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## CHEMISTRY

# BOOKS - S DINESH \& CO CHEMISTRY (HINGLISH) 

## STRUCTURE OF ATOM

## Example

1. The atomic number of an element is 5 and mass number is 11 . Find the number of electrons, protons and neutrons present in an atom of it. How can this element be represented ?

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2. The electronic configuration of a dipositive ion $M^{2+}$ is $2,8,14$ and its atomic mass is 56 . what is the number of neutrons in its nucleus?
3. Calculate the number of protons, neutrons and electrons in ${ }_{35}^{80} \mathrm{Br}$.

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4. The number of electrons, protons and neutrons in a species are equal to 18,16 and 16 respectively. Assign the proper symbol of the species.

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5. Write the complete symbol for
(i) the nucleus with atomic number 56 and mass number 138
(ii) the nucleus with atomic number 26 and mass number 55
(iii) the nucleus with atomic number 4 and mass number 9 .

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6. An element with mass number 81 contains $31.7 \%$ more neutrons as compared to protons. Find the symbol of the element.

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7. Complete the following table

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8. The Vividh Bharati station broadcasts on a frquency of 1368 kHz .

Calculate the wavelength of electromag-netic radiation emitted by the transmitter.

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9. $A$ sodium street light gives off yellow light that has a wavelength of 589 nm . What is the frequency of this light?
10. 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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11. Calculate and compare the energies of two radiations one with wavelength 800 pm and the other with wavelength 400 pm .

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12. Calculate the wavelength of a photon in Angstrons having an energy of 1 electron-volt.
13. 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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14. Find the ratio of the wavelengths corresponding to the frequencies $v_{1}=7.35 \times 10^{-14} s^{-1} \quad$ and $\quad v_{2}=4.47 \times 10^{14} s^{-1} \quad$ in case of electromagnetic radiations.

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15. calculate (a) wavenumber and (b) frequency of yellow radiation having wavelength 5800 A .

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16. A 100 watt buble emits monochromatic light of wavelength 400 nm . Then the number of photons emitted per seccond by the buble is nearly -

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17. Calculate the frequency, wave number and energy associated with photon of radiations having wavelength 6000 Ã... .

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18. 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 $1.3 \times 10^{-19} \mathrm{~J}$. Calculate the threshold frequency $\left(v_{0}\right)$ for the metal.

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19. Light of wavelength $5000 \AA$ fall on a metal surface of work function 1.9 eV . Find
a. The energy of photon
b. The kinetic energy of photoelectrons

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20. Let a light of wavelength $\lambda$ 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). $\lambda$ is halved (b) intensity $I$ is doubled?

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21. When electromagnetic radiation of wavelength 300 nm falls on the surface of sodium, electrons are emitted with kinetic energy of $1.68 \times 10^{5} \mathrm{Jml}^{-1}$. What is the minimum energy needed to remove an
electron from sodium ? What is the maximum wavelength that will cause a photoelectron to be emitted.

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22. In a hydrogen atom, an electron jumps from third orbit to the orbit. Find out the spectral line.

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23. In a hydrogen atom, the energy of an electron in first Bohr's orbit is $13.12 \times 10^{5} \mathrm{Jmol}^{-1}$. What is the energy required for its excitation to Bohr's second orbit?

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24. What are the two longest wavelength lines (in manometers) in the Lyman series of hydrogen spectrum ?
25. The wavelength of the first line in the balmer series is 656 nm .

Calculate the wavelength of the second line and the limiting line in the Balmer series.

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26. The atomic spectrum of $\mathrm{Li}^{2+}$ arises due to the transition of an electron from $n_{2}$ to $n_{1}$ level. If $n_{1}+n_{2}$ is 4 and $n_{2}-n_{1}$ is 2 , calculate the wavelength (in nm) of the transition for this series in $L i^{2+}$

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27. Calculate the velocity of an electron in Bhor's first orbit of hydrogen atom. (Given $r=0.53 \times 10^{-10} \mathrm{~m}$ )
28. A ball of mass 100 g is moving with a velocity of $100 \mathrm{~m} \mathrm{sec}^{-1}$. Find its wavelength.

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29. Calcualte the mass of a photon of sodium light having wavelength $5894 \AA$ Å and velocity $3 \times 10^{9} \mathrm{~ms}^{-1}, h=6.6 \times 10^{-34} \mathrm{~kg}^{2} \mathrm{~s}^{-1}$.

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30. What is the ratio of the velocities of $\mathrm{CH}_{4}$ and $\mathrm{O}_{2}$ molecules such that they are associated with de broglie waves of equal wavelength?

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31. Calculate de Broglie wavelength of an electron travelling at $1 \%$ of the speed of light.
32. The kinetic energy of an electron is $4.55 \times 10^{-25} \mathrm{~J}$. The mass of electron is $9.1 \times 10^{-31} \mathrm{~kg}$. Calculate velocity, momentum and wavelength of the electron.

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33. What is the wavelength for the electron accelerated by $1.0 \times 10^{4}$ volts?

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34. Calculate the kinetic energy of a moving electron which has wavelength of 4.8 pm .
35. When would wavelength associated with an electron become equal to the wavelength associated with a proton ?
$\left(m_{e}=9.1095 \times 10^{-28} g\right.$ and $\left.m_{p}=1.6725 \times 10^{-24} g\right)$.

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36. what should be the velocity of an electron so that its momentum becomes equal to that of a photon of wavelength $5200 \AA$

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37. Calculate the wavelength of de Broglie waves associated with a proton
of kinetic energy 500 eV. (Given
$\left.m_{p}=1.67 \times 10^{-27} \mathrm{~kg}, h=6.63 \times 10^{-34} \mathrm{Js}\right)$.

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38. Calculate the number of waves by a Bohr electron in one complete revolution in its third orbit.

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39. The mass of an electron is $9.1 \times 10^{-25} J$, if its K.E. is $3.0 \times 10^{-25} J$.

Calculate its wavelength.

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40. The atomic masses of He and Ne are 4 and 20 a.m.u. respectively.

What is the ratio of de Broglie wavelength of Hegas at $-73^{\circ} \mathrm{C}$ compared to that of Ne gas at $727^{\circ} \mathrm{C}$ ?

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41. Calculate the uncertainty in the momentum of an electron if it is confined to a linear region of length $1 \times 10^{-10}$ metre.

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42. An electron has a speed of $40 \mathrm{~m} / \mathrm{s}$, accurate up $99.99 \%$. What is the uncertainty in locating position?

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43. A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Ã.... What is the uncertainty involved in the measurement of its velocity?

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44. $A$ golf ball has a mass of $40 g$ and a speed of $45 \mathrm{~m} / \mathrm{s}$. If the speed can be measured within accuracy of $2 \%$, calculate the uncertainty in the position.

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45. A proton is accelerated to one tenth of velocity of light. If the velocity can be measured with a precision of $\pm 0.5 \%$, what must be the uncertainty in its position ? $\left(m_{p}=1.675 \times 10^{-27} \mathrm{~kg}\right)$.

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46. The uncertainty in measuring the speed of an accelerated electron is $1.2 \times 10^{5} \mathrm{~ms}^{-1}$, Calculate the uncertainty in finding its location while it is still in motion. (Given : $m_{e}=9.31 \times 10^{-31} \mathrm{~kg}$ ).

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47. The uncertainty in the position of a moving bullet of mass $10 g$ is $10^{-5} m$. Calculate the uncertainty in its velocity.

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

$$
\left(h=6.6 \times 10^{-34} k g \quad m^{2} s^{-1}\right)
$$

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49. Show that Heisenberg's uncertainty principle is of negligible significance for an object of mass $10^{-6} \mathrm{~kg}$
(Given $h / 4 \pi=0.528 \times 10^{-34} \mathrm{kgm}^{2} \mathrm{~s}^{-1}$ ).

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50. If a body weighing 1.0 g is travelling along x axis at $100 \mathrm{~cm} \mathrm{~s}^{-1}$ within 1 $\mathrm{cm} s^{-1}$, what is the theoretical uncertainty in its position ?

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51. The uncertainty in the position and velocity of a particle are $10^{-10} \mathrm{~m}$ and $5.27 \times 10^{-24} \mathrm{~ms}^{-1}$ respectively. Calculate the mass of the particle.

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52. a. An atomic orbit has $n=3$ What are the possible values of $i$ ?
b. An atomic orbital has $l=3$ when are the possible value of $m$ ?

