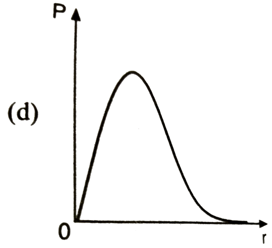
51. P is the probability of finding the Is electron of hydrogen atom in a spherical shell of infitesimal thickness, dr, at a distance r from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of P on r is

A. 

B. 

C. 

D. 

Answer: D

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Assertion Reason

1. Assertion (A) :F atom has less electron than CI^{Θ} atom

Reason (R) : Additional electrons are repelled more effectively by $3p$ electron in CI atom than by$2p$ electron in F atom

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: C

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2. Statement: Nuclide $._{13}^{30} Al$ is less stable than $._{20}^{40} Ca$

Explanation: Nuclides having odd number of protons and neutrons are general unstable.

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: A

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3. Assertion (A) : The first IE of Be is greater than that of B

Reason (R) : $2p$ orbitals is lower in energy than $2s$

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: C

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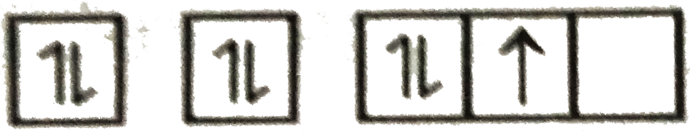
4. Assertion (A) : The electronic configuration of nitrogen atom is represented as

and not as



Reason (R) : The electronic configuration of the ground state of an atom is the one which has the greatest multiplicity

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: A

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5. Statement : For $n = 3, l$ may be $0, 1$ and $2,$ and m may be$0, \pm 1$ and $\pm 2.$

Explanation : For each value of (n) there are 0 to (n-1) possible values of $l,$ and for each value of l there are (0) to $\pm l$ values of (m).

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: C

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6. Statement : For $n = 3, l$ may be $0, 1$ and $2,$ and m may be$0, \pm 1$ and $\pm 2.$

Explanation : For each value of (n) there are 0 to (n-1) possible values of l, and for each value of l there are (0) to $\pm l$ values of (m).

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: A

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7. Assertion : An orbital cannot have more than two electrons.

Reason : The two electrons in an orbital create opposite magnetic fields.

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: B

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8. Statement-I : The configuration of B atom cannot be $1s^2 2s^3$.

Because

Statement-II : Hund's rule demands that the configuration should display maximum multiplicity.

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: C

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9. Assertion (A) : The ionization energy of N is more than that of O

Reason (R) : Electronic configuration of N is more stable due to half - filled $2p$ orbitals

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: C

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10. Assertion (A) : p orbital is dumb- bell shaped

Reason (R) :Electron presents in p orbital can have any one of three value of magnetic quantum number i.e. $0, \ +1, \ \text{or} \ \ -1$

A. If both (A) and (R) are correct and (R) is the correct reason for (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation for (A).

C. If (A) is correct but (R) is incorrect.

D. If (A) is incorrect but (R) is correct.

Answer: A

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11. Assertion (A) : A spectral line will be seen for $2p_x$-$2p_y$ transition

Reason (R) : Energy is raleased in the form of wave of light when the electron drops from $2p_x$, to $2p_y$ orbital.

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: D

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12. Assertion: Ionisation potential of Be (atomic no.4) is less than B (atomic no.5).

Reason: The first electron released from Be is of p-orbital but that from B is of s-orbital.

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: A

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13. Statement-I : In Rutherford's gold foil experiment, very few α-particles are deflected back.

Because

Statement-II : Nucleus present inside the atom is heavy.

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: B

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14. Assertion (A) : Limiting line is the balmer series has a wavelength of $364.4nm$

Reason (R) : Limiting line is obtained for a jump electron from $n = \infty$

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: A

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15. Assertion (A) : Each electron in an atom has two spin quantum number

Reason (R) : Spin quantum numbers are obtained by solving Schrodinger wave equation

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: D

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16. Assertion (A) : There are two spherical nodes in $3s$ orbital

Reason (R) : There is no planar nodes in $3s$ orbital.

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: B

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17. Assertion (A) : In an atom, the velocity of electron in the higher orbits keeps on decreasing

Reason (R) : Velocity of electron in inversely proportional to the radius of the orbit

A. If (A) and (R) are both correct and (R) is the correct reason for (A).

B. If (A) and (R) are both correct but (R) is not the correct reason for (A).

C. If (A) is true but (R) is false.

D. If both (A) and (R) false.

Answer: C

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18. Assertion (A) : If the potential difference applied to an electron is made 4 time , the de Broglie wavelength associated is halved

Reason (R) : On making potential difference 4 times , velocity is doubled and hence λ is halved

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19. (A) Angular momentum of 1s,2s,3s, etc., all have spherical shape.

(R) 1s,2s,3s, etc. all hae spherical shape.

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20. Assertion (A) : The radial probability of$1s$ electrons first increases,till it is maximum at 53Å and then decreases to zero

Reason (R) : Bohr's radius for the first is 53Å

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21. Assertion (A) : On increasing the intensity of incident radiation, the photo electrons eject and then KE increases

Reason (R) : Greater the intensity means greater the energy which in turn means greater the frequency of the radiation.

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22. Assertion (A) : A spectral line will be seen for $2p_x$-$2p_y$ transition

Reason (R) : Energy is raleased in the form of wave of light when the electron drops from $2p_x$, to $2p_y$ orbital.

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Matrix matching Type Question

1. Match List-I (Electromagnetic wave type) list-ii (Its assocation/application):

List-I		List-II	
(a)	Infrared	(p)	Absorbed by the ozone layer of the atmosphere
(b)	Radiowaves	(q)	To detect fracture of bones
(c)	X-rays	(r)	For broadcasting
(d)	Ultraviolet rays	(s)	To treat muscular strain

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2. Matrix Matching problems

Column-I	Column-II
(a) X-rays	(p) Davisson and Germer experiment
(b) Atomic number determination	(q) Crystal structure determination
(c) Dual nature of matter	(r) Moseley's law
(d) Dual nature of radiation	(s) Bragg's law

[B] Match the Column-I and Column-II:

Column-I	Column-II
(a) Lyman series	(p) Visible region
(b) Balmer series	(q) UV region
(c) Pfund series	(r) IR region
(d) Light emitted by sodium lamp	(s) Line emission spectrum

[C] Match the List-I with List-II in hydrogen atom spectrum:

List-I	List-II
(a) Lyman series	(p) Visible region
(b) Balmer series	(q) Infrared region
(c) Paschen series	(r) Absorption spectrum
(d) Brackett series	(s) Ultraviolet region

[D] Match the List-I with List-II:

List-I	List-II
(a) K-shell	(p) Electrons in elliptical orbit
(b) L-shell	(q) Electrons in circular orbit

List-I		List-II	
(a)	Mn^{2+}	(p)	Diamagnetic
(b)	V^{2+}	(q)	Paramagnetic
(c)	Zn^{2+}	(r)	Coloured compounds
(d)	Ti^{4+}	(s)	Magnetic moment = 2.82 BM

[F] Match the List-I with List-II:

List-I		List-II	
(a)	Mg^{2+}	(p)	Zero spin multiplicity
(b)	Fe^{2+}	(q)	Spin multiplicity = 3
(c)	Co^{3+}	(r)	Total spin = 0
(d)	Ca^{2+}	(s)	Total spin = 2

[G] Match the properties of List-I with the formulae in List-I

List-I		List-II	
(a)	Angular momentum of electron	(p)	$\sqrt{l(l+1)}\frac{h}{2\pi}$
(b)	Orbital angular momentum	(q)	$I\omega$
(c)	Wavelength of matter wave	(r)	$nh/2\pi$
(d)	Quantised value(s)	(s)	h/p

