CHEMISTRY

ALLEN

ATOMIC STRUCTURE

Solved Example

1. If no. of protons in X^{-2} is 16. Then no. of e^{-} in X^{+2} will be-

A. 14

B. 16

C. 18

D. None

Answer:

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2. In C^{12} atom if mass of e^- is doubled and mass of proton is halved, then calculate the percentage change in mass no. of C^{12}

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3. Assuming that atomic weight of C^{12} is 150 unit from atmic table, then according to this assumption, the weight of O^{16} will be:-

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4. An α-particle having $K.E. = 7.7MeV$ is scattered by gold $(z = 79)$ nucleus through 180° Find distance of closet approach.

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5. A particular radiostation broadcasts at a frequency of 1120 Kilo Hertz another radio station broadcasts at a frequency of 98.7 mega Hertz. What are the wave length of radiations from each station?

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6. How long would it take a radio wave of frequency $6 \times 10^3 \sec^{-1}$ to travel from mars to the earth, a distance of $8 \times 10^7 km$?

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7. At the closest approach, the distance between Mars and Earth is found to be 58 million km. When planets are at this closest distance, how long would it take to send a radio message from a space probe of mars to earth?

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8. A sodium street light gives off yellow light that has a wavelength of $589nm$. What is the frequency of this light?

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9. the vividh bharati station of All india Radio, Delhi , broadcasts on a frequency of 1,368 kHz (kilo hertz). Calculate the wavelength of the electromagnetic radiation emitted by transmitter . Which part of the electromagnetic spectrum does it belong to

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10. A near ultra violet photon of wavelength $300nm$ is absorbed by a gas and then emitted as two photons. One photons is of red light with wavelength $760nm$. What would be the wave length of the second photon?

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11. Calculate the frequency $\&$ energy of a photon of wave length $4000A$.

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12. How many photons of lights having a wave length of $5000A$ are necessary to provide 1 Joule of energy?

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13. A photon of wavelenth 3000 A strikes a metal surface, the work function of the metal being $2.20eV$. Calculate (i) the energy of the photon in $eV(ii)$ the kinetic energy of the emitted photo electron and (iii) the velocity of the photo electron.

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14. Photoelectrons are liberated by ultra light of wavelength 2000Å from a metallic surface for which the photoelectric threshold is 4000Å. Calculate the de Broglie wavelenth of electrons emitted with maximum kinetic energy.

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15. What does the negative electronic energy (negative sign for all values of energy) for hydrogen atom means?

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16. Calculate the radius of 1^{st}, 2^{nd}, 3^{rd}, 4^{th} Bohr's Orbit of hydrogen.

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17. Calculate the radius ratio of $3^{rd}\&5^{th}$ orbit of He^{+}.

$r = 0.529 \times \frac{n^2}{Z}\text{Å}$

At. Number of of He $= 2$

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18. Calculate the radius ratio of 2^{nd} orbit of hydrogen and 3^{rd} orbit of Li^{+2}

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19. The ratio of the radius of two Bohr's orbit of Li^{+2} is $1:9$. What would be their nomenclature.

A. $K\&L$

B. $L\&M$

C. $K\&M$

D. $K\&N$

Answer:

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20. Calculate the radius of 2^{nd} excited state of Li^{+2}

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21. Calculate the radius ratio of 2^{nd} excited state of $H\&1^{st}$ excited state of Li^{+2}.

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22. Calculate the energy of Li^{+2} atom for 2^{nd} excited state.

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23. Calculate the ratio of energies of He^+ for $1^{st}\&2^{nd}$ excited state.

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24. If the $P.E.$ of an electron is $-68eV$ in hydrogen atom then find out $K.E.$, E of orbit where electron exist $\&$ radius of orbit.

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25. The ionization energy for the hydrogen atom is $13.6eV$ then calculate the required energy in eV to excite it from the ground state to 1^{st} excited state.

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26. If the total energy of an electron is $-1.51eV$ in hydrogen atom then find out $K.E, P.E.$, orbit radius and velocity of the electron in that

orbit.

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27. Calculate the velocity of an electron placed in the 3^{rd} orbit of the Li^{2+} ion. Also calculate the number of revolution per second that it makes around the nucleous.

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28. In a hydrogen spectum if electron moves from 7 to 1 orbit by transition in multi steps then find out the total number of lines in the spectum.

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29. In a hydrogen spectum if electron moves from 6^{th} to 2^{nd} by transition in multi steps then find out the number of lines in spectum

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30. In a hydrogen spectum if electron moves from 6^{th} to 2^{nd} by transition in multi steps then find out the number of lines in spectum

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31. In Balmer series of H atom spectrum, which electronic transitions represents 3^{rd} line?

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32. What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from the energy level with $n = 4$ to the energy level with $n = 1$?

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33. Calculate the wavelength of the first and the last line in the Balmer series of hydrogen spectrum?

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34. Calculate the de Broglie wavelength of a ball of mass $0.1kg$ moving with a speed of $30ms^{-1}$

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35. The mass of a particle is $1mg$ and its velocity is $4.5 \times 10^5 cm$ per second. What should be the wavelength of this particle if $h = 6.652 \times 10^{-27}$ erg second.

A. $1.4722 \times 10^{-24} cm$

B. $1.4722 \times 10^{-29} cm$

C. $1.4722 \times 10^{-32} cm$

D. $1.4722 \times 10^{-34} cm$

Answer:

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36. Which of the following should be the wavelength of an electron if its mass is $9.1 \times 10^{-31} kg$ and its velocity is $1/10$ of that of light and the value of h is 6.6252×10^{-24} joule second?

A. 2.446×10^{-7} metre

B. 2.246×10^{-9} metre

C. 2.246×10^{-11} metre

D. 2.246×10^{-13} metre

Answer:

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37. What should be the momentum (in gram cm per second) of a particle if its De Broglie wavelength is 1Å and the value of h is 6.6252×10^{-27} erg second?

A. 6.6252×10^{-19}

B. 6.6252×10^{-21}

C. 6.6252×10^{-24}

D. 6.6252×10^{-27}

Answer:

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38. What should be the mass of the sodium photon if its wavelength is 5894Å, the velocity of light is 3×10^{8} metre//second and the value of h is $6.6252 \times 10^{-34} kgm^2 / \text{sec.}$?

A. 3.746×10^{-26}

B. 3.746×10^{-30}

C. 3.746×10^{-34}

D. 3.746×10^{-36}

Answer:

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39. Calculate de-Broglie wavelength when e^- is accelerated by the following voltage.

(i) $750V$ (ii) 300 volt

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40. Find de-Broglie wavelength of electron with $KE = 9.6 \times 10^{-19} J$.

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41. What is a particle or matter wave and how it is different from electro-megnetic wave?

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42. Why electron cannot exist inside the nucleous according to heisnberg's uncertainty principle ?

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43. The uncertainty in the momentum of a particle is $6 \times 10^{-9} kgms^{-1}$. Calculate the uncertainty in its position.

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44. A golf ball has a mass of 40 g , and a speed of 45m/s. if the speed can be measured with in accuracy of 2 % . Calculate the uncertainty in the

position .

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45. Calculate the uncertainty in velocity of a cricket ball (mass = 0.15 kg) if its uncertainty in position is of the order of 1Å

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46. Compare Schrodinger equation with most important equation of Newtions law.

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}=-(E-V)\frac{8\pi^2 m}{h}\psi \quad \text{Schrodinger equation....}(i$$

$$m\frac{d^2x}{dt^2}=Fm \quad \text{Newton's law} \quad \ldots.(ii)$$

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47. Find the distance at which probability of finding electron is maximum for $1s$ orbital in a He atom. The wave function orbital given as.

$$\psi_{1s} = \frac{4}{a_0^{3/2}} e^{\frac{2r}{a_0}}$$

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48. Consider ψ (wave function) of $2s$ atomic orbital of H-atom is-

$$\psi_{2s} = \frac{1}{4\sqrt{2\pi a_0^{3/2}}} \left[2 - \frac{r}{a_0}\right] e^{\cdot \frac{r}{2a_0}}$$

Find distance of radial node from nucleous in terms of a_0

A. $r = a_0$

B. $r = 2a_0$

C. $r = a_0$

D. data insufficient

Answer:

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

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

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

The radial node of orbital is at distance from nucleous.

A. 0.529Å

B. 2.12Å

C. 1.06Å

D. 0.423Å

Answer:

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50. For 2s orbital , $\Psi_r = \frac{1}{\sqrt{8}}\left(\frac{z}{a_0}\right)^{\frac{3}{2}}\left(2-\frac{zr}{a_0}\right)e^{\frac{zr}{2a_0}}$ then , hydrogen radial node will be at the distant of

A. $2s$

B. $3p$

C. $2p$

D. $3d$

Answer: A::B

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51. $\psi_{1s} = \frac{1}{\sqrt{\pi a_0^{3/2}}} e^{\frac{r}{a_0}}$

Find the distance r from nucleous at which e^- finding probability is max.