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53. Using $s, p$ and $d$ notations, describe the orbitals with following quantum numbers :
(a) $n=1, l=0$, (b) $n=2, l=0$
(c) $n=3, l=1$, (d) $n=4, l=2$

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54. From the following sets of quantum numbers, state which are possible. Explain why the others are not possible.
(a)

$$
\begin{equation*}
n=0, l=0, m_{l}=0, s=+1 / 2 \tag{ii}
\end{equation*}
$$

$n=1, l=0, m_{l}=0, s=-1 / 2$
(iii)

$$
n=1, l=1, m_{1}=0, s=+1 / 2
$$

$n=1, l=0, m_{l}=+1, s=+1 / 2$

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55. Which of the following sets of quantum numbers is correct for an electron in 4 f-orbital?
56. Using the Aufban principal , write the electron configuration for the gropuped srtate of the following atomic boron $(Z=5)$ neon ( $Z=10$ ) aluminum $(Z=13)$ chlorine $(Z=17)$ calcium $(Z=20)$, rabidium ( $Z=13$ )

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57. Gives the values of all the four quantum numbers for $2 p$ electron in nitrogen $(Z=7)$

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58. Write the electronic configuration of the elements with $\mathrm{Z}=17$ and predict (i) no. of p electrons (ii) no. of filled orbitals (iii) no. of half filled orbitals?

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59. Which of the following do and which donot make sense ?
$2 p^{5}, 2 d^{4}, 4 s^{2}, 3 f^{7}, 4 p^{10}$.

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60. Arrange the electrons represented by the following sets of quantum numbers in decreasing order of energy.
(i) $n=4, l=0, m_{l}=0, s=+1 / 2$,
$n=3, l=1, m_{l}=1, s=-1 / 2$
(iii)

$$
\begin{equation*}
n=3, l=2, m_{l}=0, s=+1 / 2, \tag{iv}
\end{equation*}
$$

$n=3, l=0, m_{l}=0, s=-1 / 2$

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61. The mass number of an element is twich its atomic number. If there are four electrons in $2 p$ obitals, write the electronic configuration of the element and name it.
62. Write the electronic configuration of (i) $\mathrm{Mn}^{4+}($ ii $) \mathrm{Fe}^{3+}\left(\right.$ iii) $\mathrm{Cr}^{2+}$ and $Z n^{2+}$. Report the number of upaired electrons in each case.

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63. (a) write the values of azimuthal and magnetic quantum nos. for $n=2$.
(b) Write the four quantum numbers for 21st. Electron of ${ }_{21} S c$.

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64. Name the tripositive ion which is represented by the configuration : $1 s^{2} 2 s^{2} s p^{6} 3 s^{2} 3 p^{6} 3 d^{5}$

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65. What additional information is needed to answer the following: Which ion has the electronic configuration : $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6}$ ?

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66. How many electrons can be filled in all the orbitals with $n+l=5$ ?

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67. How many unpaired electrons are present in $\mathrm{pd}(\mathrm{Z}=46)$ ?

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68. A transition element $X$ has a configuration $[A r] 3 d^{4}$ in its +3 oxidation state. Its atomic number is

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69. A compound of vanadium has a magnetic moment of $1.73 B M$. Work out the electronic configuration of vanadium in the compound

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70. State the basic ideas which are violated by each of the following electronic configurations and replace each by the correct configuration.
(a) $B_{5}-1 s^{2} 2 s^{3}$,
(b) $N a_{11}-1 s^{2} 2 s^{2} 2 p^{6} 2 d^{1}$,
(c) $K_{19}-[A r] 3 d^{1}$,
$T i_{22}-[A r] 4 s^{2} 4 p^{2}$.

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71. A neutral atom has 2 K electrons, 8 L electrons and 6 M 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.
72. Give the possible value for the missing quantum number (s) in each of the following sets.
(a) $n=3, l=0, m_{l}=$ ?,
(b) $n=3, l=$ ?, $m_{l}=-1$
(c) $n=$ ?, $l=1, m_{l}=+1$, (d) $n=?, l=2, m_{l}=$ ?.

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73. Complete the following :
(a) $\ldots \ldots . .=1 s^{2} 2 s^{2} s p^{6} 3 s^{2} 3 p^{3}$,
(b) $X^{n+}(Z=26)=1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{5}$
(c) $F e^{2+}=1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{?} 4 s^{?}$,
(d) $O^{2-}=1 s^{2} 2 s^{2} 2 p$ ?

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## Board Examinations

1. (i) Calculate the number of electrons which will together with one gram
(ii) Calculate the mass and charge on one mole of electrons.

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2. (i) Calculate the total number of electrons present in 1 mole of methane.
(ii) Find (a) the total number and (b) the total mass of neutrons in 7 mg of . ${ }^{14} C$. (Assume that mass of a neutron $=1.675 \times 10^{-27} \mathrm{~g}$ )
(iii) Find (a) the total number of protons and (b) the total mass fo protons in 32 mg of $\mathrm{NH}_{3}$ at $S T P$. ( mass of proton $=1.672 \times 10^{-27} \mathrm{~g}$ ) Will the answer change if the temperature and pressure are changed ?

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3. How many protons and neutrons are there in the following nuclei ?
${ }_{.6} C^{12}{ }_{, .8} O^{17}{ }_{, .12} M g^{25}{ }_{., 26} \mathrm{Fe}^{56}{ }_{, .38} \mathrm{Sr}^{88}$

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4. Write the complete symbol for the atom with the given atomic number
$(Z)$ and atomic mass $(A)$.
a. $Z=17, A=35$,
b. $Z=92, A=233$,
c. $Z=4, A=9$

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5. Yellow light emitted from a sodium lamp has a wavelength ( $\lambda$ ) of 580 nm . Calculate the frequency (v). Wave number and energy of yellow light photon.

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6. Find energy of each of the photons which
a. correspond to light of frequency $3 \times 10^{15} \mathrm{~Hz}$.
b. have wavelength of $0.50 \AA$.
7. Calculate the wavelength, frequency, and wave number of a light wave whose period is $2.0 \times 10^{-10} s$.

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8. What is the number of photons of light with wavelength 4000 pm which provide 1 Joule of energy?

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9. A photon of wavelength $4 \times 10^{-7} \mathrm{~m}$ strikes on metal surface, the work function fo the metal being 2.13 eV Calculate :
(i) the energy of the photon (ev)
(ii) the kinetic energy fo the emission and the velocity fo the photoelectron $\left(1 e V=1,6020 \times 10^{-19} J\right)$,
10. Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise the sodium atom. Calculate the ionisation energy of sodium in kJ $\mathrm{mol}^{-1}$.

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11. A 25 watt bulb emits monochromatic yellow light of wavelength of 0. $57 \mu \mathrm{~m}$. Calculate the rate of emission of quanta per second .

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12. Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength $6800 \AA$. Calculate threshold frequency $\left(v_{0}\right)$ and work function ( $W_{0}$ ) of the metal.

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13. What is the wavelength of light emitted when the electron of a hydrogen atom undergoes a transition from an energy level with $n=4$ to an energy level with $n=2$ ? What is the colour corresponding to this wavelength?

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14. How much energy is required to ionise an $H$ atom if the electron occupies $n=5$ orbit? Compare your answer with the ionisation energy of $H$ atom (energy required to remove the electron from $n=1$ orbit).

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15. What is the maximum number of emission lines when the excited electron of a H atom in $n=6$ drop to the ground state?

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16. (i) The energy associated with first orbit in hydrogen atom is $-2.17 \times 10^{-18} \mathrm{Jatom}^{-1}$. What is the energy associated with the fifth orbit?
(ii) Calculate the radius of Bohr's fifth orbit for hydrogen atom.

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17. Calculate the wave number for the longest wavelength transition in the Balmer series fo atomic hydrogen . $\left(R_{H}=109677 \mathrm{~cm}^{-1}\right)$.

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18. What is the energy in joules required to shift the elertcon of the hydrogen atom from the first Bohr orbit to the fifth Bohr orbit ? And what is the wavelenght of the light emitted when the electron returns to the ground state ? The ground state electron energy is $-218 \times 10^{-11}$ erg.
19. 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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20. Calculate the wavelength of an electron moving with a velocity fo
21. $05 \times 10^{7} \mathrm{~ms}^{-1}$.

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21. The mass of an electron is $9.1 \times 10^{-25} \mathrm{~J}$, if its K.E. is $3.0 \times 10^{-25} \mathrm{~J}$.

Calculate its wavelength.
22. Which of the following are isoelectronic species, i.e., those having the same number of electrons:
$N a^{\oplus}, K^{\oplus}, M g^{2+}, C a^{2+}, S^{2-}, A r$

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23. i. Write the electronic conifigurations of the following ions:
a. $H^{\Theta}$,
b. $N a^{\oplus}$,
c. $O^{2-}$,
d. $F^{\Theta}$
ii. What are the atomic numbers of elements whose outermost electrons are represented by
a. $3 s^{1}$,
b. $2 p^{3}$,
c. $3 p^{5}$ ?
iii. Which atoms are indicated by the following configurations?
a. $[H e] 2 s^{1}$,
b. $[N e] 3 s^{2} 3 p^{3}$,
c. $[A r] 4 s^{2} 3 d^{1}$

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24. What is the lowest value of $n$ that allows $g$ orbitals to exist?
25. An electron is in one of the $3 d$ orbitals. Give the possible values of $n, l$, and $m$ for this electron.

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26. An atom of an element contains 29 electrons and 35 neutrons. Deduce
a. The number of protons and
b. The elctonic configuration of the element.