[H] Match the orbitals of List-I with the nodal properties o List-II:

List-I		List-II	
(a)	$2s$	(p)	Angular node = 1
(b)	$1s$	(q)	Radial node = 0
(c)	$2p$	(r)	Radial node = 1
(d)	$3p$	(s)	Angular node = 0

List-I	List-II
(a) $n = 6 \longrightarrow n = 3$	(p) 10 lines in the spectrum
(b) $n = 7 \longrightarrow n = 3$	(q) Spectral lines in visible region
(c) $n = 5 \longrightarrow n = 2$	(r) 6 lines in the spectrum
(d) $n = 6 \longrightarrow n = 2$	(s) Spectral lines in infrared region

[J] Match the List-I with List-II:

List-I	List-II
(a) Radius of electron orbit	(p) Principal quantum number
(b) Energy of electron	(q) Azimuthal quantum number
(c) Energy of subshell	(r) Magnetic quantum number
(d) Orientation of the atomic orbitals	(s) Spin quantum number

[K] Match the List-I with List-II:

List-I	List-II
(a) Electron cannot exist in the nucleus	(p) de Broglie wave
(b) Microscopic particles in motion are associated with	(q) Electromagnetic wave
(c) No medium is required for propagation	(r) Uncertainty principle
(d) Concept of orbit was replaced by orbital	(s) Transverse wave

[L] According to Bohr theory: **(IIT 2006)**

E_n = Total energy

K_n = Kinetic energy

V_n = Potential energy

r_n = Radius of nth orbit

Match the following:

Column-I	Column-II
(a) $V_n/K_n = ?$	(p) 0
(b) If radius of nth orbit $\propto En^x$; $x = ?$	(q) -1
(c) Angular momentum in lowest orbital	(r) -2
(d) $\frac{1}{r^n} \propto Z^y$; $y = ?$	(s) 1

List-I	List-II
(a) Radius of nth orbital	(p) Inversely proportional to Z
(b) Energy of nth shell	(q) Integral multiple of $h/2\pi$
(c) Angular momentum of electron	(r) Proportional to n^2
(d) Velocity of electron in nth orbit	(s) Inversely proportional to 'n'

[N] Match the entries in Column-I with the correctly related quantum number(s) in Column-II:

Column-I	Column-II
(a) Orbital angular momentum of the electron in a hydrogen-like atomic orbital	(p) Principal quantum number
(b) A hydrogen-like one electron wave function obeying Pauli principle	(q) Azimuthal quantum number
(c) Shape, size and orientation of hydrogen-like atomic orbitals	(r) Magnetic quantum number
(d) Probability density of electron at the nucleus in hydrogen-like atom	(s) Electron spin quantum number

[O] Match the List-I with List-II: **(IIT 2006)**

List-I	List-II
(a) Wave nature of radiation	(p) Photoelectric effect
(b) Photon nature of radiation	(q) Compton effect
(c) Interaction of a photon with an electron, such that quantum energy is slightly equal to or greater than the binding energy of electron, is more likely to result in	(r) Diffraction
(d) Interaction of a photon with an electron, such that photon energy is much greater than the binding energy of electron, is more likely to result in	(s) Interference

[P] Match the Column-I with Column-II:

Column-I	Column-II
(a) Orbital angular momentum of an electron	(p) $\sqrt{s(s+1)}\,h/2\pi$
(b) Angular momentum of electron	(q) $\sqrt{n(n+2)}$ BM
(c) Spin angular momentum of electron	(r) $nh/2\pi$
(d) Magnetic moment of atom	(s) $\sqrt{l(l+1)}\,h/2\pi$

Column-I	Column-II
(a) Scintillation	(p) Wave nature
(b) Photoelectric effect	(q) Particle nature
(c) Diffraction	(r) Particle nature dominates over wave nature
(d) Principle of electron microscope	(s) Wave nature dominates over particle nature

Column-I	Column-II
(a) Radial function R	(p) Principal quantum number 'n'
(b) Angular function Θ	(q) Azimuthal quantum number 'l'
(c) Angular function Φ	(r) Magnetic quantum number 'm'
(d) Quantized angular momentum	(s) Spin quantum number 's'

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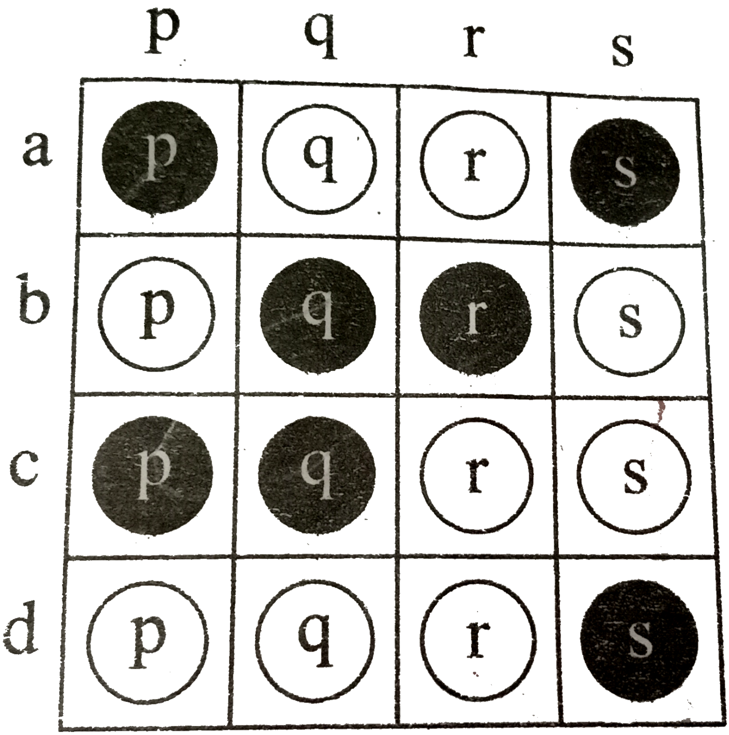

3.

Q. Match the column-I with Column-II

	Column-I	Column-II
(a)	$4s$	(p) Circular orbit around nucleus
(b)	$4p$	(q) Non-direction orbitals
(c)	$1s$	(r) Angular momentum $= \frac{2h}{\pi}$
(d)	$3d$	(s) Number of radial node = 0

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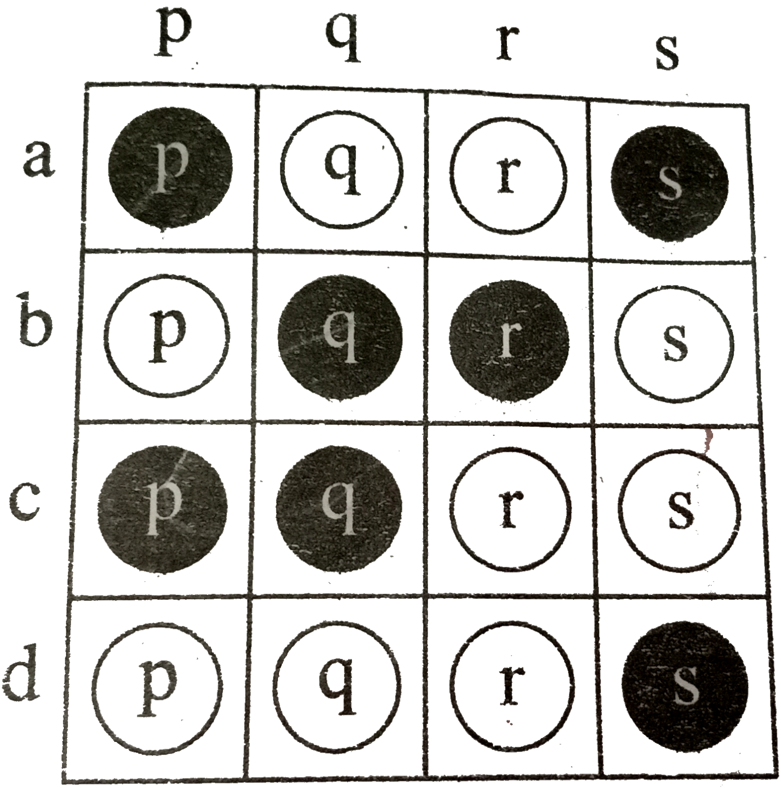

4.