[For H-atom]$a_0 \rightarrow I$ Bohr radius

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52. The number of radial nodes and angular nodes for d-orbital can be represented as

A. zero,zero

B. $0, 2$

C. $2, 0$

D. $2, 1$

Answer: C

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53. According to qauntum mechanical model of H-like species, and electron can be represented by a wave function (ψ) which contain all dynamic information about the electron. The nature of wave function depends on the type of the orbital to which the electron belongs. For an orbital

$$\psi = \left[\frac{\sqrt{2}}{81\sqrt{3\pi}}\right]\left(\frac{1}{a_0}\right)^{3/2}(27 - 18\sigma + 2\sigma^2)e^{\frac{\sigma}{3}}$$

Where, $\sigma = \left(\frac{Zr}{a_0}\right)$, r = radial distance from nucleous, $a_0 = 52.9 \pm$

The orbital could possibly be

A. $4s$

B. $4p$

C. $3s$

D. $3p$

Answer: C

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54. For a 3s-orbital

$$\Phi(3s) = \frac{1}{a\sqrt{3}}\left(\frac{1}{a_0}\right)^{3/2}\left(6 - 6\sigma + \sigma^2\right) \in^{-\sigma/2}$$

where $\sigma = \frac{2rZ}{3a_\sigma}$

What is the maximum radial distance of node from nucleus?

A. $r = \frac{1}{2}\left(3 + \sqrt{3}\right)a_0$

B. $r = \frac{1}{2}\left(3 - \sqrt{3}\right)a_0$

C. $r = \frac{3}{2}\left(3 - \sqrt{6}\right)a_0$

D. $r = \frac{3}{2}(3+\sqrt{3})a_0$

Answer: D

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55. How many sub-shell are there in N shell? How many orbitals are there in d sub-shell?

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56. A wave function for an atomic orbital is given as $\Psi_{2,1,0}$ Recogine the orbital

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57. State which of the following sets of quantum number would be possible and which would not be permisible for an electron in an atom.

(i) $n = 3, I = 3, m_l = +3, m_s = +\frac{1}{2}$

(ii) $n = 3, I = 3, m_l = +1, m_s = -\frac{1}{2}$

(iii) $n = 5, I = 4, m_l = +3, m_s = (1)$

(iv) $n = 0, I = 0, m_l = 0, m_s = +\frac{1}{2}$

(v) $n = 4, I = 3, m_l = -2, m_s = -\frac{1}{2}$

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58. Give the sets of quantum number that describe an electron in a $3p$ orbital

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59. What is the maximum number of electrons that can be accommodated :

(i) in the shell with $n = 3$

(ii) in the subshell with $I = 3$

(iii) in the orbital with $m_I = +3$

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60. Which pf the following orbitals are not possible?

$2d$, $4f$, $4g$ and $6d$

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61. A electron can exist in bound system as well as an independent particle. Which quantum number is always associated with an electron ?

A. s

B. l

C. m

D. n

Answer: A

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62. What are the possible values of l for an electron with $n = 3$?

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63. What are the possible values of m_l for an electron with $l = 2$?

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64. What are possible values of m_s for an electron with $m_l = 0$?

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65. Explain the origin of term magnetic quantum number ?

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66. Explain the origin of term magnetic quantum number ?

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67. What is the angular momentum of an electron in $3P$ orbital.

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68. What is spin angular momentum of an electron.

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69. The angular momentum of electron in 3d orbital of an atom is

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

B. $\sqrt{5}\frac{h}{2\pi}$

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

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

Answer: A::B::D

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70. What will be the orbital angular momentum of an electron in 2s-orbital?

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

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

C. 0

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

Answer: A::B::C::D

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71. Match the column :

	Column-I (Quantum, no. of mono electron atom)		Column-II (Quantisation of)
(A)	n	(P)	magnitude of orbital a
(B)	l	(Q)	energy & position
(C)	m	(R)	magnetic & direction
(D)	s	(S)	direction of orbital ang

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72. What are the possible set of quantum number for highest energy electron (in ground state) for chlorine atom.

	n	l	m
(A)	2	0	0
(B)	2	1	-2
(C)	3	1	2
(D)	3	1	0

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73. The electrons, identified by quantum number n and l

i. $n = 4, l = 1$ ii. $n = 4, l = 0$ iii. $n = 3, l = 2$ iv. $n = 3, l = 1$

Can be palced in the order of increasing energy from the lowest to highest,its

A. $(iv) < (ii) < (iii) < (i)$

B. $(ii) < (iv) < (i)$

C. $(i) < (iii) < (ii) < (iv)$

D. $(iii) < (i) < (iv) < (ii)$

Answer: A

Apply Aufbau priciple :

(i) The orbital with lowest value of $(n + l)$ **have lowest energy.**

(ii) If $n + l$ **value for two orbitals are same, the orbital with lower value of** n **is having lower energy.**

for $(i) n + l = 5$

$(ii) n + l = 4$

$(iii) n + l = 5$

$(iv) n + l = 4$

for (iii) **and** $(iv) n$ **is lower hence correct order is** $(iv) < (ii) < (iii) < (i)$

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74. A compound of vanadium has a magnetic moment of $1.73BM$. Work out the electronic configuration of vanadium in the compound

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75. Calculate distance of closet approach by an α-particle of $KE = 2.5MeV$ being scattered by gold nucleus $(Z = 79)$.

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76. (a) Calculate KE of photoelectron emiited from sodium surface when light of wavelength $400nm$ is incident on it (Work function of sodium $= 2.28eV$).

(b) Calculate maximum wavelength (threshold wavelength) that can cause emission of photoelectron from sodim surface.

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77. $0.24eV$ of energy is required to stop photoelectron emitted by radiation of wavelength 2480Å. Find work function of metal used?

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78. Calculate no. of photons emitted by $60W$ bulb in 10 hours that produces light of wavelength 6.626Å

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79. What maximum wavelength is required for a photon to dissociate : $X_2(g) \rightarrow 2X(g)$ if bond energy of $X - X$ bond is $240kJ/mol$?

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80. O_2 undergoes photochemical dissociation into one normal oxygen atom and one excited oxygen atom. Excited oxygen atom is $1.967eV$

more energetic than normal . The dissociation of O_2 into two normal atoms of oxygen required $498kJmol^{-1}$, what is the maximum wavelength effective for photochemical dissociation of O_2?

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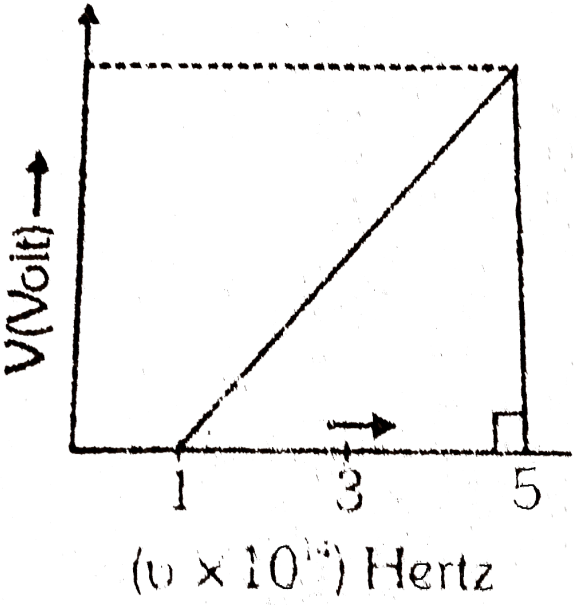
81. Stopping potential [V volts] is plotted against frequancy of light used $[\rightarrow]$.

Find work function (eV)



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82. A light source of power 16 watts emits light of wavelength $310nm$. If all emitted photons are made to strike a metal plate of work function $1.5eV$ then find out the magnetic of photo-current if $50\,\%$ of incident photons eject photoelectrons.

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83. A vessel contains X moles of $H(g)$ at P atm & T.K. If radiation is used to excite these H-atoms from ground state to nth excited state find total energy (in joules) required in form of radiations?

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84. Photons of wavelength λ are made incident on sample of diatomic gas X_2. If bond energy of $X-X$ bond is $EkJmol^{-1}$:

(a) Find critical value of 'λ' so as break $X-X$ bond

(b) Assuming photons posses more energy than required to break the

$X - X$ bond, what X-then would be the KE per $X(g)$ atom after the bond is broken ?

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85. The period of revolution of an electron in the ground state of hydrogen atom is T. The period of revolution of the electron in the first excited state is

A. $n_{rev} \propto \frac{Z^2}{n^3}$

B. $n_{rev} = \frac{1}{T}$

C. $T \propto \frac{n^3}{Z^2}$

D. All of these

Answer:

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86. Find radius

(A) 1^{st} Bohr orbit of H-atom

(B) 2^{nd} shell of Li^{+2} ion $(Z = 3)$

(C) M shell of He^{+} ion $(Z = 2)$

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87. Find ratio of radius of 2^{nd} orbit of He^{+} ion $\&3^{rd}$ orbit of Be^{+3} ion.