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27. Give the number of electrons in the species $\mathrm{H}_{2}^{+}, \mathrm{H}_{2}$ and $\mathrm{O}_{2}^{\oplus}$

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28. a. An atomic orbital has $n=3$. What are the possible values of $l$ and $m$ ?
b. List the quantum numbers ( $m$ and $l$ ) of electrons for $3 d$ orbital.
c. Which of the following orbitals are possible" $1 p, 2 s, 2 p$, and $3 f$ ?

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29. Using $s, p, d$ notations, descibe the orbital with the following quantum numbers.
a. $n=1, l=0$, b. $n=3, l=1$
c. $n=4, l=2$, d. $n=4, l=3$

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30. From the following sets of quantum numbers, state which are possible. Explain why the others are not possible.

$$
\begin{equation*}
n=0, l=0, m_{l}=0, m_{s}=+1 / 2 \tag{i}
\end{equation*}
$$

$n=1, l=0, m_{l}=0, m_{s}=-1 / 2$
(iii)

$$
\begin{equation*}
n=1, l=1, m_{l}=0, m_{s}=+1 / 2 \tag{iv}
\end{equation*}
$$

$n=1, l=0, m_{l}=+1, m_{s}=+1 / 2$
(v) $\quad n=3, l=3, m_{l}=-3, m_{s}=+1 / 2$
$n=3, l=1, m_{l}=0, m_{s}=+1 / 2$

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31. How many electron in an atom may have the following quantum number?
a. $n=4, m_{s}=-\frac{1}{2}$
b. $n=3, l=0$

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32. Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength associated with the electron revolving around the orbit.
33. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n=4$ to $n=2$ of $\mathrm{He}^{+}$spectrum ?

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34. Calcultte the enrgy required for the process,
$H e^{+}(g) \rightarrow H e^{2+}(g)+e$
The ionization energy for the $H$-atom in the grounds state is
35. $18 \times 10^{-18} \mathrm{Jatom}^{-1}$.

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35. If the diameter of a carbon atom is 0.15 nm , calculate the number of carbon atom which can be placed side by side in a straight line length of scale of length 20 cm long.
36. $2 \times 10^{8}$ atoms of carbon are arranged side by side. Calculate the radius of carbon atom if the length of this arrangement is 2.4 cm .

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37. The diameter of zinc atom is 2.6 A . Calculate (a) radius of zinc atom in pm and (b) number of atoms present in a length of 1.6 cm if the zinc atoms are arranged side by side lengthwise.

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38. A certain particle carries $2.5 \times 10^{-16} \mathrm{C}$ of static electric charge.

Calculate the number of electrons present in it.

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39. In Millikan's experiment, static electric charge on the oil droplets two obtained by shining $X$ rays. If the static electric charges on an oil drople is $-1.282 \times 10^{-18} C$, the number of electrons captured by the droplet is

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40. In Rutherford's experiment, generally the thin foil of heavy atoms, such as gold, platinum, etc. have been used to be bombarded by the $\alpha$ particles. If the thin foil of light atoms such as aluminium etc. is used, what difference would be observed form the above results?

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41. Symbols.$_{35}^{79} \mathrm{Br}$ and.$^{79} \mathrm{Br}$ can be written whereas symbols ${ }_{79}^{35} \mathrm{Br}$ and .35 Br are not accepted. Answer in brief.

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42. An element with mass number 81 contains $31.7 \%$ more neutrons as compared to protons. Assign the atomic symbol.

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43. An ion with mass number 37 possesses one unit of negative charge. If the ion contains $11.1 \%$ more neutrons than the electrons, find symbol of the ion.

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44. An ion with mass number 56 contains 3 units of positive charge and $30.4 \%$ more neutrons then electrons. Assign the symbol to this ion.

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45. Arrange the following type of radiations in increasing order of frequency: (a) radiation from microwave oven (b) amber light from traffic
signal (c). radiation from FM radio (d) cosmic rays from outer space and (e) X-rays

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46. Nitrogen laser produces a radiation at a wavelength of 33.71 nm . If the number of photons emitted is $5.6 \times 10^{24}$. calculate the power of this laser.

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47. Neon gas is generally used in the sign boards. If it emits strongly at 616 nm , calculate
a. The frequency of emission,
b. The distance travelled by this radiation in $30 s$
c. The energy of quantum and
d. The number of quanta present if it produces $2 J$ of energy.
48. In astronomical observations, signals observed from the distant stars are generally weak. If the photon detector receives a total of $3.15 \times 10^{-18} \mathrm{~J}$ from the radiations of 600 nm , calculate the number of photons received by the detector.

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49. Lifetimes of the molecules in the excited states are often measured by using pulsed radiation source of duration nearly in the nano second range. If the radiation source has the duration of 2 ns and the number of photons emitted during the pulse is $2.5 \times 10^{15}$, calculate the energy of the source.

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50. The longest wavelength doublet absorption is observed at 589 and 589.6 nm . Caiculate the frequency of each transition and energy
difference between two excited states.

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51. The work function for caesium atom is 1.9 eV . Calculate (a) the threshold wavelength and (b) the threshold frequency of the radiation. If the caesium element is irradiated with a wavelength 500 nm , calculate the kinetic energy and the velocity of the ejected photoelectron.

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52. Following results are observed when sodium metal is irradiated with different wavelengths. Calculate (a) threshold wavelength and (b) Planck's constant.

| $\lambda(\mathrm{nm})$ | 5000 | 450 | 400 |
| :--- | :--- | :--- | :--- |
| $v \times 10^{-5}\left(\mathrm{cms}^{-1}\right)$ | 2.55 | 4.35 | 5.35 |

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53. The ejection of the photoelectron from the silver metal in the photoelectric effect exeriment can be stopped by applying the voltage of 0.35 V when the radiation 256.7 nm is used. Calculate the work function for silver metal.

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54. If the photon of the wavelength 150 pm strikes an atom and one of its inner bound electrons is ejected out with a velocity of $1.5 \times 10^{7} \mathrm{~ms}^{-1}$, calculate the energy with which it is bound to the nucleus.

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55. Emission transitions in the Paschen series end at orbit $n=3$ and start from orbit $n$ and can be represented as $v=3.29 \times 10^{15}(H z)\left[1 / 3^{2}-1 / n^{2}\right]$

Calculate the value $\mathrm{f} n$ if the transition is observed at $1285 n m$. Find the region of the spectrum.

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56. Calculate the wavelength for the emission transition if it starts from the orbit having radius 1.3225 nm ends at 211.6 pm . Name the series to which this transition belongs and the region of the spectrum.

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57. Dual behaviour of matter proposed by de Broglie led to the discovery of electron microscope often used for the highly magnified images of biological molecules and other type of material. If the velocity of the electron in this microcope is $1.6 \times 10^{6} \mathrm{~ms}^{-1}$. Calculate de Broglie wavelength associated with this electron.

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58. Similar to electron diffraction, neutron diffraction microscope is also used for the determination of the structure of molecules. If the
wavelength used here is 800 pm , calculate the characteristic velocity associated with the neutron.

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59. If the velocity of the electron in Bohr's first orbit is $2.19 \times 10^{6} \mathrm{~ms}^{-1}$, calculate the de Broglie wavelength associated with it.

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60. The velocity associated with a proton moving in a potential difference of 1000 V is $4.37 \times 10^{5} \mathrm{~ms}^{-1}$. If the hockey ball of mass 0.1 kg is moving with this velocity, calculate the wavelength associated with this velocity.

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61. If the position of the electron is measured within an accuracy of $\pm 0.002 \mathrm{~nm}$. Calculate the uncertainty in the momentum of the electron.

Suppose the momentum of the electron is $h / 4 \pi_{m} \times 0.05 n m$, is there any problem in defining this value.

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62. The quantum numbers of six electrons are given below. Arrange them in order of increasing energies. If any of these combination(s) has/have the same energy lists:
63. $n=4, l=2, m_{i}=-2, m_{s}=-1 / 2$
64. $n=3, l=2, m_{l}=1, m_{s}=+1 / 2$
65. $n=4, l=2, m_{l}=-2, m_{s}=-1 / 2$
66. $n=3, l=2, m_{i}=-1, m_{s}=+1 / 2$
67. $n=3, l=1, m_{l}=-1, m_{s}=+1 / 2$
$n=4, l=1, m_{l}=0, m_{s}=+1 / 2$

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63. The bromine atom possesses $3 s$ electrons. It contains six electrons in $2 p$ orbitals, six electrons in $3 p$ orbitals and five electrons in $4 p$ orbitals.

Which of these electrons experience the lower effective nuclear charge?

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64. Among the following pairs of orbital which orbital will experience the larger effective nuclear charge?
a. $2 s$ and $3 s$, b. $4 d$ and $4 f$, c. $3 d$ and $3 p$

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65. The unpaired electrons in $A l$ and $S i$ are present in $3 p$ orbital. Which electrons will experience more effective nuclear charge from the nucleus?

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66. Indicate the number of unpaired electrons in:
a. $P, b . S i, c . C r$,
d. $F e, e . K r$
67. a. How many sub-shell are associated with $n=4$ ?
b. How many electron will be present in the sub-shell having $m_{s}$ value of $-1 / 2$ for $n=4$ ?