Q. Match the properties of column-I with the formulae in Column-II

Column-I	Column-II
(a) Angular momentum of electron	(p) $\sqrt{l(l+1)}\,\frac{h}{2\pi}$
(b) Orbital angular momentum	(q) $I\omega$
(c) Wavelength of matter wave	(r) $\frac{nh}{2\pi}$
(d) Quantised value(s)	(s) h/p

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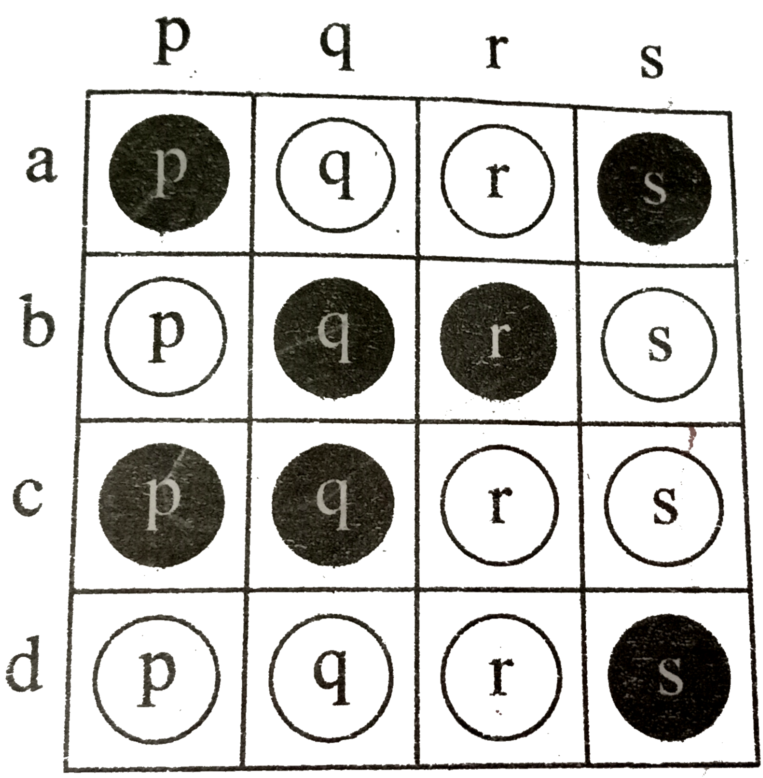

5.

Match the column-I with Column-II

	Column-I		Column-II
(a)	Electrons cannot exist in the nucleus	(p)	de Broglie wave
(b)	Microscopic particles in motion are associated with	(q)	Electromagnetic wave
(c)	No medium is required for propagation	(r)	Uncertainty principle
(d)	Concept of orbit was replaced by orbital	(s)	Transverse wave

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Integer Type Question

1. For Li^{2+}, when an electron falls from a higher orbit to nth orbit, all the three types of lines ,i.e., Luyman, balmer and paschen was found int eh spectrum. Here, the value of 'n' will be

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2. The emission lines of hydrogen contains ten lines. The highest orbit in which the electron is expected to be found is:

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3. Total number of nodes present in 4d-orbitals will be:

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4. Spin multiplicity of Nitrogen atom is

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5. Orbital frequency of electron in nth orbit of hydrogen is twice that of 2nd orbit. The value of n is:

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6. If kinetic energy of an electron is reduced by (1/9) then how many times its de Broglie wavelength will increase.

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7. If electrons in hydrogen sample return from 7th shell to 4 th shell then how many maximum number of lines can be observed in the spectrum of hydrogen.

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8. An electron in Li^{2+} ion is in excited state (n_2). The wavelength corresponding to a transition to second orbit is 48.24 nm. From the same orbit, wavelength corresponding to a transition to third orbit is 142.46 nm. The value of n_2 is:

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9. The energy corresponding to one of the lines in the paschen series of H-atom is 18.16×10^{-20}J. Find the quantum numbers for the transition which produce this line.

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10. The angular momentum of electron in the shell in which the g-subshell first appears is $x \times \dfrac{h}{2\pi}$. The value of x will be:

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11. The maximum number of electrons that can have principal quantum number $n = 4$ and spin quantum number $m_s = -\frac{1}{2}$ is:

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12. The work function (ϕ) of some metals is listed below . The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metal is :

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
ϕ (eV)	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

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13. The work function of Silver and sodium are 4.6 and $2.3 eV$, respectively . The ratio of the slope of the stopping potential versus frequency plot for silver to that of sodium is

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14. The atomic masses of He and Ne are 4 and 20 amu respectively . The value of the de Broglie wavelength of He gas at $-73.^{\circ}C$ is "M" times that of the de Broglie wavelength of Ne at $727.^{\circ}C$. M is

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15. In an atom, the total number of electrons having quantum numbers $n=4, |m_l|=1$ and $m_s=-\frac{1}{2}$ is

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16. Not considering the electronic spin, the degeneracy of the second excited state $(n=3)$ of H-atom is 9, while the degeneracy of the second excited state of H^{-} is

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17. A hydrogen atom in its ground state is irradiated by light of wavelength 970Å Taking $hc/e = 1.237 \times 10^{-6}$eV m and the ground state energy of hydrogen atom as $-13.6eV$ the number of lines present in the emmission spectrum is

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Linked Comprehension Type Question

1. The observed wavelegnth in the line spectrum of hydrogen atom were first expressed in terms of a series by Johann Jakob Balmer, a Swiss teacher.

Balmer's emipirical formula is

$$\frac{1}{\lambda} = R_H\left[\frac{1}{2^2} - \frac{1}{n^2}\right]n = 3, 4, 5\ldots$$

$R_H = 109678cm^{-1}$ is the Rydberg constant.

Niels Bohr derived this expression theoretically in 1913. The formula is generalised to any one electron atom/ion.

Q. Calculat ethe longest wavelength in Ã...(1Ã...=$10^{-10}m$) in the balmer series of singly ionized helium He^{+}. Select the correct answer. Ignore the nuclear motion in your calculation.

A. 2651Ã...

B. 1641.1Ã...

C. 6569Ã...

D. 3249Ã...

Answer: B

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2. The observed wavelegnth in the line spectrum of hydrogen atom were first expressed in terms of a series by Johann Jakob Balmer, a Swiss teacher.

Balmer's emipirical formula is

$$\frac{1}{\lambda} = R_H \left[\frac{1}{2^2} - \frac{1}{n^2}\right] n = 3, 4, 5 \ldots$$

$R_H = 109678 cm^{-1}$ is the Rydberg constant.

Niels Bohr derived this expression theoretically in 1913. The formula is

generalised to any one electron atom/ion.Howmany lines in the spectrum will be observed when electrons return from 7th shell to 2nd shell?

A. 13

B. 14

C. 15

D. 16

Answer: C

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3. The observed wavelegnth in the line spectrum of hydrogen atom were first expressed in terms of a series by Johann Jakob Balmer, a Swiss teacher.

Balmer's emipirical formula is

$$\frac{1}{\lambda} = R_H\left[\frac{1}{2^2} - \frac{1}{n^2}\right] n = 3, 4, 5 \dots$$

$R_H = 109678 cm^{-1}$ is the Rydberg constant.

Niels Bohr derived this expression theoretically in 1913. The formula is

generalised to any one electron atom/ion.