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88. Find ratio of velocities of electrons in 2^{nd} excited state of Li^{+2} ion $\&3^{rd}$ excited state of H-atom.

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89. Find total energy, $PE\&KE$ of electron in :

(A) 2^{nd} orbit of He^{+} ion.

(B) 1^{st} excited state of Be^{+3} ion.

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90. An excited He^{+} ion emits photon of wavelength λ in returning to ground state from n^{th} orbit. If R is Rydberg's constant then :

A. $n = \sqrt{\frac{4\lambda R}{4\lambda R - 1}}$

B. $n = \sqrt{\frac{4\lambda R}{4\lambda R + 1}}$

C. $n = \sqrt{\frac{4\lambda R - 1}{4\lambda R}}$

D. $n = \sqrt{\frac{4\lambda R + 1}{4\lambda R}}$

Answer:

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91. How many unique spectral lines are emitted when e^- returns from n_2^{th} orbit to n_1^{th} orbit in a sample of H-like species ?

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92. If electrons in H-likes species jump, from n_3 to n_1 emitting photon of wavelength λ, from n_3 to intermediate orbit $n_2[n_3 > n_2 > n_1]$ emits photon with wavelength λ_1 & from n_2 to n_1 emits photon with wavelength λ_2 then correct option is :

A. $\lambda = \lambda_1 + \lambda_2$

B. $\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

C. $\lambda = \frac{\lambda_1 - \lambda_2}{\lambda_1 \lambda_2}$

D. None of these

Answer:

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93. Find wavelength of 1^{st} line of Paschen series of hydrogen spectrum.

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94. If shortest wavelength of H-atom in Balmer series is X then

(i) What is the shortest wave length in Lyman series.

(ii) What is the longest wave length in Paschen series.

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

(a) Find atmoic number (z) of element

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

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

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96. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?

A. $He^{+}(n=2)$

B. $Li^{2+}(n=2)$

C. $Li^{2+}(n=3)$

D. $Be^{3+}(n=2)$

Answer: D

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97. Find the wavelength of light emitted when an electron drops from $n=3$ level to ground state in He^{+} ion Given Rydberg constant $=10^{7}m^{-1}$

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98. The maximum number of electron that can be accommodated in 4^{th} shell is.

A. 8

B. 16

C. 32

D. 50

Answer:

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99. Write the electronic configuration whose atomic number are $6, 16, 26, 36, 56.$

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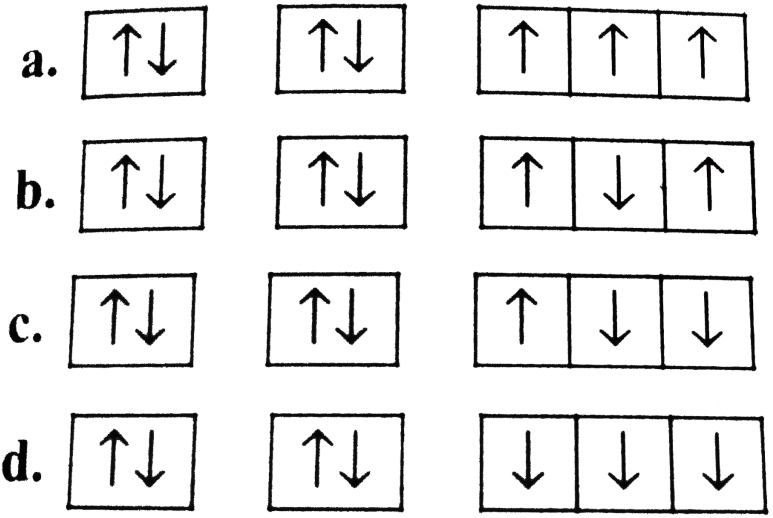
100. The less ground state electronic configeration of nitrogen atom can be represented by



A. ↑ ↓ ↑ ↓ ↑ ↑ ↑

B. ↑ ↓ ↑ ↓ ↑ ↑ ↓

C. ↑ ↓ ↑ ↓ ↑ ↓ ↑

D. ↑ ↓ ↑ ↓ ↓ ↓ ↓

Answer: A::D

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101. What is the electronic configuration of Cu^{+} ion

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102. Which of the following violates the Pauli exclusion principle :-

A. ↑ ↓ ↑ ↓

B. ↑ ↓ ↑ ↓ ↑

C. ↑ ↑ ↑ ↑ ↑

D. ↑ ↑ ↑ ↑

Answer: C

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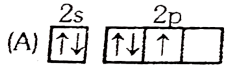
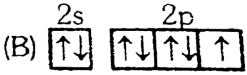
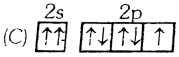
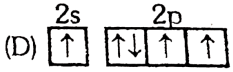
103. Which of the following violates the Aufbau principal ?

A. (A) 

B. (B) 

C. 

D. (D) 

Answer: D

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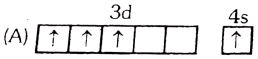
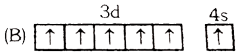
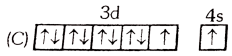
104. Which of the following electronic configuration have the highest exchange energy :-

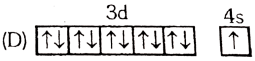
A. (A) 

B. (B) 

C.



D.



Answer: D

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105. Predict total spin for each configuration :

(A) $1s^2$ $(B)1s^2, 2s^2, 2p^6$

(C) $1s^2, 2s^2, 2p^5$ $(D)1s^2, 2s^2, 2p^3$

(E) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$

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106. Calculate wavelength :

(a) of electron moving with velocity of $10^3 m/\sec$

(b) of cricket ball moving with velocity of $10^3 m/\sec$ having mass $0.5 kg$

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107. If uncertainity in position of electron is 0.33pm. What will be uncertanity in its velocity ?

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

A. The electronic configuration of Cr is $[Ar]3d^5, 4s^1$ (Atomic No. of $Cr = 24$)

B. The magnetic quantum number may have a negative value

C. In silver atom 23 electrons have spin of one type and 24 of the opposite type (Atomic No. of Ag =47)

D. The oxidation state of nitrogen in HN_3 is $-1/3$

Answer:

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109. Many elements have non-integral atomic masses because

A. they have isotopes

B. their isotopes have non-intergral masses

C. their isotopes have different masses

D. the constituents, neutrons, protons and electrons combine to give rational masses

Answer:

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Exercise 01

1. Element having no neutron is

A. hydrogen

B. nitrogen

C. helium

D. boron

Answer: A

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2. The particles present in the nucleus of an atom are-

A. the proton and the electron

B. the electron and the neutron

C. the proton and the neutron

D. none of these

Answer: C

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3. The fraction of volume occupied by the nucleus with respect to the total volume of an atom is.

A. 10^{-15}

B. 10^{-5}

C. 10^{-30}

D. 10^{-10}

Answer: A

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4. Which of the following is iso-electronic with neon-

A. O^{2-}

B. F^{+}

C. Mg

D. Na

Answer: A

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5. The approximate size of the nucleus of ${}_{28}^{64}Ni$ is :

A. $3fm$

B. $4fm$

C. $5fm$

D. $2fm$

Answer: C

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6. Which is true about an electron-

A. rest mass of electron is $9.1 \times 10^{-28}g$

B. mass of electron increases with the increase in velocity

C. molar mass of electron is $5.48 \times 10^{-4} g/\text{mole}$

D. e/m of electron is $1.7 \times 10^{8} \text{coulomb}/g$

Answer: A::B::C::D

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

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

B. $._{33}^{77}As$

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

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

Answer: B::D

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8. When alpha particle are sent through a thin metal foil ,most of them go straight through the foil because

A. alpha particle are much heavier than electrons

B. alpha particles are positively charged

C. most part of the atom is empty space

D. alpha particle move with high speed

Answer: A::C

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9. Many elements have non-integral atomic masses, because:

A. they have isotopes

B. their isotopes have non-intergral masses

C. their isotopes have different masses

D. the constituents, neutrons, protons and electrons combine to give rational masses

Answer: A::C

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10. The MRI (magnetic resonance imaging) body scanners used in hospitals operate with $400MHz$ radio frequency. The wavelength corresponding to this radio frequency is.

A. $0.75m$

B. $0.75cm$

C. $1.5m$

D. $2m$

Answer: A

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11. Photon of which light has maximum energy :

A. Red

B. Blue

C. Violet

D. Green

Answer: C

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

A. 5×10^{-18}

B. 4×10^{1}

C. 3×10^{7}

D. 2×10^{-25}

Answer: B

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13. Bohr's theory is not applicable to-

A. He

B. Li^{2+}

C. He^{2+}

D. the H-atom

Answer: A::B

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14. What is likely to be principal quantum number for a circular orbit of diameter $20nm$ of the hydrogen atom if we assume Bohr orbit be the same as that represented by the principal quantum number?