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## Short Answer Type Questions

1. Arrange $\mathrm{s}, \mathrm{p}$ and d subshells of a shell in the increasing order of effective nuclear charge $\left(Z_{e f f}\right)$ experienced by the electron present in them.

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2. Show the distribution of electrons in oxygen atom (atomic number 8) using orbital diagram.
3. Nickel atom can lose two electrons to form $\mathrm{Ni}^{2+}$ ion. The atomic number of nickel is 28 . From which orbital will nickel lose two electrons?

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4. Which of the following orbitals are degernate?

$$
3 d_{x y}, 4 d_{x y}, 3 d_{z^{2}, 3 d_{y z} z}, 4 d_{y z}, 4 d_{z 2}
$$

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5. Calculate the total number of angular nodes and radical nodes present in $3 p$ orbital.

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6. The arrangement of orbitals on the basis of energy is based upon their $(\mathrm{n}+\mathrm{I})$ value. Lower the value of $(\mathrm{n}+\mathrm{l})$, lower is the energy. For orbitals having same values of $(n+1)$. The orbital with lower value of $n$ will have lower energy.
I. Based upon the baove information arrange the following orbitals in the increasing order of energy.
(a) $1 \mathrm{~s}, 2 \mathrm{~s}, 3 \mathrm{~s}, 2 \mathrm{p}$ (b) $4 \mathrm{~s}, 3 \mathrm{~s}, 3 \mathrm{p}, 4 \mathrm{~d}$
(c) $25 \mathrm{p}, 4 \mathrm{~d}, 5 \mathrm{~d}, 4 \mathrm{f}, 6 \mathrm{~s}$ (d) $5 \mathrm{f}, 6 \mathrm{~d}, 7 \mathrm{~s}, 7 \mathrm{p}$
II. Based upon the above information Solve the question. give below.
(a) hich of the following orbitals has the lowest energy
$4 d, 4 f, 5 s, 5 p$
(b) which of the following orbitals has the higher energy?
$5 p, 5 d, 5 f, 6 s, 6 p$

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7. Which of the following will not show deflection from the path on passing through an electric field?

Proton,cathode rays, electron,neutron.

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8. An atom having mass number 13 has 7 neutrons. What is the atomic number of the atom.

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9. Wavelengths of different radiations are given below:
(A) 300 nm (B) $300 \mu \mathrm{~m}$ (C) $3 \mathrm{~nm}\left(30 A^{\circ}\right.$

Arrange these radiations in the increasing order of their energies.

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10. The electronic configuration of valence shell of Cu is $3 d^{10} 4 s^{2}$. How is this configuration explained ?
11. The Balmer series in the hydrogen spectrum corresponds to the transition from $n_{1}=2$ to $n_{2}=3,4 \ldots \ldots .$. . This series lies in the visible region. Calculate the wave number of line associated with the transition in Balmer series when the electron moves to $\mathrm{n}=4$ orbit.

$$
\left(R_{H}=109677 \mathrm{~cm}^{-1}\right)
$$

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12. According to de-Brogile, matter should exhibit dual behaviour, that is both particle and wave like properties. However, a cricket ball of mass 100 $g$ does not move like a wave when it is thrown by abowler at a speed of $100 \mathrm{~km} / \mathrm{h}$. calculate the wavelength of the ball and explain why it does not show wave nature.

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13. What is the experimental evidence in support of the diea that electronic energies in an atom are quantized?

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14. Out of electron and proton which one will have, a higher velocity to produce matter waves of the same wavelength ? Explain it.

## - Watch Video Solution

15. A hypothetical electromagnetic wave is shown in figure. Find out the wavelength of the radiation.

16. Chlorophyll present in green leaves of plants absorbs light at $4.620 \times 10^{14} \mathrm{~Hz}$. Calculate the wavelength of radiation in nanometer. Which part of the electromagnetic spectrum does it belong to?

## - Watch Video Solution

17. What is the difference between the terms orbit and orbital ?

## - Watch Video Solution

18. Table-tennis ball has mass 10 g and s peed of $90 \mathrm{~m} / \mathrm{s}$. if speed can be meausred within an accuracy of $4 \%$. What will be the uncertainly in speed and position?

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19. The effect of uncertainty principle is significant only for motion of microscopic particles and is negligible for the macroscopic particles. Justify the statement with the help of a suitable example.

## - Watch Video Solution

20. Hydrogen atom has only one electron, So, mutual repulsion between electrons is absent. However, in multielectron atoms mutual repulsion between the electrons is significant. How does this affect the energy of an electron in the orbitals of the same prinicipal quantum number in multielectron atoms?

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21. Thershold frequency, $v_{0}$ is the minimum frequency which a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency $1.0 \times 10^{15} s^{-1}$ was allowed to hit a metal surface, an electron having $1.988 \times 10^{-19} \mathrm{~J}$ of kinetic energy was
emitted. Calculated the threshold frequency of this metal. equal to 600 nm hits the metal surface.

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22. When an electric discharge is passed through hydrogen gas, the hydrogen molecules dissociate to produce excited to produce excited hydrogen atoms. These excited atoms emit electromagnetic radiation of discrete frequencies which can be given by the general formula $\vec{v}=109677\left[\frac{1}{n_{i}^{2}}-\frac{1}{n_{f}^{2}}\right]$
What points of Bohr's model of an atom can be used to arrive at this formula? Based on these points derive the above formula giving description of each step and each term.

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23. Calculate the energy and frequency of the radiation emitted when an electron jumps from $n=3$ to $n=2$ ina hydrogen atom.
24. Why was a change in the Bohr Model of atom required ? Due to which important development (s), concept of movement of an electron in an orbit was replaced by the concept of probability of finding electron in an orbital ? What is the name given to the changed model of atom?

## - View Text Solution

## Concept Based Questions

1. Distinguish between a photon and quantum.

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2. What type of metals are used in photoelectric cells ? Give one example.
3. What will happen to the mass of electron if it travels with velocity of light?

## - Watch Video Solution

4. In summer, we are advised not to wear black clothes. Assign reason.

## - Watch Video Solution

5. Can a moving cricket ball have a wave character ?

## - Watch Video Solution

6. What is the significance of de Broglie relationship ?

## - Watch Video Solution

7. The two electrons in the 1s orbital of helium have antiparallel spin. Why do not they have parallel spin ?

## - Watch Video Solution

8. Heisenberg uncertainty principle has no significance in our every day life. Explain.

## - Watch Video Solution

9. When is the energy of electron regarded as zero ?

## D Watch Video Solution

10. What is the difference between the notations I and $L$ ?

## - Watch Video Solution

11. Out of 3 d and 4 s orbitals, which is filled first ?

## - Watch Video Solution

12. Why can $2 p$ sub-shell accommodate more electrons than 2 s sub-shell ?

## - Watch Video Solution

13. Write the electronic configuration of (i) $\mathrm{Mn}^{4+}(i i) \mathrm{Fe}^{3+}(i i i) \mathrm{Cr}^{2+}$ and (iv) $Z n^{2+}$. Report the number of upaired electrons in each case.

## - Watch Video Solution

14. What will be the maximum number of electrons having the same spin in an atom with $n+l=4$ ?

## - Watch Video Solution

15. Write down all the four quantum numbers for (i) 19th electron of ${ }_{\cdot 24} C r$ (ii) 21st electron for ${ }_{21} S c$.

## - Watch Video Solution

16. Name a dipositive metal ion with configuration : $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{5}$

## - Watch Video Solution

17. We do not see a car moving as a wave on the road. Explain.

## - Watch Video Solution

18. How are $d^{x y}$ and $d_{x^{2}-y^{2}}$ orbitals related to each other?

## - Watch Video Solution

19. What is the deviation from Aufbau Principle in case of electronic configuration of La (Z=57)?

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## H O T S Conceptual Questions

1. If the uncertainty in the position of a moving electron is equal to its de Broglie wavelength, then its velocity will be completely uncertain. Explain.

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2. Why are 2 d and 3 forbitals not possible ?

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3. $A$ certain element ' $A$ ' undergoes photoelectric emission when bombarded by one photon of indigo light. When the material containing the same element was bombarded by two photons of red light with a total of same energy as that of indigo photon, no electron was emitted. Explain.

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4. What is the difference between angular momentum of an electron present in 3 p orbital from that of an electron present in $4 p$ orbital ?

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5. Why does that splitting of spectral lines occur when the source of the spectrum is placed in a magnetic field ?

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6. Find the total number of electrons in a molecule of phosphoric acid $\left(\mathrm{H}_{3} \mathrm{PO}_{4}\right)$.

## - Watch Video Solution

7. If an electron and proton when in motion have the same wavelength associated with each of them, which would be moving faster and why ?

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8. Why can't we overcome the uncertainty predicted by Heisenberg principle by building more precise devices to reduce the error in measurement below the $h / 4 \pi$ limit ?