The wavelength of first line of Balmer spectrum of hydrogen will be:

A. 4340Ã...

B. 4101Ã...

C. 6569Ã...

D. 4861Ã...

Answer: C

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4. The observed wavelegnth in the line spectrum of hydrogen atom were first expressed in terms of a series by Johann Jakob Balmer, a Swiss teacher.

Balmer's emipirical formula is

$$\frac{1}{\lambda} = R_H\left[\frac{1}{2^2} - \frac{1}{n^2}\right] n = 3, 4, 5 \dots$$

$R_H = 109678cm^{-1}$ is the Rydberg constant.

Niels Bohr derived this expression theoretically in 1913. The formula is

generalised to any one electron atom/ion.

Q.In which region of electromagnetic spectrum does the Balmer series lie?

A. UV

B. Visible

C. Infrared

D. Far infrared

Answer: B

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5. The observed wavelegnth in the line spectrum of hydrogen atom were first expressed in terms of a series by Johann Jakob Balmer, a Swiss teacher.

Balmer's emipirical formula is

$$\frac{1}{\lambda} = R_H \left[\frac{1}{2^2} - \frac{1}{n^2} \right] n = 3, 4, 5 \ldots$$

$R_H = 109678 cm^{-1}$ is the Rydberg constant.

Niels Bohr derived this expression theoretically in 1913. The formula is generalised to any one electron atom/ion.

Which of the following is not correctly matched?

A. $H_{\alpha} -$ 6569Ã...(Red)

B. $H_{\beta} -$ 4861Ã...

C. $H_{\gamma} -$ 4340Ã... (Orange)

D. $H_{\delta} -$ 4101Ã...(Violet)

Answer: C

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6. A formula analogous to Rydberg formula applies to the series of spectral ines which arise from transition from higher energy level to the lower energy level of hydrogen atom.

A muonic hydrogen atom is like a hydrogen atom in which the electron is replaced by a heavier particle,t he 'muon'. the mass of the muon is about 207 times the mass of an electron, while the charge remains same as that of the electron. Rydberg formula for hydrogen atom is:

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right](R_H = 109678cm^{-1})$$

Q. Radius of first Bohr orbit of muonic hydrogen atom is:

A. $\frac{0.259}{207}$Ã...

B. $\frac{0.529}{207}$Ã...

C. 0.529×207Ã...

D. 0.259×207Ã...

Answer: B

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7. A formula analogous to Rydberg formula applies to the series of spectral ines which arise from transition from higher energy level to the lower energy level of hydrogen atom.

A muonic hydrogen atom is like a hydrogen atom in which the electron is replaced by a heavier particle,t he 'muon'. the mass of the muon is about

207 times the mass of an electron, while the charge remains same as that of the electron. Rydberg formula for hydrogen atom is:

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right](R_H = 109678cm^{-1})$$

Q. Energy of first Bohr orbit of muonic hydrogen atom is:

A. $-\frac{13.6}{207}eV$

B. $13.6 \times 207eV$

C. $+\frac{13.6}{207}eV$

D. $+13.6 \times 207eV$

Answer: B

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8. A formula analogous to Rydberg formula applies to the series of spectral ines which arise from transition from higher energy level to the lower energy level of hydrogen atom.

A muonic hydrogen atom is like a hydrogen atom in which the electron is replaced by a heavier particle,t he 'muon'. the mass of the muon is about 207 times the mass of an electron, while the charge remains same as that of the electron. Rydberg formula for hydrogen atom is:

$$\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] (R_H = 109678 cm^{-1})$$

Q.

A. $+\frac{13.6}{207} eV$

B. $+13.6 \times 207 eV$

C. $-\frac{13.6}{207} eV$

D. $-13.6 \times 207 eV$

Answer: B

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9. A formula analogous to Rydberg formula applies to the series of spectral ines which arise from transition from higher energy level to the lower energy level of hydrogen atom.

A muonic hydrogen atom is like a hydrogen atom in which the electron is replaced by a heavier particle,t he 'muon'. the mass of the muon is about 207 times the mass of an electron, while the charge remains same as that of the electron. Rydberg formula for hydrogen atom is:

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]\left(R_H = 109678cm^{-1}\right)$$

Q. Angular momentum of 'muon' in muonic hydrogen atom may be given as:

A. $\frac{h}{\pi}$

B. $\frac{h}{2\pi}$

C. $\frac{h}{4\pi}$

D. $\frac{h}{6\pi}$

Answer: B

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10. A formula analogous to Rydberg formula applies to the series of spectral ines which arise from transition from higher energy level to the lower energy level of hydrogen atom.

A muonic hydrogen atom is like a hydrogen atom in which the electron is replaced by a heavier particle,t he 'muon'. the mass of the muon is about 207 times the mass of an electron, while the charge remains same as that of the electron. Rydberg formula for hydrogen atom is:

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right](R_H = 109678cm^{-1})$$

Q. Distance between first and third Bohr orbits of muonic hydrogen atom will be:

A. $\frac{0.529}{207} \times 2$Ã...

B. $\frac{0.529}{207} \times 7$Ã...

C. $\frac{0.529}{207} \times 8$Ã...

D. $\frac{0.529}{207}$Ã...

Answer: C

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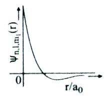
11. The wave function Φ_{n,l,m_1} is a methematical function whose value depends upon shperical upon spherical polar coordinates (r, θ, ϕ) of the electron and characterized by the quantum numbers, n,l and m_1. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. in the mathematical functions given in the table, Z is atomic number, a_0 is Bohr radius.

Column-1	Column-2	Column-3
(I) $1s$ orbital	(i) $\psi_{n,l,m_1} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) $2s$ orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) $2p_z$ orbital	(iii) $\psi_{n,l,m_1} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta$	(R) Probability density is maximum at nucleus
(IV) $3d_z^2$ orbital	(iv) xy- plane is a nodal plane	(S) Energy needed to excite electron from $n = 2$ state to $n = 4$ state is $\frac{27}{32}$ times the energy needed to excite electron from $n = 2$ state to $n = 6$ state

Q. For the given orbital in column 1, the only correct combination forany hydrogen-like species is:

A. (IV) (iv) (R)

B. (II) (ii) (P)

C. (III) (iii) (P)

D. (I) (ii) (S)

Answer: B

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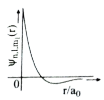
12. The wave function Φ_{n,l,m_1} is a methematical function whose value depends upon shperical upon spherical polar coordinates (r, θ, ϕ) of the electron and characterized by the quantum numbers, n,l and m_1. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. in the mathematical functions given in the table, Z is atomic number, a_0 is Bohr radius.

Column-1	Column-2	Column-3
(I) 1s orbital	(i) $\psi_{n,l,m_1} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) 2s orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) $2p_z$ orbital	(iii) $\psi_{n,l,m_1} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta$	(R) Probability density is maximum at nucleus
(IV) $3d_z^2$ orbital	(iv) xy- plane is a nodal plane	(S) Energy needed to excite electron from $n = 2$ state to $n = 4$ state is $\frac{27}{32}$ times the energy needed to excite electron from $n = 2$ state to $n = 6$ state

Q. For He^+ ion, the only INCORRECT combination is:

A. (II) (ii) (Q)

B. (I) (i) (P)

C. (II) (i) (Q)

D. (I) (i) (S)

Answer: D

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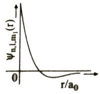
13. The wave function Φ_{n,l,m_1} is a methematical function whose value depends upon shperical upon spherical polar coordinates (r, θ, ϕ) of the electron and characterized by the quantum numbers, n,l and m_1. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. in the mathematical functions given in the table, Z is atomic number, a_0 is Bohr radius.