A. 10

B. 14

C. 12

D. 16

Answer: B

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15. 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

Answer: B

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16. If the value of $E = -78.4\text{kcal}//\text{mol}$, the order of the orbit in hydrogen atom is-

A. 4

B. 3

C. 2

D. 1

Answer: C

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17. If velocity of an electron in 1st orbit of H atoms is V , what will be the velocity in 3rd orbit of Li^{2+} ?

A. V

B. $V/3$

C. $3V$

D. $9V$

Answer: A

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18. In a certain electronic transition in the hydrogen atoms from an initial state (1) to a final state (2), the difference in the orbit radius $((r_1 - r_2)$ is 24 times the first Bohr radius. Identify the transition-

A. $5 \rightarrow 1$

B. $25 \rightarrow 1$

C. $8 \rightarrow 3$

D. $7 \rightarrow 5$

Answer: A

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19. Match the following -

(a)	Energy of ground state of He^+	(i)	$-6.04eV$
(b)	Potential energy of I orbit of H-atom	(ii)	$-27.2eV$
(c)	Kinetic energy off II excited state of He^+	(iii)	$8.7 \times 10^{-18}J$
(d)	Ionisation pottential of He^+	(iv)	$-54.4eV$

A. $A-(i), B-(ii), C-(iii), D-(iv)$

B. $A-(iv), B-(iii), C-(ii), D-(i)$

C. $A-(iv), B-(ii), C-(i), D-(iii)$

D. $A-(ii), B-(iii), C-(i), D-(iv)$

Answer: C

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20. The energy of 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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21. Total no of lines in Lyman series of H spectrum will be-

(where n=no. of orbits)

A. n

B. $n - 1$

C. $n-2$

D. $n(n+1)$

Answer: B

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22. The spectrum of He is expected to be similar to.

A. Li^{+}

B. He

C. H

D. Na

Answer: C

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23. What possibly can be the ratio of the de Broglie wavelength for two electrons each having zero initial energy and accelerated through 50 volts and 200 volts?

A. $3:10$

B. $10:3$

C. $1:2$

D. $2:1$

Answer: D

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24. The uncertainty in momentum of an electron is $1 \times 10^{-5} kg - m/s$. The uncertainty in its position will be $\left(h = 6.62 \times 10^{-34} kg = m^2/s\right)$.

A. $1.05 \times 10^{-28} m$

B. $1.05 \times 10^{-26} m$

C. $5.27 \times 10^{-30} m$

D. $5.25 \times 10^{-28} m$

Answer: C

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25. An $\alpha -$ particle is accelerated through a potential difference of V volts from rest. The de-Broglie's wavelengths associated with it is.

A. $\sqrt{\frac{150}{V}} A^{\circ}$

B. $\frac{0.286}{\sqrt{V}} A^{\circ}$

C. $\frac{0.101}{\sqrt{V}} A^{\circ}$

D. $\frac{0.983}{\sqrt{V}} A^{\circ}$

Answer: C

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26. The orbital with zero orbital angular momentum is.

A. s

B. p

C. d

D. f

Answer: A

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27. Which of the following is electronic configuration of $Cu^{2+}(Z = 29)$?

A. $[Ar]4s^1 3d^8$

B. $[Ar]4s^2 3d^{10} 4p^1$

C. $[Ar]4s^1 3d^{10}$

D. $[Ar]3d^9$

Answer: D

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28. The electronic configuration of the Mn^{4+} ion is -

A. $3d^4 4s^0$

B. $3d^2 4s^1$

C. $3d^1 4s^2$

D. $3d^3 4s^0$

Answer: D

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29. Which of the following has the maximum number of unpaired d-electron?

A. Zn^{2+}

B. Fe^{2+}

C. Ni^{3+}

D. Cu^{+}

Answer: B

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30. The total spin resulting from a d^7 configuration is :

A. 1

B. 2

C. $5/2$

D. $3/2$

Answer: D

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31.

Given	K	L	M	N
	2	8	11	2

The number of electrons present in $l = 2$ is -

A. 3

B. 6

C. 5

D. 4

Answer: A

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32. The configuration is $1s^2 2s^2 2p^5\ 3s^1$ shows :

A. ground state of the fluorine atom

B. excited state of the fluorine atom

C. excited state of the neon atom

D. excited state of O_2^- ion

Answer: C

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33. The possible value of l and m for the last electron in the $Cl^- ion$ are :

A. 1 and 2

B. 2 and $+1$

C. 3 and -1

D. 1 and -1

Answer: D

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34. In which transition, one quantum of energy is emitted -

A. $n = 4 \rightarrow n = 2$

B. $n = 3 \rightarrow n = 1$

C. $n = 4 \rightarrow n = 1$

D. $n = 2 \rightarrow n = 1$

Answer: A::B::C::D

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35. Chose the currect on the basis of Bohr's theory

A. Velocity of electron $\propto \frac{1}{n}$

B. frequancy of revolution $\propto \frac{Z^2}{n^3}$

C. radius of orbit $\propto n^2 Z$

D. force on electron $\propto \frac{Z^3}{n^4}$

Answer: A::B::D

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36. The mangnitue of spin angular momentum of electron is givenby :

A. $S = \sqrt{s(s+1)}\,\frac{h}{2\pi}$

B. $S = s\frac{h}{2\pi}$

C. $S = \frac{\sqrt{3}}{2} \times \frac{h}{2\pi}$

D. $S = \pm\frac{1}{2} \times \frac{h}{2\pi}$

Answer: A::C

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37. The change in orbital angular momentum corresponding to an electron transition inside a hydrogen atom can be-

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

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

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

D. $\frac{h}{8\pi}$

Answer: B::C

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38. In which of these options do both consituents 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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Exercise 02

1. The maximum energy is present in any electron at

A. Nucleus

B. Ground state

C. First excited state

D. Infinite distance from the nucleus

Answer: D

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2. Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon?

A. $3s$

B. $2P$

C. $2S$

D. $1S$

Answer: D

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3. The third in Balmer series corresponds to an electronic transition between which Bohr's orbits in hydrogen

A. $5 \rightarrow 3$

B. $5 \rightarrow 2$

C. $4 \rightarrow 3$

D. $4 \rightarrow 2$

Answer: B

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4. The correct set of four quantum numbers for the valence elections of rubidium atom (Z= 37) is:

A. $5.0.0. \ +\frac{1}{2}$

B. $5.1.0. \ +\frac{1}{2}$

C. $5.1.1. \ +\frac{1}{2}$

D. $6.0.0. \ +\frac{1}{2}$

Answer: A

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

A. $\overset{2s}{\uparrow\downarrow}\ \overset{2p_x}{\uparrow\downarrow}.\ \overset{2p_y}{\uparrow}.\ \overset{2P_z}{\downarrow}$

B. . $\overset{2s}{\uparrow}\ \overset{2p_x}{\uparrow\downarrow}.\ \overset{2p_y}{\uparrow}.\ \overset{2P_z}{\uparrow}$

C. $\overset{2s}{\uparrow\downarrow}.\ \overset{2p_x}{\uparrow}.\ \overset{2p_y}{\uparrow}.\ \overset{2P_z}{\uparrow}$

D. $\overset{2s}{\uparrow\downarrow}\ \overset{2p_x}{\uparrow\downarrow}\ \overset{2p_y}{\uparrow\downarrow}.\ \overset{2P_z}{\uparrow}$

Answer: B

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6. The total number of neutrons in dipositive zinc ions with mass number 70 is

A. 34

B. 40

C. 36

D. 38

Answer: B

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

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8. The explanation for the presence of three unpaired electrons in the nitrogen atom can be given by -

A. Pauli's exclusions principle

B. Hund's rule

C. Aufbau's principle

D. Uncertainty principle

Answer: B

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9. 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 form

D. None

Answer: B

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10. Which of the following has maximum number of unpaired electron (atomic number of $Fe26$)

A. Fe

B. $Fe(II)$

C. $Fe(III)$

D. $Fe(IV)$

Answer: C

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11. Which quantum number is not related with Schrodinger equation :-

A. Principal

B. Azimuthal

C. Magnetic

D. Spin

Answer: D

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12. If λ_0 is the threshold wavelength for photoelectric emission. λ wavelength of light falling on the surface on the surface of metal, and m mass of electron. Then de Broglie wavelength of emitted electron is :-

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

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

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

D. $\left[\frac{h\lambda\lambda_0}{2mc}\right]\frac{1}{2}$

Answer: A

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13. It is known that atom contain protons. Neutrons and electrons. If the mass of neutron is assumed to half of its orginal value where as that of proton is assumed to be twice of its original value then the atomic mass of ${}_{6}^{14}C$ will be :-

A. same

B. 25% more

C. 14.28% more

D. 28.5% more

Answer: C

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14. Give the correct order of initials T (true) or F (false) for following statements :-

(I) If an ion has 2 electrons in K shell, 8 electrons in I. Shell and 6 electrons in M shell, then number of S electrons present in that element is 6.