## - Watch Video Solution

9. Answer the following :
(a) How many electrons can be filled in all the orbitals with $\mathrm{n}+\mathrm{l}=5$ ?
(b) Which of the two is paramagnetic, V (IV) orV (V) and why ?
(c) How many unpaired electrons are present in $\mathrm{Pd}(\mathrm{Z}=46)$ ?
(d) The ion of an element has configuration $[A r] 3 d^{4}$ in +3 oxidation state.

What will be the electronic configuration of its atom ?

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10. Give the name and atomic number of the inert gas atom in which the total number of $d$-electrons is equal to the difference in number to the $p$ and $-s$-electrons.

## - Watch Video Solution

11. The two electrons in the 1s orbital of helium have antiparallel spin.

Why do not they have parallel spin ?

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1. Is an electron stationary in stationary energy state ?

## - Watch Video Solution

2. Does an electron follow a fixed circular path as suggested by Bohr ?

## - Watch Video Solution

3. Is de Broglie relation applicable to only electron ?

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4. We can not see a moving microscopic particle without disturbing it. Do you agree ? Name the principle on which this statement is based.

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5. What is the significance of the sign $\psi^{2}$ ?

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6. Name the quantum number which does not follow from the solution of Schrodinger wave equation?

## D Watch Video Solution

7. Which d-orbital does not have four lobes?

## - Watch Video Solution

8. Why do two electrons in an orbital have opposite spin ?

## - Watch Video Solution

9. How many orientations are possible for the orbitals present in the f-sub-shell?

## - Watch Video Solution

10. Give the relation between wavelength and momentum of a moving microscopic particle. What is the relation known as ?

## (D) Watch Video Solution

11. When moving with the same velocity which of the following particles has the largest de Broglie wavelength and why?
(i) Electron (ii) Proton (iii) $\alpha$-particle.

## - Watch Video Solution

12. Mention the fundamental change which uncertainty principle introduced in Bohr's concept of definite path of electron in an orbit.

## - Watch Video Solution

13. How do $p_{x}, p_{y}$ and $p_{z}$ atomic orbitals differ ?

## - Watch Video Solution

14. How does change in velocity of the moving micro-particle affect the wavelength of the particle ?

## - Watch Video Solution

15. Does $4 p^{10}$ configuration make any sense ?

## - Watch Video Solution

16. Write the electronic configuration and number of unpaired electrons in $\mathrm{Fe}^{2+}$ ion.

## - Watch Video Solution

17. What is the ground state electronic configuration of oxygen in $O F_{2}$ ?

## - Watch Video Solution

18. Name the dipositive ion represented by configuration : $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6}$.

## - Watch Video Solution

19. Write the values of all the four quantum numbers for the last electron in case of $\mathrm{K}(\mathrm{Z}=19)$.
20. How many orbitals are present in g-subshell ?

## ( Watch Video Solution

21. How many electrons can be filled in all the orbitals with $n+l=5$ ?

## - Watch Video Solution

22. Carbon atom has electronic configuration $1 s^{2} 2 s^{2} 2 p_{x}^{1} 2 p_{y}^{1}$ and not $1 s^{2} 2 s^{2} 2 p_{x}^{2}$. Why ?

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23. The mass number of an element is twice its atomic number. If there are four electrons in $2 p$ orbitals, Write the electronic configuration of the element and name it.
24. $d_{z^{2}}$ orbital has zero electron density in xy-plane. Comment.

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25. What will become to the wavelength a moving particle if its velocity is doubled ?

## - Watch Video Solution

26. Which experimental evidence most clearly supports the suggestion that electrons have wave properties ?

## - Watch Video Solution

27. How do 1 s and 2 s orbitals differ in number of spherical nodes ?
28. Predict the magnetic moment of $\mathrm{Cu}^{2+}$ ion.

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29. With what neutral molecule is $C I O^{\ominus}$ isoelectronic?

## - Watch Video Solution

30. What is the sequence of the energy of the orbitals $3 \mathrm{~s}, 3 \mathrm{p}$ and 3 d for $\mathrm{He}^{+}$ion ?

## - Watch Video Solution

31. Which d-orbtial has its four lobes along the axis?
32. Indicate the number of unpaired electrons in:
a. $P, b . S i, c . C r$,
d. $F e, e . K r$

## - Watch Video Solution

33. a. How many sub-shell are associated with $n=4$ ?
b. How many electron will be present in the sub-shell having $m_{s}$ value of $-1 / 2$ for $n=4$ ?

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34. What is Hund's rule of maximum multiplicity ? Explain by taking example of nitrogen.

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35. Why does in the building of an atom, the filling of 4 s orbital takes place before filling in 3d orbital ?

## Watch Video Solution

36. (a) State Pauli's exclusion principle (b) State Heisenberg's uncertaninty principe. Give its mathematical form.

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37. Write the values of $n$ and $I$ for 3 p orbital.

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38. The correct ground state electronic configuration of chromium atom(Z=24) is :
39. The word 'aufbau ' in German menas 'building up' . The building up of orbitals the filling up of orbials with electrons. In the ground state of the atoms, the orbitals are filled in order of is their increasing energies. In unielectron species, energy is determined by ' n ' but in multielectron species, energy is determined by $n+l$ value .

Answer the following question on the basis of above paragraph :
(a) State Aufbau principle .
(b) Out of 4 f and 5 s electron orbitals, inbitals, indicate which of higher energy ?

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## H O T S Numerical Problems

1. How many protons are present in 5.6 L of oxygen at N.T.P.using $\mathrm{O}-16$ isotope only?
2. An oxide of $N$ has vapour density 46 . Find the total number of electron in its $92 g .\left(N_{A}=\right.$ Avogdro's number $)$

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

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4. One quantum is absorbed per molecule of gaseous iodine for converting into iodine atoms. If light absorbed has wavelength of $5000 A^{\circ}$, The energy required in $\mathrm{kJol}^{-1}$ is
5. 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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6. Calculate the number of photons emitted in 10 hours by a 60 W sodium lamp $(\lambda$ of photon $=5893 \AA)$

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7. The wavelength of a photon is $1.4 \AA$. It collides with an electron. Its wavelength after collision is $2.0 \AA$. Calculate the energy of the scattered electron.

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8. If the binding energy of electrons in a metal is $250 \mathrm{~kJ} \mathrm{~mol}^{-1}$, what is the threshold frequency of the striking photons?

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9. If $\lambda_{0}$ is the threshold wavelength for photoelectric emission. $\lambda$ 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 :-

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10. For a photoelectron, the frequency is given by the expression :
$v=3.3 \times 10^{15}\left(\frac{1}{2^{2}}-\frac{1}{n^{2}}\right)$
If the wavelength of the electron is $6600 \tilde{A} . .$. , what will be the value of $n$ ?

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11. 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 $\lambda=3.0 \times 10^{-8} \mathrm{~m}$ ? Which hydogen -like species does this atomic number correspond to ?

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12. If uncertainties in the measurement of position and momentum are equal, then uncertainty in the measurement of velocity is

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13. A maruti car weighing $3.0 \times 10^{3} \mathrm{~kg}$ is moving on a highway. Its speed can be measured with a accuracy of $\pm 0.01$ mile. Is Heisenberg uncertainty principle valid?
14. 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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15. The energy of an a-particle is $6.8 \times 10^{-18} \mathrm{~J}$. What will be the wave length associated with it ? $h=6.62 \times 10^{-34} \mathrm{Js}, 1 \mathrm{amu}=1.67 \times 10^{-27} \mathrm{~kg}$.

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16. An electron beam can undergo defraction by crystals. Through what potential should a beam of electrons be accelerated so that its wavelength becomes equal to $1.54 \AA$

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17. An electron and proton are possessing the same amount of kinetic energy. Which of the two have greater wavelength ?

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18. A compound of vanadium has a magnetic moment of $1.73 B M$. Work out the electronic configuration of vanadium in the compound

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## Value Based Questions

1. We all know that a large number of elements exist as isotopes. The isotopes of an element have same atomic number but different mass numbers. The isotopes. With higher mass number are mostly radioactive in nature. These are called radioisotopes. These isotopes have a wide range of applications.
(i) Which isotope is used to study the kinetics of photosynthesis ?
(ii) Name the isotope which can detect a blood clot.
(iii) Which isotope is used to detect the deformity in bones, if any ?

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2. Neils Bohr has a major contribution towords the structure of atom. He has given Bohr's Bury rules for the distribution of electrons in the various shells in an atom. Apart from that, he has also introduced the concept of ground state and excited states for an electron. But Bohr theory does suffer from certain defects. The present picture of the atom is mainly due to the researches carried by Heisenberg.
(i) State the Heisenberg's uncertainty principle.
(ii) Give its mathemetical form.
(iii) Why does the principle have no utility in daily life?

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3. The complete designation of the electrons in an atom is given with the help of four quantum numbers. They specify the shell, sub-shell and the
orbital in a which a particular electron can be present.
(i) Which quantum number describes the electron spin ?
(ii) What is the significance of this quantum number ?
(iii) If the two electrons repel each other and will not be in a position to remain in the same orbital.