Column-1	Column-2	Column-3
(I) 1s orbital	(i) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) 2s orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) $2p_z$ orbital	(iii) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta$	(R) Probability density is maximum at nucleus
(IV) $3d_z^2$ orbital	(iv) xy- plane is a nodal plane	(S) Energy needed to excite electron from $n = 2$ state to $n = 4$ state is $\frac{27}{32}$ times the energy needed to excite electron from $n = 2$ state to $n = 6$ state

Q. For hydrogen atom the only CORRECT combination is :

A. (I) (iv) (R)

B. (I) (I) (P)

C. (II) (i) (Q)

D. (I) (i) (S)

Answer: D

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14. The substances which contain species with unpaired electrons in their orbitals behave as paramagnetic sustances. Such substances are weakly attracted by the magnetic field. The paramagnetism is expressed in terms of magnetic moment. The magnetic moment is related to the number of unpaired electrons according tot he following relation:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

where n=number of unpaired electrons.

BM stands for Bohr magneton, a unit of magnetic moment.

$1BM = \frac{eh}{4\pi mc} = 9.27 \times 10^{-24} Am^2$ or JT^{-1}

Q. Which of the following ions has the highest magnetic moment?

A. Fe^{2+}

B. Mn^{2+}

C. Cr^{3+}

D. V^{3+}

Answer: B

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15. The substances which contain species with unpaired electrons in their orbitals behave as paramagnetic sustances. Such substances are weakly attracted by the magnetic field. The paramagnetism is expressed in terms of magnetic moment. The magnetic moment is related to the number of unpaired electrons according tot he following relation:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

where n=number of unpaired electrons.

BM stands for Bohr magneton, a unit of magnetic moment.

$1BM = \frac{eh}{4\pi mc} = 9.27 \times 10^{-24} Am^2$ or JT^{-1}

Q. Which of the following ions has magnetic moment equal to that of Ti^{3+}?

A. Cu^{2+}

B. Ni^{2+}

C. Co^{2+}

D. Fe^{2+}

Answer: A

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16. The substances which contain species with unpaired electrons in their orbitals behave as paramagnetic sustances. Such substances are weakly attracted by the magnetic field. The paramagnetism is expressed in terms of magnetic moment. The magnetic moment is related to the number of unpaired electrons according tot he following relation:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

where n=number of unpaired electrons.

BM stands for Bohr magneton, a unit of magnetic moment.

$1BM = \frac{eh}{4\pi mc} = 9.27 \times 10^{-24} Am^2$ or JT^{-1}

Q. An ion of a d-block element has magnetic moment 5.92 BM. Select the ion among the following:

A. Zn^{2+}

B. Sc^{3+}

C. Mn^{2+}

D. Cr^{3+}

Answer: C

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17. The substances which contain species with unpaired electrons in their orbitals behave as paramagnetic sustances. Such substances are weakly attracted by the magnetic field. The paramagnetism is expressed in terms of magnetic moment. The magnetic moment is related to the number of unpaired electrons according tot he following relation:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

where n=number of unpaired electrons.

BM stands for Bohr magneton, a unit of magnetic moment.

$1BM = \frac{eh}{4\pi mc} = 9.27 \times 10^{-24} Am^2$ or JT^{-1}

Q. In Which of these options do both constituents of the pair have the same magnetic moment?

A. Zn^{2+} and Cu^{+}

B. Co^{2+} and Ni^{2+}

C. Mn^{4+} and Co^{2+}

D. Mg^{2+} and Sc^{+}

Answer: A::C

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18. The substances which contain species with unpaired electrons in their orbitals behave as paramagnetic sustances. Such substances are weakly attracted by the magnetic field. The paramagnetism is expressed in terms of magnetic moment. The magnetic moment is related to the number of unpaired electrons according tot he following relation:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

where n=number of unpaired electrons.

BM stands for Bohr magneton, a unit of magnetic moment.

$1BM = \frac{eh}{4\pi mc} = 9.27 \times 10^{-24} Am^2$ or JT^{-1}

Q. Which of the following ions are diamagnetic?

A. He^{2+}

B. Sc^{3+}

C. Mg^{2+}

D. O^{2-}

Answer: B::C::D

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19. At the suggestion of Earnest Rutherford, hans Geiger and ernest Marsden bombarded a thin gold foil by α-particles from a polonium source. It was expected that α-particles would go right through the foil with hardly any deflection. Although, most of the alpha particles indeed were not deviated by much, a few were scattered through veryi large angles. Some were even scattered in the backward direction. The nly way to explain the results, rutherford found, was to picture an atom as being compoed of a tiny nucleus in which its positive charge and nearly all its mass are concentrated. Scattering of α-particles is proportional to target thickness and is inversely proportional to the fourth power of $\sin\left(\frac{\theta}{2}\right)$, where,$\theta$ is scattering angle. Distance of closest approach may be calculated as:

$$r_{\min} = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 K}$$

where, K=kinetic energy of α-particles.

Q. Rutherford's α-particle scattering led to the conclusion that:

A. mass and energy are related

B. mass and postive charge of an atom are concentrated in the nucleus

C. neutrons are present I the nucleus

D. atoms are electrically neutrally

Answer: B

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20. At the suggestion of Earnest Rutherford, hans Geiger and ernest Marsden bombarded a thin gold foil by α-particles from a polonium source. It was expected that α-particles would go right through the foil with hardly any deflection. Although, most of the alpha particles indeed were not deviated by much, a few were scattered through veryi large angles. Some were even scattered in the backward direction. The nly way to explain the results, rutherford found, was to picture an atom as being compoed of a tiny nucleus in which its positive charge and nearly all its mass are concentrated. Scattering of α-particles is proportional to target thickness and is inversely proportional to the fourth power of $\sin\left(\frac{\theta}{2}\right)$, where,$\theta$ is scattering angle. Distance of closest approach may be calculated as:

$$r_{\min} = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 K}$$

where, K=kinetic energy of α-particles.

Q. From the α-particle scattering experiemnt, rutherfod concluded that:

A. α-particle can approach within a distance of the order of $10^{-14} m$ of the nucleus.

B. the radius of the nucleus is less than 10^{-14}m

C. scattering follows Coulomb's law

D. The positively charged parts of the atom move with extremely high velocities.

Answer: A::B::C

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21. At the suggestion of Earnest Rutherford, hans Geiger and ernest Marsden bombarded a thin gold foil by α-particles from a polonium source. It was expected that α-particles would go right through the foil with hardly any deflection. Although, most of the alpha particles indeed were not deviated by much, a few were scattered through veryi large angles. Some were even scattered in the backward direction. The nly way to explain the results, rutherford found, was to picture an atom as being compoed of a tiny nucleus in which its positive charge and nearly all its mass are concentrated. Scattering of α-particles is proportional to target thickness and is inversely proportional to the fourth power of $\sin\left(\frac{\theta}{2}\right)$, where,$\theta$ is scattering angle. Distance of closest approach may be calculated as:

$$r_{\min} = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 K}$$

where, K=kinetic energy of α-particles.

Q. Rutherford's scattering formula fails for vary small scattering angles because:

A. The gold foil is very thin

B. the kinetic energy of α-particle is very high

C. The full nuclear charge of the target atom is partially screened by its electron

D. There is strong repulsive force between the α-particles and nucleus of the target.

Answer: C::D

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22. At the suggestion of Earnest Rutherford, hans Geiger and ernest Marsden bombarded a thin gold foil by α-particles from a polonium source. It was expected that α-particles would go right through the foil with hardly any deflection. Although, most of the alpha particles indeed were not deviated by much, a few were scattered through veryi large angles. Some were even scattered in the backward direction. The nly way to explain the results, rutherford found, was to picture an atom as being compoed of a tiny nucleus in which its positive charge and nearly all its mass are concentrated. Scattering of α-particles is proportional to target thickness and is inversely proportional to the fourth power of $\sin\left(\frac{\theta}{2}\right)$, where,$\theta$ is scattering angle. Distance of closest approach may be calculated as:

$$r_{\min} = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 K}$$

where, K=kinetic energy of α-particles.