(II) The maximum number of electrons in a subshell is given by $2n^2$

(III) If electron has magnetic quantum number -1, then it cannot be present in s-orbital.

(IV) Only one radial node is present in $3p$ orbital.

A. TTFF

B. FFTF

C. TFTT

D. $FFTF$

Answer: C

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15. The shortest wavelength of He^+ in Balmer series is x. Then longest wavelength in the Paschene series of Li^{+2} is :-

A. $\frac{36x}{5}$

B. $\frac{16x}{7}$

C. $\frac{9x}{5}$

D. $\frac{5x}{9}$

Answer: B

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16. 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. $1.17 Å$

C. $2.32 \times 10^9 nm$

D. 3.33pm

Answer: B

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17. In compound $FeCl_2$ the orbital angular momentum of last electron in its cation & magnetic moments (in Bohr Megneton) of this compound are :-

A. $(\sqrt{6})h, \sqrt{35}$

B. $(\sqrt{6})h, \sqrt{24}$

C. $0, \sqrt{35}$

D. none of these

Answer: B

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18. An electron, a proton and an alpha particle have kinetic energy of $16E, 4E$ and E respectively. What is the qualitavtive order of their de Broglie wavelengths :-

A. $\lambda_e > \lambda_p = \lambda_\alpha$

B. $\lambda_p = \lambda_\alpha > \lambda_e$

C. $\lambda_p > \lambda_e > \lambda_\alpha$

D. $\lambda_\alpha < \lambda_e > \ > \lambda_\alpha$

Answer: A

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19. Question : Is the specie paramagnetic ?

STATE-1 : The atomic number of speicie is 29.

STATE-2 : The charge on the specie is $+1$.

A. Statements (1) alone is sufficient but statement (2) is not sufficient

B. Statement (2) alone is sufficient but statement (1) is not sufficient

C. Both statement together are sufficient but neither statement alone is sufficient

D. Statement (1) $\%$ (2) together are not sufficient

Answer: C

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20. Given ΔH for the process $Li(g) \rightarrow Li^{+3}(g) + 3e^{-}$ is $19800 kJ/\text{mole} \& IE_1$ for Li is 520 then $IE_2 \& IE_1$ of Li^{+} are respectively (approx value) :-

A. $11775, 7505$

B. $19280, 520$

C. $11775, 19280$

D. data insufficient

Answer: A

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21. The ratio of difference in wavelengths of 1^{st} and 2^{nd} lines of Lyman series in H-like atom to difference in wavelength for 2^{nd} and 3^{rd} lines of same series is :-

A. $2.5:1$

B. $3.5:1$

C. $4.5:1$

D. $5.5:1$

Answer: B

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22. Which of the following statement is INCORRECT.

A. $\frac{e}{m}$ ratio for canal rays is maximum for hydrogen ion.

B. $\frac{e}{m}$ ratio for cathode rays is independent of the gas taken.

C. The nature of canal rays is dependent on the electrode material.

D. The $\frac{e}{m}$ ratio for electron is expressed as $\frac{E^2}{2B^2V}$, when the cathode rays go undeflected under the influence of electric field (E), magnetic field (B) and V is potential difference applied across electrodes.

Answer: C

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23. The quantum number of four electrons (el to e4) are given below :-

	n	l	m	s
$e1$	3	0	0	$+1/2$
$e2$	4	0	1	$1/2$
$e3$	3	2	2	$-1/2$
$e4$	3	1	-1	$1/2$

The correct order of decreasing energy of these electrons is :

A. $e4 > e3 > e2 > e1$

B. $e2 > e3 > e4 > e1$

C. $e3 > e2 > e4 > e1$

D. none

Answer: C

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24. If radius of second stationary orbit (in Bohr's atom) is R then radius of third orbit will be :

A. $R/3$

B. $9R$

C. $R/9$

D. $2.25R$

Answer: D

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25. The wavelength associated with a golf ball weighing 200 g and moving at a speed of $5\ \mathrm{m\ h^{-1}}$ is of the order:

A. $10^{-10}m$

B. $10^{-20}m$

C. $10^{-30}m$

D. $10^{-40}m$

Answer: C

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

A. Heisenberg uncertainty principle

B. Hunds rule

C. Pauli's exclusion principle

D. Bohr postulate of stationary orbits

Answer: C

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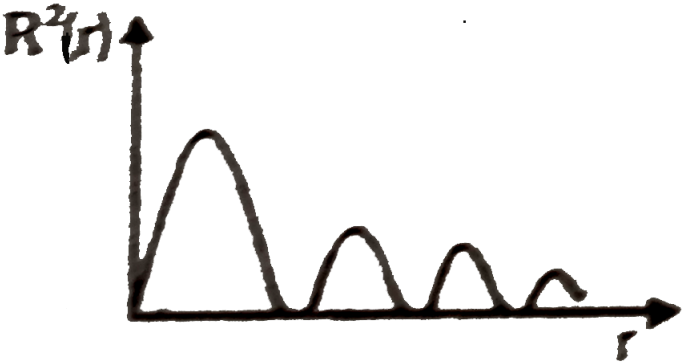
27. From the following observation predict the type of orbital :

Observation 1 : x y plane acts as nodal plane

Observation 2 : The angular function of the orbital intersect the three axis at origin only.

Observation 3 : $R^2(r)v/sr$ curve is obtained for the orbital is



A. $5p_z$

B. $6d_{xy}$

C. $6d_{x^2} - y^2$

D. $6d_{yz}$

Answer: D

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28. For a 3s - orbital, value of Φ is given by following realation:

$$\Psi(3s) = \frac{1}{9\sqrt{3}}\left(\frac{1}{a_0}\right)^{3/2}(6 - 6\sigma + \sigma^2)e^{-\sigma/2}, \quad \text{where} \quad \sigma = \frac{2r.\,Z}{3a_0}$$

What is the maximum radial distance of node from nucleus?

A. Statement (1) alone is sufficient.

B. Statement (2) alone is sufficient

C. Both together is sufficient

D. Neither is sufficient

Answer: B

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29. Consider the following nuclear reactions involving X and Y.

$X \rightarrow Y + {}_{2}^{4}He$

$Y \rightarrow {}_{8}O^{18} + {}_{1}H^{1}$

If both neutrons as well as protons in both the sides are conversed in nuclear reaction then moles of neutrons in 4.6 g on X :

A. $3, 2.4N_A$

B. $3, 2.4$

C. $2, 4.6$

D. $3, 0.2N_A$

Answer: B

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30. Electromagnetic radiation having λ=310 Å is subjected to a metal sheet having work function =12.8 eV. What will be the velocity of photo-electrons having maximum kinetic energy.

A. 0, no emmision will occur

B. $2.18 \times 10^6 m/s$

C. $2.18\sqrt{2} \times 10^6 m/s$

D. $8.72 \times 10^6 m/s$

Answer: C

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31. If in Bohr's model, for unielectronic atom, time period of revolution is represented as $T_{n,z}$ where n represents shell no. and Z represents atomic number then the value of $T_{1,2} : T_{2,1}$ will be :

A. $8:1$

B. $1:8$

C. $1:1$

D. None of these

Answer: D

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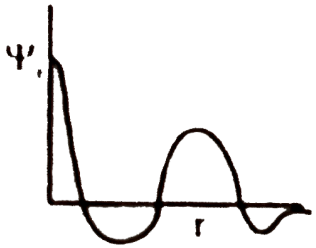
32. Coloumn I & Column II contain data on Schrondinger Wave-Mechanical model, where symbols have their usual meanings. Match the column :-

(A)



(B)

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33. Which orbitals is non-directional ?

A. s

B. p

C. d

D. All

Answer: A

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34. A particular hydrogen like atom has its ground state binding energy = 122.4 eV . It is in ground state. Then,

A. its atomic number is 3

B. an electron of $90eV$ can excite it to a higher state

C. an $80eV$ electron cannot excite it to a higher state

D. an electron of $8.2eV$ and a photon of $91.8eV$ are emitted when a $100eV$ electron interacts with it

Answer: A::C::D

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35. If the uncertainties in position and momentum are equal, the uncertainty in the velocity is :

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

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

C. $\frac{1}{2m}\sqrt{h}$

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

Answer: C

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36. For which orbital angular probability distribution is maximum at an angle of 45° to the axial direction ?

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

B. d_{Z^2}

C. d_{xy}

D. P_x

Answer: C

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37. Which orbit would be the first to have g subshell :-

A. 3^{rd}

B. 4^{th}

C. 5^{th}

D. 6^{th}

Answer: C

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38. The decreasing order of energy of the $3d$, $4s$, $3p$, $3s$ orbital is :-

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

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

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

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

Answer: C

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

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

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

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

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

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

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

Answer: D

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40. how fast is an electron moving if it has a wavelength equal to the distance travelled in one second ?