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## Problems For Practice

1. There are 14 protons and 13 neutrons in the nucleus of an atom. What is its mass number?

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2. Indicate the number of electrons, protons and neutrons in the element ${ }_{19}^{39} \mathrm{~K}$.
3. What is common in the different isotopes of an element?

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4. From the following nuclei, choose the isotopes and isobars :
(i) $8 p+8 n$, (ii) $8 p+9 n$, (iii) $18 p+22 n$, (iv) $20 p+20 n$

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5. How are the following species related ?
$.{ }_{6}^{14} \mathrm{C}, .{ }_{7}^{15} \mathrm{~N}, .{ }_{8}^{16} \mathrm{O}$

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6. Give examples of each of the following :
(i) Isotope of ${ }_{17}^{35} C I$, (ii) Isobar of ${ }_{18}^{40} \mathrm{Ar}$, (iii) Isotone of ${ }_{7}^{15} \mathrm{~N}$
7. The atomic number of cation $M^{2+}$ is 12 . How many electrons are present in it ?

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8. How are $\mathrm{Cl}^{-}$and $\mathrm{S}^{2-}$ ions related to each other ?

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9. Which isotope of hydrogen is called protium ?

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10. Which particles determine the mass of an atom ?
11. The frequency of an electromagnetic radiation is 1556 kilohertz. What is the wavelength ?

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12. The wavelength of a violet radiation is $3.7 \times 10^{5} \mathrm{pm}$. What is its frequency?

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13. What is the frequency of light with a wavelength of 480 nm

## - Watch Video Solution

14. The wavelength of visible spectrum extends extends from violet (400 $n m$ ) tored (750 nm). Express the corresponding frequency ranges.
15. Calculate the Einstein when the frequency of photon is $10^{10} \mathrm{kHz}$.

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16. A photon of light with wavelength 700 nm has energy E . A photon of light of what wavelength would correspond to energy 2E ?

## - Watch Video Solution

17. Calculate the frequency and wave number of radiations with wavelength 480 nm .

## - Watch Video Solution

18. What is the ratio between the energies of two radiations one with a wavelength of $6000 \tilde{A} . .$. and other with $2000 \tilde{A} . .$. ?
19. When a certain metal was irradiated with light of frequency $1.6 \times 10^{16} \mathrm{~Hz}$, the photoelectrons emitted had twice the kinetic energy as photoelectrons emitted when the same metal was irradiated with light of frequency $1.0 \times 10^{6} \mathrm{~Hz}$. Calculate the threshold frequency $\left(v_{0}\right)$ for the metal.

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

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

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22. Photoelectric emission is observed from a metal surface for frequencies $v_{1}$ and $v_{2}$ incidents radiations $\left(v_{1}>v_{2}\right)$. If the maximum kinetic energy of the two electrons are in the ratio $1: 2$, then how is threshold frequency $\left(v^{\circ}\right)$ experssed.

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23. Calculate the wavelength of the radiations in nanometers emitted when an electron in hydrogen atom jumps from third orbit to the ground state. $\left(R_{H}=109677 \mathrm{~cm}^{-1}\right)$

## - Watch Video Solution

24. The ionisation energy of hydrogen atom is $1.312 \times 10^{6} \mathrm{Jmol}^{-1}$. Calculate the energy required to excite an electron in a hydrogen atom from the ground state to the first excited state.

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25. Calculate the wavelength from the Balmer formula when $n_{2}=3$.

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26. Ionisation energy of $\mathrm{He}^{+}$is $19.6 \times 10^{-18} \mathrm{Jatom}^{-1}$. The energy of the first stationary state $(n=1)$ of $L i^{2+}$ is.

## - Watch Video Solution

27. Calculate the wavelength of photon which will be emitted when the electron of hydrogen atom jumps from fourth shell to the first shell.

Ionisation energy of hydrogen atom is $1.312 \times 10^{3} \mathrm{hJmol}^{-1}$.

## - Watch Video Solution

28. Calculate the first excitation energy of electron in the hydrogen atom.

## - Watch Video Solution

29. The energy difference between ground state of an atom and its excited state is $3 \times 10^{-19} \mathrm{~J}$. What is the wavelength of photom required for this radiation ?

## - Watch Video Solution

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
$L i^{2+} .\left(R_{H}=109677 \mathrm{~cm}^{-1}, c=3 \times 10^{8} \mathrm{~ms}^{-1}, Z=3\right)$

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31. Calculate the momentum of a particle which has de Broglie wavelength of $2.5 \times 10^{-10} \mathrm{~m}$.

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32. The kinetic energy of a sub-atomic particle is $5.65 \times 10^{-25} \mathrm{~J}$. Calculate the frequency of the particle wave.

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33. Calculate the wavelength associated with an electron moving with a velocity of $10^{3} \mathrm{~ms}^{-1}$.
34. Calculate the momentum of a particle which has de Broglie wavelength of 0.1 nm .

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35. An electron is moving with a kinetic energy of $2.275 \times 10^{-25} \mathrm{~J}$.

Calculate its de Broglie wavelength.

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36. calculate the mass of a photon with wavelength 3.6 A

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37. Calculate the velocity of electron in Bohr's first orbit of hydrogen atom. How many times does the electron go in Bohr's first orbit in one

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38. Calculate the de Broglie wavelength of an electron moving at $1.5 \%$ of the speed of light.

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39. A beam of helium atoms moves with a velocity of $2 \times 10^{3} \mathrm{~ms}^{-1}$. Find the wavelength associated with helium atoms.

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40. Calculate the kinetic energy of $O_{2}$ molecule which has wavelength of 2.5 pm .
41. Calculate the wavelength of 100 kg rocket moving with a velocity of 300 km per hour.

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42. The wavelength associated with an electron accelerated through a potential difference of 100 V is nearly

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43. The mass of electron is $9.11 \times 10^{-31} \mathrm{~kg}$. Calculate the uncertainty in its velocity if the uncertainty in position is the uncertainty in position is of the order of $\pm 10 \mathrm{pm} .\left(h=6.6 \times 10^{-34} \mathrm{kgm}^{2} \mathrm{~s}^{-1}\right)$.

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44. An electron has a speed of $500 \mathrm{~m} s^{-1}$ with uncertainty of $0.02 \%$. What is the uncertainty in locating its position?

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45. Calculate the product of uncertainty in displacement and velocity for an electron of masss $9.1 \times 10^{-31} \mathrm{~kg}$ according to Heisenberg's uncertainty principle.

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46. what will be uncertainty in the velocity of an electron if it is located within $5 \times 10^{-5}$ Ã... ?

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47. The correctness of velocity of an electron moving with velocity $50 \mathrm{~ms}^{-1}$ is $0.005 \%$. The accuracy with which its position can be measured will be

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48. A cricket ball weighing 100 g is located within 1 nm . What is the uncertainty in the velocity ?

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49. Calculate the uncertainty in the velocity of a particle of mass $1.1 \times 10^{-27} \mathrm{~kg}$ if the uncertainty in the uncertainty in its position is $3 \times 10^{-10} \mathrm{~cm}$.

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50. Calculate the uncertainty in the position of an electron if the uncertainty in its velocity is $5.77 \times 10^{5} \mathrm{~ms}^{-1}$.

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51. State whether the following sets of quantum numbers can be allowed or not:
$n=3, l=2, m_{1}=-1, s=+1 / 2$

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52. What is the maximum number of orbitals in any energy level ?

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53. Describe the orbital with $n=4$ and $l=0$
54. Write the values of all the quantum numbers of the electron with $2 s^{2}$ configuration.

## - Watch Video Solution

55. Can we designate an orbital as 2 d ?

## - Watch Video Solution

56. An atomic orbital has $n=3$, what are the possible values of $l$ ?

Watch Video Solution
57. Which shell would be the first to have $g$ sub-shell ?
58. List all the values of $l$ and $m_{1}$ for $n=2$.

## - Watch Video Solution

59. List the values of $l$ and $m_{1}$ for $n=1$.

## - Watch Video Solution

60. If a quantum number $l$ has value of 2 , what are the permitted values of quantum number ' $m_{1}$ ' ?

## - Watch Video Solution

61. What are the values of n and I for 4 d orbitals ?

## - Watch Video Solution

62. What is the orbital angular momentum of an electron in 2 s orbital ?

## - Watch Video Solution

63. What is the orbital angular momentum for an electron in d orbital ?

## - Watch Video Solution

64. Compute the number of subshells for $M$-shell.

## - Watch Video Solution

65. Which of the following represent ground state configurations and which are excited state configurations.
(i) $1 s^{2}, 2 s^{2} 2 p^{4}$,
(ii) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{1} 3 p^{1}$,
(iii) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{4}$.

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66. Write the values of all the four quantum numbers for the last electron in case of $K(Z=19)$.

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67. Name the elements indicated by the following configurations :
(i) $1 s^{2} 2 s^{2} 2 p^{5}$,
(ii) $\quad 1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{2} 4 s^{2}$
(iii) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2}$ $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{4}$

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68. A p-sub-shell which consists of px, py and pz orbitals contains only one electron. In which one of these three orbitals should the electron be located?