Q. Alpha particles that come closer to the nuclei:

A. are deflected more

B. are deflected less

C. make more collision

D. are slowed down more.

Answer: A

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23. At the suggestion of Earnest Rutherford, hans Geiger and ernest Marsden bombarded a thin gold foil by α-particles from a polonium source. It was expected that α-particles would go right through the foil with hardly any deflection. Although, most of the alpha particles indeed were not deviated by much, a few were scattered through veryi large angles. Some were even scattered in the backward direction. The nly way to explain the results, rutherford found, was to picture an atom as being compoed of a tiny nucleus in which its positive charge and nearly all its mass are concentrated. Scattering of α-particles is proportional to target thickness and is inversely proportional to the fourth power of $\sin\left(\frac{\theta}{2}\right)$, where,$\theta$ is scattering angle. Distance of closest approach may be calculated as:

$$r_{\min} = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 K}$$

where, K=kinetic energy of α-particles.

Q. Which of the following quantities will be zero for alpha particles at the point of closest approach to the gold atom, in Rutherford's scattering of alpha particles?

A. Acceleration

B. Kinetic energy

C. Potential energy

D. Electrical energy

Answer: B

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24. The splitting of spectral lines by a magnetic field is called the zeeman effect after the Dutch physicist Pieter Zeeman. The Zeeman effect is a vivid confirmation of of space quantization. Magnetic quantum number 'm' was introduced during the study of zeeman effect. 'm' can have the (2l+1) values (-l,0,+l). Magnetic quantum number represents the orientation of atomic orbitals in three-dimensional space. the normal zeeman effect consists of the splitting of a spectral line of frequency v_0 into three components i.e.,

$$v_1 = v_0 - \frac{e}{4\pi m}B, v_2 = v_0, V_3 = v_0 + \frac{e}{4\pi m}B$$

Here, B is magnetic field.

Q. Which of the following statements is incorrect with reference to the Zeeman effect?

A. In a magnetic field, the energy of a paritcular atomic state depends on the values of 'm' and 'n'

B. Zeeman effect is used to calculate the e/m ratio for an electron

C. Individual spectral lines split into separate lines. The distance between them is independent of the magnitude of the magnetic field.

D. Individual spectral lines split into seprate lines. The distnace between them is independent of the magnitude of the magnetic field

Answer: B

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25. The splitting of spectral lines by a magnetic field is called the zeeman effect after the Dutch physicist Pieter Zeeman. The Zeeman effect is a vivid confirmation of of space quantization. Magnetic quantum number 'm' was introduced during the study of zeeman effect. 'm' can have the (2l+1) values (-l,0,+l). Magnetic quantum number represents the orientation of atomic orbitals in three-dimensional space. the normal zeeman effect consists of the splitting of a spectral line of frequency v_0 into three components i.e.,

$$v_1 = v_0 - \frac{e}{4\pi m}B, v_2 = v_0, V_3 = v_0 + \frac{e}{4\pi m}B$$

Here, B is magnetic field.

Q. A d-subshell in an atom in the presence and absence of magnetic field is:

A. five-fold degenerate, non-degenerate

B. seven-fold degenerate, non-degenerate

C. five-fold degenerate,five-fold degenerate

D. non-degenerate, five-fold degenerate.

Answer: D

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26. The splitting of spectral lines by a magnetic field is called the zeeman effect after the Dutch physicist Pieter Zeeman. The Zeeman effect is a vivid confirmation of of space quantization. Magnetic quantum number 'm' was introduced during the study of zeeman effect. 'm' can have the (2l+1) values (-l,0,+l). Magnetic quantum number represents the orientation of atomic orbitals in three-dimensional space. the normal zeeman effect consists of the splitting of a spectral line of frequency v_0 into three components i.e.,

$$v_1 = v_0 - \frac{e}{4\pi m}B, v_2 = v_0, V_3 = v_0 + \frac{e}{4\pi m}B$$

Here, B is magnetic field.

Q. Which among the following is/are correct about the orientation of atomic orbitals in space?

A. s-orbitals has single orientation

B. d-subshell orbitals have three orientations along x,y and z directions

C. f-subshell have seven orientations in their orbitals

D. None of the above

Answer: A::C

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27. The splitting of spectral lines by a magnetic field is called the zeeman effect after the Dutch physicist Pieter Zeeman. The Zeeman effect is a vivid confirmation of of space quantization. Magnetic quantum number 'm' was introduced during the study of zeeman effect. 'm' can have the (2l+1) values (-l,0,+l). Magnetic quantum number represents the orientation of atomic orbitals in three-dimensional space. the normal zeeman effect consists of the splitting of a spectral line of frequency v_0 into three components i.e.,

$$v_1 = v_0 - \frac{e}{4\pi m}B, v_2 = v_0, V_3 = v_0 + \frac{e}{4\pi m}B$$

Here, B is magnetic field.

Q. Zeeman effect explains splitting of spectral lines is:

A. Magnetic field

B. electric field

C. both (a) and (b)

D. None of these

Answer: A

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28. The splitting of spectral lines by a magnetic field is called the zeeman effect after the Dutch physicist Pieter Zeeman. The Zeeman effect is a vivid confirmation of of space quantization. Magnetic quantum number 'm' was introduced during the study of zeeman effect. 'm' can have the (2l+1) values (-l,0,+l). Magnetic quantum number represents the orientation of atomic orbitals in three-dimensional space. the normal zeeman effect consists of the splitting of a spectral line of frequency v_0 into three components i.e.,

$$v_1 = v_0 - \frac{e}{4\pi m}B, v_2 = v_0, V_3 = v_0 + \frac{e}{4\pi m}B$$

Here, B is magnetic field.

Q. In presence of magnetic field, d-suborbit is:

A. five-fold degenerate

B. three-fold degenerate

C. seven-fold degenerate

D. non-degenerate

Answer: D

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29. Spin angular momentum of an electron has no analogue in classical mechanics. Howerver, it turns out that the treatment of spin angular momentum is closely analogous to the treatment of orbital angular momentum

Spin angular momentum $= \sqrt{s(s+1)}h$

Orbital angular momentum $= \sqrt{l(l+1)}h$

Total spin of ana tom or ion is a multiple of $\frac{1}{2}$. Spin multiplicity is a factor to confirm the electronic configuration of an atom or ion.

Spin multiplicity $= \left(2\sum s + 1\right)$

Q. Total spin of $Mn^{2+}(Z = 25)$ ion will be:

A. $\frac{3}{2}$

B. $\frac{1}{2}$

C. $\frac{5}{2}$

D. $\frac{7}{2}$

Answer: C

Watch Video Solution

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Q. Which of the following electronic configurations have four spin multiplicity?

A. (a) | ↑ | ↑ | ↑ |

B. (b) | ↑ | ↑ | ↓ |

C. (c) | ↑ | ↓ | ↑ |

D. (d) | ↓ | ↓ | ↓ |

Answer: A

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Spin angular momentum $= \sqrt{s(s+1)}h$

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Total spin of ana tom or ion is a multiple of $\frac{1}{2}$. Spin multiplicity is a factor to confirm the electronic configuration of an atom or ion.

Spin multiplicity $= \left(2\sum s+1\right)$

Q. Which of the following quantum numbers is not derived from schrodinger wave equations?

A. Principal quantum number

B. Azimuthal

C. Magnetic

D. Spin

Answer: D

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Orbital angular momentum $= \sqrt{l(l+1)}h$

Total spin of ana tom or ion is a multiple of $\frac{1}{2}$. Spin multiplicity is a factor to confirm the electronic configuration of an atom or ion.