A. $\lambda = \frac{h}{p}$

B. $\lambda = \frac{h}{m}$

C. $\lambda = \sqrt{\frac{h}{p}}$

D. $\lambda = \sqrt{\frac{h}{m}}$

Answer: D

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41. According to Schrodinger model nature of electron in an atom is as :-

A. Particles only

B. Wave only

C. Both simultaneously

D. Sometimes waves and sometimes particle

Answer: B

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42. Which describes orbital :-

A. Ψ

B. Ψ^2

C. $\left|\Psi^2\right|\Psi$

D. All

Answer: B

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43. In order to have the same wavelength for the electron (mass m_e) and the neutron (mass m_n) their velocities should be in the ratio (electron velocitiy/neutron velocitiy) :-

A. m_n / m_e

B. $m_n \times m_e$

C. m_e / m_n

D. one

Answer: A

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

A. Rotation of the electron in clockwise and anticlockwise direction respectively.

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

C. Magnetic moment of the electron pointing up and down respectively.

D. Two quantum mechanical spin states which have no classifical analogue.

Answer: D

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45. Which is true about Ψ :-

A. Ψ represented the probability of finding an electron around the nucleus

B. Ψ represent the amplitude of the electron wave

C. Both A and B

D. None of these

Answer: B

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46. The circumference of n^{th} orbit in H-atom can be expressed in terms of deBroglie wavelength λ as :

A. $(0.529)n\lambda$

B. $\sqrt{n\lambda}$

C. $(13.6)\lambda$

D. $n\lambda$

Answer: D

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47. A particle X moving with a certain velocity has a debroglie wave length of $1A^{\circ}$. If particle Y has a mass of $25\,\%$ that of X and velocity $75\,\%$ that of X, debroglies wave length of Y will be :-

A. $3A^{\circ}$

B. $5.33A^{\circ}$

C. $6.88A^{\circ}$

D. $48A^{\circ}$

Answer: B

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48. 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. $0, 0\sqrt{20h}, \sqrt{6}$

Answer: A

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49. If m = magnetic quantum number and l = azimuthal quantum number then :-

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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50. The number of unpaired electron in $Mn^{4+}(Z = 25)$ is :-

A. Four

B. Two

C. Five

D. Three

Answer: D

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51. After np orbitals are filled, the next orbital filled will be :-

A. $(n+1)s$

B. $(n+2)p$

C. $(n+1)d$

D. $(n+2)s$

Answer: A

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52. The value of the magnetic moment of a particular ion is 2.83 Bohr magneton. The ion is :-

A. Fe^{2+}

B. Ni^{2+}

C. Mn^{2+}

D. Co^{3+}

Answer: B

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53. In Bohr's model of the hydrogen atom, the ratio between the period of revolution of an electron in the orbit of $n = 1$ to the period of revolution of the electron in the orbit $n = 2$ is

A. $1:2$

B. $2:1$

C. $1:4$

D. $1:8$

Answer: D

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54. If v_1 is the frequency of the series limit of lyman seies, v_2 is the freqency of the first line of lyman series and v_3 is the fequecny of the series limit of the balmer series, then

A. $v_1 - v_2 = v_3$

B. $v_2 - v_1 = v_3$

C. $v_3 = 1/2(v_1 - v_3)$

D. $v_1 + v_2 = v_3$

Answer: A

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55. The energies of energy levels A, B and C for a given atom are in the sequence $E_A < E_B < E_C$. If the radiations of wavelength λ_1, λ_2 and λ_3 are emitted due to the atomic transitions C to B, B to A and C to A respectively then which of the following relations is correct :-

A. $\lambda_1 + \lambda_2 + \lambda_3 = 0$

B. $\lambda_3 = \lambda_1 + \lambda_2^2$

C. $\lambda_3 = \lambda_1 + \lambda_2$

D. $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

Answer: D

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56. The wavelengths of photons emitted by electron transition between two similar leveis in H and He^+ are λ_1 and λ_2 respectively. Then :-

A. $\lambda_2 = \lambda_1$

B. $\lambda_2 = 2\lambda_1$

C. $\lambda_2 = \lambda_1 / 2$

D. $\lambda_2 = \lambda_1 / 4$

Answer: D

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57. If first ionisation potential of a hypothetical atom is $16V$, then the first excitation potential will be :

A. $10.2V$

B. $12V$

C. $14V$

D. $16V$

Answer: B

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58. In which transition minimum energy is emitted :-

A. $\infty \rightarrow 1$

B. $2 \rightarrow 1$

C. $3 \rightarrow 2$

D. $n \rightarrow (n-1)(n \geq 4)$

Answer: D

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59. No. of visible lines when an electron returns from 5^{th} orbit up to ground state in Hspectrum :

A. 5

B. 4

C. 3

D. 10

Answer: C

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Exercise 03

1. MATCH THE COLUMN

	Column-I		Column-II
(A)	Aufbau principal	(p)	Line spectrum in visible region
(B)	de broglie	(q)	Orientation of an electron in an orbital
(C)	Angular momentum	(r)	Photon
(D)	Hund's rule	(s)	$\lambda = h/mv$
(E)	Balmer series	(t)	Electron configuration
(F)	Planck's law	(u)	mvr

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2.

	Column-I		Column-II
(A)	Cathode rays	(p)	Helium nuclei
(B)	dumb-bell	(q)	Uncertainty principle
(C)	Alpha particles	(r)	Electromagnetic radiation
(D)	Moseley	(s)	p-orbital
(E)	Heisenberg	(t)	Atomic number
(F)	X-ray	(u)	electrons

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3. Frequancy $= f_1$, Time period = T, Energy of n^{th} orbit $= E_n$, radius of n^{th} orbit $= r^n$, Atomic number = Z, Orbit number = n :

	Column-I		Column-II
(A)	f	(p)	n^3
(B)	T	(q)	Z^2
(E)	E_n	(r)	$\frac{1}{n^2}$
(D)	$\frac{1}{r_n}$	(s)	Z

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4. Statement-I : Nodal plane of p_x atmoic orbital is yz plane.

Because

Statement-II : In p_x atmoic orbital electron density is zero in the yz plane.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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5. Statement-I : No two electrons in an atom can have the same values of four quantum number.

Because

Statement-II : No two electrons in an atom can be simultaneously in the same shell, same subshell, same orbitals and have same spin.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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6. 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. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: B

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7. Statement-I : The ground state configuration of Cr is $3d^5 4s^1$.

Because

Statement-II : A set of exactly half filled orbitals containing parallel spin arrangement provide extra stability.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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8. Statement-I : Mass numbers of most of the elements are fractional.

Because

Statemen-II Mass numbers are obtained by comparing with the mass number of carbon taken as 12.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer:

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9. 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. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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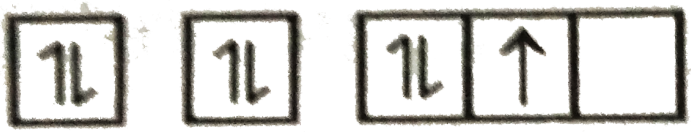
10. Assertion (A) : The electronic configuration of nitrogen atom is represented as

and not as



Reason (R) : The electronic configuration of the ground state of an atom is the one which has the greatest multiplicity

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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11. Assertion:The configuration of boron atom cannot be $1s^2 2s^3$

Reason :Hund's rule demands that the configuration should display maximum multiplicity

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: B

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12. Statement-I : 2p orbitals do not have spherical nodes.

Because

Statement-II : The number of spherical nodes in p-orbitals is given by $(n-2)$

A. Statement-I is true, Statement-II is true, Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

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. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: B

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14. Statement-I : Each electron in an atom has two spin quantum numbers.

Because

Statement-II : Spin quantum numbers are obtained by solving Schrodinger wave equation.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer:

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15. Statement-I : There are two spherical nodes in 3s-orbital.

Because

Statement-II : There is no angular node in 3s-orbital.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I.

B. Statement-I is true, Statement-II is true , Statement-II is NOT a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: B

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16. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

No two electrons in an atom can have the same set of quantum number.

$C(Z=24), Mn^{+}(Z=25), Fe^{2+}(Z=26)$ and $Co^{3+}(Z=27)$ are isoelectronic each having 24 electrons. Thus,

A. all have configuration as $[Ar]4s^{1}3d^{5}$

B. Cr and Mn^{+} have configuration as $[Ar]4s^{1}3d^{5}$ while Fe^{2+} and Co^{3+} have configuration as $[Ar]3d^{5}$

C. all have configurations as $[Ar]3d^{6}$

D. all have configurations as $[Ar]4s^{2}3d^{6}$

Answer: B

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17. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

No two electrons in an atom can have the same set of quantum number.