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69. Write the electronic configuration of $C I^{-}$ion. To which configuration does it resemble?

## - Watch Video Solution

70. Write the electronic configuration of the elements
(i). ${ }_{9}^{19} \mathrm{~F}$, (ii) ${ }_{18}^{36} \mathrm{Ar}$, (iii) ${ }_{16}^{32} S$

Point out the element with (a) Maximum nuclear charge (b) Minimum number of neutrons , (c) Maximum mass number. , (d) Maximum number of unpaired electrons.

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## Multiple Choice Questions Type I

1. Which of the following conclusions couldnot be derived from Rutehrford's a-paticle scattering experiment?
A. Most of the space in the atom is empty.
B. The radius of the atom is about $10^{-10} m$ while that of nucleus is $10^{-15} \mathrm{~m}$.
C. Electrons move in a circular path of fixed energy called orbits.
D. Electrons and the nucleus are held together by electrostatic forces of attraction.

## Answer: C

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2. Which of the following options does not represent ground state electronic configuration of an atom?
A. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{8} 4 s^{2}$
B. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{9} 4 s^{2}$
C. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{10} 4 s^{1}$
D. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{5} 4 s^{1}$

Answer: B

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3. The probability density plots of 1 s and 2 s orbitals are given in figure.


The density of dots in a region represetns the probability density of finding electrons in the region. On the basis of above diagram which of the following statements is incorrect?
A. 1 s and 2 s orbitals are spherical in shape.
B. The probability of finding the electron is maximum near the nucleus.
C. The probability of finding the electron at a given distance is equal in all directions.
D. The probability density of electrons for 2s orbital decreases uniformly as distance from the nucleus increases.

## Answer: D

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4. Which of the following statement is not correct about the characterstics of cathode rays
A. They start from the cathode and move towards the anode.
B. They travel in straight line in the absence of an external electrical or magnetic field.
C. Characteristics of cathode rays do not depend upon the material of electrodes in cathode ray tube.
D. Characteristics of cathode rays depend upon the nature of gas present in the cathode ray tube.

## Answer: D

## - Watch Video Solution

5. Which of the following statements about the electron is incorrect?
A. It is a nagatively charged particle.
B. The mass of electron is equal to the mass of neutron.
C. It is a basic constituent of all atoms.
D. It is a constituent of cathode rays.

## Answer: B

6. Which of the following properties of atom could be explained correctly by Thomson model of atom?
A. Overall neutrality of atom.
B. Spectra of hydorgen atom.
C. Position of electrons, protons and neutrons in atom.
D. Stability of atom.

## Answer: A

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7. Two atoms are said to be isobars is
A. they have same atomic number but different mass number.
B. they have same number of electrons but different number of
C. they have same number of neutrons but different number of electrons.
D. Sum of the number of protons and neutrons is same but the number of protons is different.

## Answer: D

## D Watch Video Solution

8. The number of nodes in $3 p$ orbital
A. 3
B. 4
C. 2
D. 1

## Answer: D

9. Number of angular nodes for 4d orbtial is
A. 4
B. 3
C. 2
D. 1

## Answer: C

## - Watch Video Solution

10. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons?
A. Pauli's exclusion principle
B. Heisenberg's uncertainty principle.
C. Hund's rule of maximum multiplicity.
D. Aufbau principle.

## Answer: B

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11. Total number of orbitals associated with thrid shell will be.....
A. 2
B. 4
C. 9
D. 3

## Answer: C

## - Watch Video Solution

12. Orbital angular momentum depends on
A. 1
B. n and I
C. $n$ and $m$
D. $m$ and $s$.

## Answer: A

## - Watch Video Solution

13. Chlorine exists in two isotopic forms $\mathrm{Cl}-37$ and $\mathrm{Cl}-35$ but its atomic mass is 35.5 . this indicates the ratio of $\mathrm{Cl}-37$ and $\mathrm{Cl}-35$ is appromimately
A. $1: 2$
B. 1:1
C. $1: 3$
D. $3: 1$

## Answer: C

14. Which one of the following pairs of ions have the same electronic configuration?
A. $\mathrm{Cr}^{3+}, \mathrm{Fe}^{3+}$
B. $F e^{3+}, M n^{2+}$
C. $\mathrm{Fe}^{3+}, \mathrm{Co}^{3+}$
D. $\mathrm{Sc}^{3+}, \mathrm{Cr}^{3+}$

## Answer: B

## - Watch Video Solution

15. For the electrons of oxygen atom, which of the following statemetns correct?
A. $Z_{\text {eff }}$ for an electron in a $2 s$ orbital is the same as $Z_{\text {eff }}$ for an electron in a $2 p$ orbital.
B. An electron in the 2 s orbital has the same energy as an electron in the $2 p$ orbital.
C. $Z_{\text {eff }}$ for an electron in 1 s orbital is the same as $Z_{\text {eff }}$ for an electron in a 2 s orbital.
D. The two electrons present in the $2 s$ orbital have spin quantum numbers $m_{s}$ but of opposite sign.

## Answer: D

## - Watch Video Solution

16. It travelling at same speeds, whichof the following mater waves have the shortest wavelength?
A. Electron
B. Alpha particle $\left(\mathrm{He}^{2+}\right)$
C. Neutron
D. Proton

## Answer: B

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17. Identify the paris which are not of isotopes?
A. ${ }_{6}^{12} X,{ }_{6}^{13} Y$
B. ${ }_{17}^{35} X,{ }_{17}^{37} Y$
C. ${ }_{6}^{14} X,{ }_{7}^{14} Y$
D. ${ }_{4}^{8} X,{ }_{5}^{8} Y$.

## Answer: C::D

18. Out of the folowing paris of electorns, identify the pairs of electrons present in degenrate orbitals.
A. $(i) n=3, l=2, m_{l}=-2, m_{s}=-\frac{1}{2}$
(ii) $n=3, l=2, m_{l}=-1, m_{s}=-\frac{1}{2}$
B. $(i) n=3, l=1, m_{l}=1, m_{s}=+\frac{1}{2}$
(ii) $n=3, l=2, m_{l}=1, m_{s}=+\frac{1}{2}$
C. $(i) n=4, l=1, m_{l}=1, m_{s}=+\frac{1}{2}$
(ii) $n=3, l=2, m_{l}=1, m_{s}=+\frac{1}{2}$
D. $(i) n=3, l=2, m_{l}=+2, m_{s}=-\frac{1}{2}$
(ii) $n=3, l=2, m_{l}=+2, m_{s}=+\frac{1}{2}$

## Answer: A::D

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19. Which of the following sets of quantum numbers are correct? nlmnlm

A. (a) $1 \quad 1+2$
(b) $\begin{array}{ccc}\mathrm{n} & l & m_{l} \\ 2 & 1 & +1\end{array}$
B.
n $l l l$
C.
(c) $3 \quad 2 \quad-2$
D. $\begin{array}{llll} & \mathrm{n} & l & m_{l} \\ 3 & 4 & -2\end{array}$

## Answer: B::C

## - Watch Video Solution

20. In which of the following pairs, the ions are iso-electronic ?
A. $N a^{+}, M g^{2+}$
B. $A l^{3+}, O^{-}$
C. $\mathrm{Na}^{+}, \mathrm{O}^{2-}$
D. $\mathrm{N}^{3-}, \mathrm{Cl}^{-}$

## D Watch Video Solution

21. Which of the following statements concerning the quantum numbers are correct?
A. Angular quantum number determines the three dimensional shape of the orbital.
B. The principal quantum number determines the orientation and energy of the orbital.
C. Magnetic quantum number determines the size of the orbital.
D. Spin quantum number of an electron determines the orientation of the spin of electron relative to the chosen axis.

## Answer: A::D

22. Match the following species with their corresponding ground state electronic configuration.
Atom/lon
Electronic configuration
(a) Cu
(i) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{10}$
(b) $\mathrm{cu}^{2+}$
(ii) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{10} 4 s^{2}$
(c) $\mathrm{Zn}^{2+}$
(iii) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{10} 4 s^{1}$
(d) $\mathrm{cr}^{3+}$
(iv) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{9}$
(v) $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{3}$

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23. Match the quantum numbers with the information provided by these.

Quantum number
(a) Principal quantum number
(b) Azimuthal quantum number
(c) Magnetic quantum number
(d) Spin quantum number

Information provided
(i) orientation of the orbital
(ii) energy and size of orbital
(iii) spin of electron
(iv) Shape of the orbital

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24. Match the following rules with their statement :

Rules
(a) Hund's Rule
(b) Aufbau Principle
(c) Pauli Exclusion Principle
(d) Heisenberg's Uncertainty
(v) In the ground state of atoms, orbita

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25. Match the following :
(a) X-rays
(i) $\quad v=10^{0}-10^{4} \mathrm{~Hz}$
(b) UV
(ii) $\quad \mathrm{v}=10^{10} \mathrm{~Hz}$
(c) Long radio waves
(iii) $\mathrm{v}=10^{16} \mathrm{~Hz}$
(d) Microwave
(iv) $\mathrm{v}=10^{18} \mathrm{~Hz}$
26. Match the following :
(a) Photon
(i) value is 4 for N -shell
(b) Electron
(ii) Probability density
(c) $\psi^{2}$
(iii) Always negative value
(d) Principal quantum number n
(iv) Exhibits both momentum and

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27. Match species given in Column I with the electronic configuration given in Column II.