Spin multiplicity $= \left(2\sum s + 1\right)$

Q. In any subshell, the maximum number of electrons having same value of spin quantum numbers is:

A. $\sqrt{l(l+1)}$

B. $l + 2$

C. $2l + 1$

D. $4l + 2$

Answer: C

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33. Spin angular momentum of an electron has no analogue in classical mechanics. Howerver, it turns out that the treatment of spin angular momentum is closely analogous to the treatment of orbital angular momentum

Spin angular momentum $= \sqrt{s(s+1)}h$

Orbital angular momentum $= \sqrt{l(l+1)}h$

Total spin of ana tom or ion is a multiple of $\frac{1}{2}$. Spin multiplicity is a factor to confirm the electronic configuration of an atom or ion.

Spin multiplicity $= \left(2\sum s+1\right)$

Q. The orbital angular momentum of a 2p-electron is:

A. $\sqrt{3}h$

B. $\sqrt{6}h$

C. zero

D. $\sqrt{2}\frac{h}{2\pi}$

Answer: D

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34. Dual nature of matter was proposed by de Broglie in 1923, it was experimentally verified by Davisson and Germer by diffraction experiment. Wave character of amtter has significance only for microscopic partiles. De Broglie wavelength or wavelength of matter wave can be calculated using the following relation:

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

Where, 'm' and 'v' are te mass and velocity of the particle. de Broglie hypothesis suggested that electron waves were being diffracted by the target, much as X-rays are diffracted by planes of atoms in the crystals.

Q. Planck's constant has same dimension as that of:

A. work

B. energy

C. power

D. angular momentum

Answer: D

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35. Dual nature of matter was proposed by de Broglie in 1923, it was experimentally verified by Davisson and Germer by diffraction experiment. Wave character of amtter has significance only for microscopic partiles. De Broglie wavelength or wavelength of matter wave can be calculated using the following relation:

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Q. Wave nature of electrons is shown by:

A. Photoelectric effect

B. compton effect

C. diffraction experiment

D. stark effect

Answer: C

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Q. de Broglie equation is obtained by combination of which of the following theories?

A. Planck's quantum theory

B. Einstein's theory of mass-energy equivalence.

C. Theory of interference

D. Theory of diffraction.

Answer: A::B

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Where, 'm' and 'v' are te mass and velocity of the particle. de Broglie hypothesis suggested that electron waves were being diffracted by the target, much as X-rays are diffracted by planes of atoms in the crystals.

Q. Which among the following is not used to calculate the de Broglie wavelength?

A. $\lambda = \frac{c}{v}$

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

C. $\lambda = \frac{h}{\sqrt{2Em}}$

D. $\lambda = \frac{h}{\sqrt{2qVm}}$

Answer: A

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38. Dual nature of matter was proposed by de Broglie in 1923, it was experimentally verified by Davisson and Germer by diffraction experiment. Wave character of amtter has significance only for microscopic partiles. De Broglie wavelength or wavelength of matter wave can be calculated using the following relation:

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

Where, 'm' and 'v' are te mass and velocity of the particle. de Broglie hypothesis suggested that electron waves were being diffracted by the target, much as X-rays are diffracted by planes of atoms in the crystals.

Q. The wavelength of matter waves associated with a body of mass 1000 g moving with a velocity of 100 m/sec is:

A. $6.62 \times 10^{-39} cm$

B. $6.62 \times 10^{-36} cm$

C. $6.626 \times 10^{-36} cm$

D. $3.31 \times 10^{-32} cm$

Answer: C

Watch Video Solution

39. Dual nature of matter was proposed by de Broglie in 1923, it was experimentally verified by Davisson and Germer by diffraction experiment. Wave character of amtter has significance only for microscopic partiles.

De Broglie wavelength or wavelength of matter wave can be calculated using the following relation:

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

Where, 'm' and 'v' are te mass and velocity of the particle. de Broglie hypothesis suggested that electron waves were being diffracted by the target, much as X-rays are diffracted by planes of atoms in the crystals.

Q. An electron microscope is used to probe the atomic arrangement to a resolution of 5Å.... What should be the electric potential to which the electrons need to be accelerated?

A. 2.5 V

B. 6V

C. 2.5 kV

D. 5 kV

Answer: B

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40. Orbital is the region in an atom where the probability of finding the electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function Φ. Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since, many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes, except s-orbitals, all other orbitals hae different shapes, except s-orbitals, all other orbital have different shapes, except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to $(n-l-1)$. Orbital angular momentum of an electron is $\sqrt{l(l+1)}h$.

Q. Which of thef ollowing orbitals is not cylinderically symmetrical about z-axis?

A. $3d_{z^2}$

B. $4p_z$

C. $6s$

D. $3d_{yz}$

Answer: D

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41. Orbital is the region in an atom where the probability of finding the electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function Φ. Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since, many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes, except s-orbitals, all other orbitals hae different shapes, except s-orbitals, all other orbital have different shapes, except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to $(n - l - 1)$. Orbital angular momentum of an electron is $\sqrt{l(l+1)}h$.

Q. The nodes present in 5p-orbital are:

A. one planar, five spherical

B. one planar, four spherical

C. one planar, three spheical

D. four spherical

Answer: C

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42. Orbital is the region in an atom where the probability of finding the electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function Φ. Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since, many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes, except s-orbitals, all other orbitals hae different shapes, except s-orbitals, all other orbital have different shapes, except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to $(n - l - 1)$. Orbital angular momentum of an electron is $\sqrt{l(l+1)}h$.

Q. When an atom is placed in a magnetic field, the possible number of orientations for an orbital of azimuthal quantum number 3 is:

A. three

B. one

C. five

D. seven

Answer: D

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43. Orbital is the region in an atom where the probability of finding the electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function Φ. Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since, many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes, except s-orbitals, all other orbitals hae different shapes, except s-orbitals, all other orbital have different shapes, except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to $(n-l-1)$. Orbital angular momentum of an electron is $\sqrt{l(l+1)}h$.

Q. Orbital angular momentum of f-electrons is:

A. $\sqrt{2}h$

B. $\sqrt{3}h$

C. $\sqrt{12}h$

D. $2h$

Answer: C

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44. Orbital is the region in an atom where the probability of finding the electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function Φ. Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since, many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes, except s-orbitals, all other orbitals hae different shapes, except s-orbitals, all other orbital have different shapes, except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to $(n - l - 1)$. Orbital angular momentum of an electron is $\sqrt{l(l+1)}h$.

Q. Which of the following orbitals has/have two nodal planes?

A. d_{xy}

B. d_{yz}

C. $d_{x^2 - y^2}$

D. All of these

Answer: D

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45. 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.

Q. The state S_1 is:

A. 1s

B. 2s

C. 2p

D. 3s

Answer: B

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46. The hydrogen -like species Li^{2+} is in a spherically symmetric state S_1 with one 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 is to the ground state energy of the hydrogen atom.

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

Answer: C

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47. The hydrogen -like species Li^{2+} is in a spherically symmetric state S_1 with one 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 is to the ground state energy of the hydrogen atom.

The orbital angular momentum quantum number of the state S_2 is

A. 0

B. 1

C. 2

D. 3

Answer: B

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48. According to the Bohr model, the energy levels of hydrogen atom can be found by making two assumptions.

(i). The electrons move in circulr orbit and (ii) the angular momentum of the electron in the n^{th} energy level is quantized to have a value $n\frac{h}{2\pi}$. The levels calculated with nuclear charge Ze, with a single electron in the orbit, are called Hydrogenic levels. Assume that the two electrons in the ground state of a helium atom occupy the corresponding lowest Hydrogenic level.

Q. The minimum repulsive energy between the two electrons would then be:

A. 3.4 eV

B. 6.8 eV

C. 13.6 eV

D. 27.2 eV

Answer: D

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49. According to the Bohr model, the energy levels of hydrogen atom can be found by making two assumptions.