A compound of vanadium has a magnetic moment of $1.73BM$. Electronic configuration of the vanadium ion in the compound is :

A. $[Ar]4s^0 3d^1$

B. $[Ar]4s^2 3d^3$

C. $[Ar]4s^1 3d^0$

D. $[Ar]4s^0 3d^5$

Answer: A

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18. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

No two electrons in an atom can have the same set of quantum number.

Which of these ions are expected to be paramagnetic and coloured in aqueous solution ?

A. $Fe^{3+}, Ti^{3+}, Co^{3+}$

B. Cu^{+}, Ti^{4+}, Sc^{3+}

C. Fe^{3+}, Ni^{2+}, V^{5+}

D. Cu^{+}, Cu^{2+}, Fe^{2+}

Answer: A

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19. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

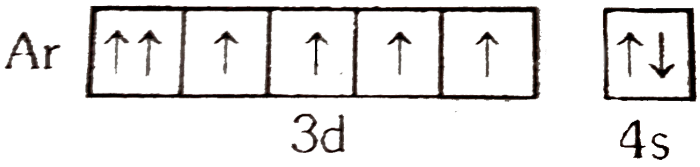
No two electrons in an atom can have the same set of quantum number.

While writing the following electronic configuration of Fe some rules have been violated :

I : Aufbau's rule,

II : Hund's rule

III : Pauli's exclusion principle



A. I, II

B. II, III

C. I, III

D. I, II, III

Answer: D

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20. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

No two electrons in an atom can have the same set of quantum number.

How many elements would be in the second period of the periodic table if the spin quantum number (m_s) could have the value of -(1)/(2),0,+(1)/(2)`?

A. 8

B. 10

C. 12

D. 18

Answer: C

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21. Comprehension # 1

Read the following rules and answer the questions at the end of it.

Electrons in various suborbits of an filled in increasing order to their energies.

Pairing of electrons in various orbitals of a suborbit takes places only after each orbital is half-filled.

No two electrons in an atom can have the same set of quantum number.

The sub-shell that arises after f sub-shell is called g sub-shell.

A. it contains 18 electrons and 9 orbitals

B. it corresponds to $l = 4$ and first occurs in $5th$ energy level

C. a g-orbital can have maximum of two electrons

D. all the above statements are true.

Answer: D

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Exercise 04 A

1. How long would it take a radio wave of frequency $6 \times 10^3 \sec^{-1}$ to travel from mars to the earth, a distance of $8 \times 10^7 km$?

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2. The energy levels of hypothetical one electron atom are shown below

e____$n = \infty$

$-0.50eV$_____$n = 5$

$-1.45eV$_____$n = 4$

$-3.08eV$____$n = 3$

$-5.3eV$ ____ $n = 2$

$-15.6eV$ ____ $n = 1$

A. Find the ionisation potential of atom?

B. Find the short wavelength limit of the series terminating at $n = 2$?

C. Find the wave no. of photon emitted for the transition made by the electron from third orbit to first orbit ?

D. Find the minimum energy that an electron will have after interacting with this atom in the ground state, if the initial kinetic energy of the electron is (i) 6eV (ii) eV ?

Answer: A::B::C::D

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3. 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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4. Find the number of photons of radiation of frequancy $5 \times 10^{13} s^{-1}$ that must be absorbed in order to melt one g ice when the latent heat of fusion of ice is $330 J / s$.

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5. The eyes of certain member of the reptile family pass a single visual signal to the brain when the visual receptors are struck by photons of wavelength $850 nm$. If a total energy of $3.15 \times 10^{14} J$ is required to trip the signal. What is the minimum number of photons that must strike the receptor?

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6. The wavelength of a certain line in the Pashchen series is $1093.6 nm$. What is the value of n_{high} for this line $\left[R_H = 1.0973 \times 10^{-7} m^{-1}\right]$

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7. Wavelength of the Balmer H, line (first line) is 6565Å. Calculate the wavelength of H_β (second line).

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8. Calculate the Rydberg constant R_H if He^+ ions are known to have the wavelength difference between the from (of the longest wavength) lines fo Balmer and Lyman series equal to $133.7nm$.

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9. 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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10. A photon having $\lambda = 854\text{Å}$ cause the ionization of a nitrogen atom. Give the I.E. per mole of nitrogen in KJ

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11. Calculate energy of electron which is moving in the orbit that has its radius , sixteen times the radius of first Bohr orbit for H-atom.

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12. The electron energy in hydrogen atom is given by $E_n = -\frac{2.18 \times 10^{-18}}{n^2} J$. 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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13. 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 x 10^{-11} erg per atom.

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14. The velocity of an electron in a certain Bohr orbit of H-atom bears the ratio 1 : 275 to the velocity of light. The quantum number (n) of the orbit is

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15. A doubly ionized lithium atom is hydrogen like with atomic number 3. Find the wavelength of the radiation required to excite the electron in Li^{++} from to the third Bohr orbit (ionization energy of the hydrogen atom equals 13.6 eV).

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16. Estimate the difference in energy between 1st and 2nd Bohr orbits for 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 $\lambda = 3 \times 10^{-8} m$? Which hydrogen atom like species does this atomic number correspond to?

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17. $1.8g$ hydrogen atoms are excited by a radiation. The study of species indicates that $27\,\%$ of the atom are in third energy level and $15\,\%$ of atom in second energy level and the rest in ground state. If IP of H is $13.6eV$, calculate

a. Number of atoms present in first and third energy levels

b. Total energy involved when all the atoms return to the ground state.

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18. One mole of $He^{\oplus}$ ions is excited. An anaylsis showed that $50\,\%$ of ions are in the third energy level $25\,\%$ are in the second energy level and the remaining are in the first energy level. Calculate the energy emitted in kilojoules when all the ions return to the ground state.

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19. The energy of an excited H-atom is $-3.4eV$. Calculate angular momentum of e^{-}

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20. The vapours of Hg absord some electron accelerated by a potiential diff. of 4.5 volt as a result of which light is emitted . If the full energy of single incident e^{-} is supposed to be converted into light emitted by single Hg atom , find the wave no. of the light

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21. The hydrogen atom in the ground state is excited by means of monochromatic radiation of wavelength xA_0 The resulting spectrum consists of 15 different lines. Calculate the value of x.

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22. If the average life time of an excited state of hydrogen is of the order of $10^{-8}s$, estimate how many whits an alectron makes when it is in the state $n=2$ and before it suffers a transition to state $n=1\left(Bohrrediusa_0=5.3\times10^{-11}m\right)$?

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23. What is the velocity of electron present in first Bohr orbit of hydrogen atom?

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24. A single electron orbits a stationary nucleus of charge $+Ze$, where Z is a constant and e is the magnitude of electronic charge . It requires $47.2eV$ to excite electron from second Bohr orbit to third Bhor orbit . Find

a the value of Z

b the energy required to excite the electron from the third to the fourth Bohr orbit.

c. the wavelength of electromagnetic rediation required to remove the electron from the first Bohr orbit to infinity.

d Find the KE, PE, and angular momentum of electron in the first Bohr orbit.

e. the redius of the first Bohr orbit

[The ionization energy of hydrogen atom $= 13.6eV$ Bohr radius $= 5.3 \times 10^{-11}m$, "velocity of light" $= 3 \times 10^{-8}jms^{-1}$, Planck's constant $= 6.6 \times 10^{-34}j - s$]

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25. A stationary hydrogen atom emits photon corresponding to the first line of Lyman series. If R is the Rydberg constant and M is the mass of the atom, then the velocity acquired by the atom is

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26. To what series does the spectral lines of atomic hydrogen belong if its wavenumber is equal to the difference between the wavenumbers of the following two lines of the Balmer series: 486.1 and $419.2nm$? What is the wavelength of that line?

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27. A particle of charge equal to that of an electron and mass 208 times the mass of the electron moves in a circular orbit around a nucleus of charge $+3e$. Assuming that the Bohr model of the atom is applicable to this system, (a) derive an expression for the radius of the n^{th} bohr orbit, (b) find the value of n for which the radius of the orbit is approximately

the same as that of the first Bohr orbit for the hydrogen atom, and (c) find the wavelength of the radiation emitted when the revolving particle jumps from the third orbit to the first.

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28. Calculate the threshold frequency of metal if the binding energy is $180.69 kJ mol^{-1}$ of electron.

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29. Calculate the binding energy per mole when threshold wavelength of photon is $240 nm$

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30. A certain metal when irradiated by light $\left(v = 3.2 \times 10^{16} Hz\right)$ emits photoelectrons with twice of K.E. as did photoelectrons when the same

metal is irradiated by light $\left(v = 2.0 \times 10^{16} Hz\right)$. The v_0 of the metal is

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31. $U.V.$ light of wavelength $800A^\circ \& 700A^\circ$ falls on hydrogen atoms in their ground state $\&$ liberates electrons with kinetic energy $1.8eV$ and $4eV$ respectively. Calculate planck's constant.

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32. A potential difference of $20kV$ is applied across on X - ray tube. The minimum wavelength of X - rays generated is

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33. The K.E. of an electron emitted from tungsten surface is $3.06eV$. What voltage would be required to bring the electron to set.

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34. What is de-Broglie wavelength of a He-atom in a container at room temperature. $\left(\text{use} U_{avg} = \sqrt{\frac{8kT}{\pi m}}\right)$

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

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36. 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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37. To what effective potential a proton beam be subjected to give its protons a wavelength of $1 \times 10^{-10} m$.

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38. Calculate the number of exchange pairs of electrons present in configuration of Cu according to Aufbau principle. Considering 3d orbitals.

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39. He atom can be excited to $1s^1 2p^1$ by $\lambda = 58.44 nm$. If lowest excited state for He lies $4857 cm^{-1}$ below the above. Calculate the energy for the lower excitation state.

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40. A certain dye absorbs $4530A^{\circ}$ and fluoresence at $5080A^{\circ}$ these being wavelength of maximum absorption that under given condition $47\,\%$ of the absorbed energy is emitted. Calculate the ratio of the no of quanta emitted to the number absorbed.

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41. The reaction between H_2 and Br_2 to form HBr in presence of light is initiated by the photo decomposition of Br_2 into free Br atoms (free radicals) by absorption of light. The bond dissociation energy of Br_2 is $192kJ/\text{mole}$.What is the longest wavelength of the photon that would initiate the reaction?

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42. The quantum yield for decomposition of HI id 0.2 .In an experiment 0.01 moles of HI are decomposed .

Find the number of photons absorbed.

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43. Calculate the wavelength of light required to break the bond between two chlorine atoms in a chlorine molecule. The Cl- Cl bond energy is 243 kJ $mol^{-1}\left(h=6.6\times10^{-34}Js, c=3\times10^{8}m/s,\right.$ Avogadro's number $\left.=6.02\times10^{23}mol^{-1}\right)$

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44. The dissociation energy of H_2 is $430.53kJmol^{-1}$, If H_2 is of dissociated by illumination with radiation of wavelength $253.7nm$, the fraction of the radiant energy which will be converted into ikinetic energy is given by

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45. An iodine molecule dissociates into atom after absorbing light of wavelength 4500Å. If quantum of radiation is absorbed by each molecule

calculate the kinetic energy of iodine (Bond energy of I_2 is $240kJmol^{-1}$)

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46. What is de-Broglie wavelength associated with an e^- accelerated through $P.D = 100kV$?

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47. Calculate the de-broglie wavelength associated with motion of earth $(mass 6 \times 10^{24}kg)$ orbiting around the sun at a speedof $3 \times 10^6 m/s$.

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48. A base ball of mass $200g$ is moving with velocity of $3 \times 10^3 cms^{-1}$. If we can locate the base ball with an error equal to the magnitude of the wavelength of the light used $(5000Å)$. How will the uncertainty in momentum be used with the total momentum of the base ball?

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49. An electron has a speed of $40 m / s$, accurate up 99.99% .What is the uncertainty in locating position ?

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Exercise 04 B

1. To what series does the spectral lines of atomic hydrogen belong if its wavenumber is equal to the difference between the wavenumbers of the following two lines of the Balmer series: 486.1 and $419.2 nm$? What is the wavelength of that line?

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2. Energy required for the excitation of H-atom its ground state to the 2^{nd} excited state is 2.67 times smaller than dissociation energy of $H_2(g)$. If

$H_2(g)$ placed in 1.0 litre flask at $27^\circ C$and 1.0 bar is to be excited to their 2^{nd} excited state, what will be the total energy consumption?

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3. Find the quantum number n corresponding to nth excited state of He^{++} ion if on transition to the ground state the ion emits two photons in succession with wavelength 108.5 nm and 30.4 nm. The ionization energy of the hydrogen atom is 13.6 eV.

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4. A gas of identical H-like atom has some atoms in the lowest (ground) energy level A and some atoms in a particular upper (excited) energy level B and there are no atoms in any other energy level. The atoms of the gas make transition to a higher energy level by aborbing monochromatic light of photon energy $2.7eV$. Subsequently, the atoms emit radiation of only six different photons energies. Some of the emitted photons have energy $2.7eV$. Some have more and some have less than $2.7eV$.

(a) Find the principal quantum number of initially excitied level B.

(b) Find the ionisation energy for the gas atoms.

(c) Find the maximum and the minimum energies of the emitted photons.

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5. A hydrogen-like atom (atomic number Z) is in a higher excited state of quantum number n.This excited atom can make transition to the first excited state by succesively emitting two photons of energies $10.20eV$ and $17.00eV$ respectively. Alternatively, the atom from the same excited state can make a transition to the second excited state by successively emitting two photons of energies $4.25eV$ and $5.95eV$ respectively. Determine the values of n and z

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6. Hydrogen atom in its ground state is excited by means of monochromatic radiation of wavelength $975A^{\circ}$. How many different lines

are possible in the resulting spectrum? Calculate the longest wavelength amongst them.

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7. An alpha particle after passing through a potential difference of 2×10^6 volt falls ona silver foil. The atomic number of silver is 47. Calculate (i) the K.E. of the alpha-particle at the time of falling on the foil. (ii) K.E. of the α-particle at a distance of $5 \times 10^{-14} m$ from the nucleus, (iii) the shortest distance from the nucleus of silver to which the α-particle reaches.

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8. Supose the potential energy between electron and proton at a distance r is given by $-\frac{Ke^2}{3r^3}$. Applicatiojn of Bohr's theroy of hydrogen atom in this case shows that

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9. The ionization energy of a hydrogen like Bohr atom is 4 Rydberg. If the wavelength of radiation emitted when the electron jumps from the first excited state to the ground state is $N-m$ and if the radius of the first orbit of this atom is $r-m$ then the value of $\frac{N}{r}=P\times 10^2$ then, value of P. (Bohr radius of hydrogen $=5\times 10^{-11}m$, 1 Rydberg $=2.2\times 10^{-18}J$)

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10. The angular momentum of an electron in a Bohr's orbit of He^+ is 3.1652×10^{-34} kg-m^2/sec. What is the wave number in terms of Rydberg constant (R) of the spectral line emitted when an electron falls from this level to the first excited state.l [Use h $=6.626\times 10^{-34}$ Js]

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Exercise 05 A

1. Uncertainty in position of a particle of $25g$ in space is $10^8 m$ Hence uncertainty in velocity $\left(ms^{-1}\right)$ is (Planck's constant $h = 6.6 \times 10^{-34} Js$)

A. 2.1×10^{-28}

B. 2.1×10^{-34}

C. 0.5×10^{-34}

D. 5.0×20^{-24}

Answer: A

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2. The de-Broglie wavelength of a tennis ball mass $60g$ moving with a velocity of $10m$ per second is approximately :

A. 10^{-25}metres

B. 10^{-33} metres

C. 10^{-31}metres

D. 10^{-16}metres

Answer: B

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

A. 3s,3p and 3d orbitals all have the same energy

B. 3s and 3p orbitals are of lower energy than 3d orbitals

C. 3p orbitals is lower in energy than 3d orbital

D. 3s orbitals is lower in energy than 3p orbital

Answer: A

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4. 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 :

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

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

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

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

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

D. $5.10 \times 10^{-3} m$

Answer: A

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5. The total number of orbitals associated with the principal quantum number 5 is:

A. 25

B. 5

C. 20

D. 10

Answer: 1

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6. Rutherford's experiment, which established the model of the atom, used a beam of :

A. β-particle, which impinged on a metal foil and get absorbed.

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

C. Helium atoms, which impinged on a metal foil and got scattered.

D. Helium nuclie, which impinged on a metal foil and got scattered.

Answer: D

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7. Spin only magnetic moment in B.M. of the compound Hg(II)[Co$(SCN)_4$] is-

A. $\sqrt{3}$

B. $\sqrt{8}$

C. $\sqrt{15}$

D. $\sqrt{24}$

Answer: C

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8. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?

A. $He^+(n=2)$

B. $Li^{2+}(n=2)$

C. $Li^{2+}(n=3)$

D. $Be^{3+}(n=2)$

Answer: D

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9. The Schrodinger wave equation for hydrogen atom is

$$\Psi_{2s}=\frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2-\frac{r}{a_0}\right)e^{-\sigma/a_0}$$

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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10. What is the velocity of electron present in first Bohr orbit of hydrogen atom?

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11. Potential energy (PE_n) and kinetic energy (KE_n) of electron in nth orbit are related as

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12. The maximum number of electrons can have principal quantum number $n = 3$ and spin quantum number $m_s = 1/2$ is

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13. The work function (ϕ) of some metal is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength fall on the metal is

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
$\phi(eV)$	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

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

A. $\frac{h^2}{4\pi^2 m a_0^2}$

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

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

D. $\frac{h^2}{32\pi^2 m a_0^2}$

Answer: C

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