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Hydrogenic level.

Q. if the hydrogen atom ionizatioin temperature is T, the temperature at which He atoms ionise completely (both electron having left the atom) would be:

A. 8T

B. 4T

C. 6T

D. 2T

Answer: C

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Self Assement

1. Which one of the following leads to third line of Balmer spectrum from red end (for hydrogen atom)?

A. $2 \rightarrow 5$

B. $5 \rightarrow 2$

C. $3 \rightarrow 2$

D. $4 \rightarrow 1$

Answer: B

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2. The orbital angular momentum and angular momentum (classical analogue) for the electron of 4s-orbital are respectively, equal to:

A. $\sqrt{12}\frac{h}{2\pi}$ and $\frac{h}{2\pi}$

B. zero and $\frac{2h}{\pi}$

C. $\sqrt{6}h$ and $\frac{2h}{2\pi}$

D. $\sqrt{2}\frac{h}{2\pi}$ and $\frac{3h}{2\pi}$

Answer: B

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3. A sample of hydrogen atom is excited to n=4 state. In the spectrum of emitted radiation, the number of lines in the ultraviolet and visible regions are respectively:

A. $3:2$

B. $2:3$

C. $1:3$

D. $3:1$

Answer: A

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4. The numer of waves made by a bohr electron in an orbit of maximum magnetic quantum number +2 is:

A. 1

B. 2

C. 3

D. 4

Answer: C

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5. First line of Lyman series of hydrogen atom occurs at $\lambda = x$Å.... The corresponding line of He^{+} will occur at:

A. 4x

B. 3x

C. x/3

D. x/4

Answer: D

6. Electronic transition in He^+ ion takes from $n_2 \text{ to } n_1$ shell such that :

$2n_2 + 3n_1 = 18$

$2n_2 + 3n_1 = 6$

What will be the total number of photons emitted when electrons transit to n_1 shell?

A. 21

B. 15

C. 20

D. 10

Answer: D

7. Which of the following sets of quantum number is not possible for an electron?

A. $n = 1, l = 0, m_l = 0, m_s = -1/2$

B. $n = 2, l = 1, m_l = 0, m_2 = -1/2$

C. $n = 1, l = 1, m_l = 0, m_s = +1/2$

D. $n = 2, l = 1, m_l = 0, m_s = +1/2$

Answer: C

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8. The average life of a excited state of hydrogen atom is of the order of 10^{-8}sec. the number of revolutions made by an electron when it returns from n=2 to n=1 is:

A. 2.28×10^6

B. 22.8×10^6

C. 8.23×10^6

D. 2.82×10^6

Answer: C

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9. The wave number of a particular spectral line in the atomic spectrum of a hydrogen like species increases 9/4 times when deuterium neuleus is introduced into its nucleus, then which of the following will be the initial hydrogen like species?

A. Li^{2+}

B. Li^{+}

C. He^{+}

D. Be^{3+}.

Answer: D

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10. Energy of electron in the first Bohr orbit of H-ato is -313.6 kcal mol^{-1}, then the energy in second Bohr orbit will be:

A. $+313.6$ kcal mol^{-1}

B. -78.4 kcal mol^{-1}

C. -34.64 kcal mol^{-1}

D. -12.5 kcal mol^{-1}

Answer: B

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11. Which phenomenon best supports the theory that matter has a wave nature?

A. Electron momentum

B. Electron diffraction

C. Photon momentum

D. Photon diffraction.

Answer: B

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12. Which of the following is/are correct?

A. An electron in excited state cannot absorb a photon

B. Energy of electrons depends ony on the principal quantum numbers

C. Energy of electrons depends only on the principal quantum number for hydrogen atom

D. Difference in potential energy of two shell is equal to the difference in kinetic energy of these shells

Answer: A::C::D

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13. Which of the following statements is/are correct?

A. Energy of 4s,4p,4d and 4f are same for hydroen

B. Angular momentum of electron $= I\omega$

C. For all values of 'n'. The p-orbitals have the same shape

D. Orbital angular momentum $= nh/2\pi$

Answer: A::B::C

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14. Which of the following orbitals are associated with angular nodes?

A. f

B. d

C. p

D. s

Answer: A::B::C

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15. The correct statement(s) among the following is/are:

A. All d-orbitals except d_{z^2} have two angular nodes.

B. $d_{x^2y^2}, d_{z^2}$ lie on the axes.

C. The degeneracy of p-orbitals remains unaffected in the presence of external magnetic field.

D. d-orbitals have 3-fold degeneracy.

Answer: A::B::C

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16. Statement-1: Kinetic energy of photoelectrons increases with increases in the frequency of incident radiation

Statement-2: The number of photoelectrons ejected increases with increases in intensity of incident radiation.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false.

D. Statement-1 is false, statement-2 is true.

Answer: D

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17. Statement-1: Photoelectric effect is easily pronounced by caesium metal.

Statement-2: Photoelectric effect is easily pronounced by the metals having high ionization energy.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false.

D. Statement-1 is false, statement-2 is true.

Answer: C

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18. Statement-1: Electrons in K-shell revolve in circular orbit.

Staement-2: Principal quantum nubmer 'n' is equal to 1 for the electrons in K-shell.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false.

D. Statement-1 is false, statement-2 is true.

Answer: B

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19. Statement-1: Orbit and orbital are synonymous.

Staetment-2: Orbit is the path around the nucleus is which electron revolves.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false.

D. Statement-1 is false, statement-2 is true.

Answer: D

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20. Statement-1: Cesium is useful as electrodes in photoelectric cells.

Statement-2: Light energy absorbed by cesium is sufficient to make an atom of cesium to lose an electron.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false.

D. Statement-1 is false, statement-2 is true.

Answer: B

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Integer Answer Type Questions

1. How many nodes are there in 5f orbitals?

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2. What is the principal quantum number of shell to which f-subshell first appear?

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3. How many Balmer spectral lines will be obtained when the excited electrons return from 8th shell to 2nd shell?

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4. A chemist was performing an experiment to study the effect of varying voltage on the velocity and de Broglie wavelength of the electrons. In first experiment, the electron was accelerated through a potential difference of 1kV and in second experiment, it was accelerated through a potential difference of 2kV.

The wavelength of de Broglie waves associated with electron is given by:

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

where, V is the voltage through which an electron is accelerated.

Putting the values of h, m and q we get:

$$\lambda = \frac{12.3}{\sqrt{V}} \text{Ã…}$$

Q. The wavelength of electron will be:

A. 1.4 times in first case than in second case

B. 1.4 times in second case than in first case

C. double in second case than in first case

D. double in first case than in second case

Answer: a

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5. A chemist was performing an experiment to study the effect of varying voltage on the velocity and de Broglie wavelength of the electrons. In first experiment, the electron was accelerated through a potential difference of 1kV and in second experiment, it was accelerated through a potential difference of 2kV.

The wavelength of de Broglie waves associated with electron is given by:

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

where, V is the voltage through which an electron is accelerated.

Putting the values of h, m and q we get:

$$\lambda = \frac{12.3}{\sqrt{V}} \text{Ã...}$$

Q. In order to get half velocity of electrons in second case, the applied potential will be:

A. 0.25 kV

B. 2 kV

C. 0.5 kV

D. 0.75 kV

Answer: a

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6. A chemist was performing an experiment to study the effect of varying voltage on the velocity and de Broglie wavelength of the electrons. In first experiment, the electron was accelerated through a potential difference of 1kV and in second experiment, it was accelerated through a potential difference of 2kV.

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Q. The velocity of electron will be:

A. same in both

B. 1.4 times in second experiment than in first experiment

C. double in second experiment than in first experiment

D. four tiems in the second case than in first case.

Answer: b

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