Column I Column II
(a) cr
(i) $[A r] 3 d^{8} 4 s^{0}$
(b) $\mathrm{Fe}^{2+}$
(ii) $[A r] 3 d^{10} 4 s^{1}$
(c) $N i^{2+}$
(iii) $[A r] 3 d^{6} 4 s^{0}$
(d) Cu
(iv) $[A r] 3 d^{5} 4 s^{1}$
(v) $[A r] 3 d^{6} 4 s^{2}$

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28. Assertion(A): All isotopes of a given element show the same type of chemical behaviour.

Reason $(R)$ The chemical properties of an atom are controlled by the numb er of electron $s$ in the atom.
A. Both $A$ and $R$ are true and $R$ is the correct explanation of $A$.
B. Both $A$ and $R$ are true but $R$ is not the correct explanation of $A$.
C. $A$ is true but $R$ is false.
D. Both $A$ and $R$ are false.

## Answer: A

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29. Assertion(A) Black body is an ideal body that emits and absorbs radiations of all frequencies.

Reason(R) The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature.
A. Both $A$ and $R$ are true and $R$ is the correct explanation of $A$.
B. Both $A$ and $R$ are true but $R$ is not the correct explanation of $A$.
C. $A$ is true but $R$ is false.
D. Both $A$ and $R$ are false.

## Answer: B

## D Watch Video Solution

30. Assertion (A) It is impossible to determine the exact position and exact momentum of an electron simultaneously.

Reason (R) The path of an electron in an atom is clearly defiened.
$A$. Both $A$ and $R$ are true and $R$ is the correct explanation of $A$.
$B$. Both $A$ and $R$ are true but $R$ is not the correct explanation of $A$.
C. $A$ is true but $R$ is false.
D. Both $A$ and $R$ are false.

## Answer: C

## Multiple Choice Questions Mcqs

1. The most abundant isotope of hydrogen is :
A. Hydrogen ion
B. Protium
C. Deuterium
D. Tritium.

## Answer: D

## - Watch Video Solution

2. The values of quantum numbers for 2 p orbitals are :
A. $n=1, l=2$
B. $n=1, l=0$
C. $n=2, \mathrm{l}=1$
D. $n=2, \mathrm{l}=0$

## Answer: C

## - Watch Video Solution

3. The correct set of quantum numbers for 4 d -electrons is
A. $4,3,2,+1 / 2$
B. $4,2,1,0$
C. $4,3,-2,+1 / 2$
D. $4,2,1,-1 / 2$.

## Answer: D

4. The shape of the orbital is determined by
A. spin quantum number
B. magnetic quantum number
C. azimuthal quantum number
D. principal quantum number.

## Answer: C

## - Watch Video Solution

5. Which of the following postutales does not belong 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 the nucleus=centrifugal force
D. The energy changes are taking place continuously.

## Answer: D

## D Watch Video Solution

6. An element with atomic number 20 will be placed in which period of the periodic table
A. 5th
B. 4th
C. 3rd
D. 2nd.

## Answer: B

## D Watch Video Solution

7. Which of the following statement about proton is correct?
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 $\alpha$-particle.

## Answer: C

## D Watch Video Solution

8. The radiation having maximum wave length is
A. ultraviolet
B. radiowave
C. X-ray
D. infra-red

## Answer: B

9. If the uncertainty in the position of an electron is zero the nucertainty in its momentum be
A. zero
B. $<h / 4 \pi$
C. $>h / 4 \pi$
D. infinite

## Answer: D

## - Watch Video Solution

10. Which electronic level would allow the hydrogen atom to absorbs a photon but not to emit a photon
A. 1 s and 2 s orbitals are spherical in shape.
B. 2 s
C. 3s
D. 4 s

## Answer: A

## - Watch Video Solution

11. Any p- orbital can accomedate upto:
A. four electrons
B. two electrons with parallel spin
C. six electrons
D. two electrons with opposite spins.

## Answer: D

## - Watch Video Solution

## Assignment

1. What are cathode rays?

## - Watch Video Solution

2. what is the $\mathrm{e} / \mathrm{m}$ value of an electron?

## - Watch Video Solution

3. What is the value of mass and charge on the proton ?

## - Watch Video Solution

4. Who discovered neutron?

## - Watch Video Solution

5. How many times is an atom bigger than the nucleus ?

## - Watch Video Solution

6. When is no. of protons and electrons same in an atom ?

## Watch Video Solution

7. Define atomic number.

## - Watch Video Solution

8. An anion $M^{3-}$ had 18 electrons, what is its atomic number ?

## - Watch Video Solution

9. What is common in the (i) isobars (ii) isotones ?
10. How does a neutron differ from proton ?

## - Watch Video Solution

11. Total charge on one mole of monovalent ion is equal to

## - Watch Video Solution

12. How many neutrons are present in $\cdot{ }_{18}^{40} C a$ ?

## - Watch Video Solution

13. What is the nature of particles which constitute positive rays ?
14. Are mass number and atomic number of an element same in all respects ?

## - Watch Video Solution

15. Do isotopes of an element possess different chemical properties ?

## - Watch Video Solution

16. Name the three fundamental particles in an atom. Write the values of their mass numbers and atomic numbers.

## - Watch Video Solution

17. Why is an electron called universal particle ?

## - Watch Video Solution

18. Enlist four properties of cathode rays.

## - Watch Video Solution

19. Define atomic number of an element. How is it related to the mass number?

## Watch Video Solution

20. Define a neutron. Mention its mass and charge.

## - Watch Video Solution

21. How are the following species related ?
$.{ }_{6}^{14} \mathrm{C},{ }_{7}^{15} \mathrm{~N}, .{ }_{8}^{16} \mathrm{O}$

Watch Video Solution
22. What are electromagnetic radiations ? Name two such radiations.

## - Watch Video Solution

23. What is the common velocity of all electromagnetic waves ?

## - Watch Video Solution

24. Define wave length. What is its S.I. unit ?

## - Watch Video Solution

25. How are frequency and wavelength related to each other ?
26. Arrrange the following electromagnetic waves in the order of their increasing wavelength:
(a) $\gamma$-rays (b) microwaves.
(c) x-rays (d) Radiowaves.

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27. Which of the following are not electro magnetic waves :
(i) $\alpha$-rays
(ii) $\beta$-rays
(iii) $\lambda$-rays (iv) cosmic rays
(v) radio waves (vi) sound waves ?

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28. Define wave length, frequency and wave number. How is frequency related to wave number ?
29. What is the wavelength of a radiowave with frequency of 1200 kHz ?

## - Watch Video Solution

30. Compare the energies of the two radiations with wavelength 6000 Ã... and $4000 \tilde{A} . . . . . ~_{\text {. }}$

## - Watch Video Solution

31. Enlist the main limitations of the Bohr's theory.

## - Watch Video Solution

## Competitive Examinations

1. For which of the following set of quantum numbers, an electron will have the highest energy ?
A. $3,2,+1,+1 / 2$
B. $4,2,-1,+1 / 2$
C. $4,1,0,-1 / 2$
D. $5,0,0,+1 / 2$

## Answer: B

## - Watch Video Solution

2. Which one of the following pairs of atoms/atom-ion have identical ground state configuration?
A. $\mathrm{Li}^{+}$and $\mathrm{He} e^{+}$
B. $\mathrm{Cl}^{-}$and Ar
C. Na and K
D. $F^{+}$and Ne

## Answer: B

3. g sub-shell is characterised by :
A. $I=5$
B. I=3
C. $\mathrm{I}=4$
D. $1=5$

## Answer: C

## - Watch Video Solution

4. Derive an expression for the de Broglie relationship.
A. $\frac{h}{m v}=p$
B. $\lambda \frac{h}{m v}$
C. $\lambda=\frac{h}{m p}$
D. $\lambda m=\frac{v}{p}$

## Answer: B

## - Watch Video Solution

5. The number of spherical nodes for 4 d orbital is :
A. zero
B. one
C. two
D. three

## Answer: B

## - Watch Video Solution

6. The configuration $1 s^{2} 2 s^{2} 2 p^{5} 3 s^{1}$ shows
A. ground state of fluorine
B. excited state of fluorine
C. excited state of neon
D. excited state of $O_{2}^{-}$ion

## Answer: C

## D Watch Video Solution

7. The electronic configuration of $C u^{2+}$ ion is :
A. $[A r] 4 s^{1} 3 d^{8}$
B. $[A r] 4 s^{2} 3 d^{10} 4 p^{1}$
C. $[A r] 4 s^{1} 3 d^{10}$
D. $[A r] 3 d^{9}$

## Answer: D

8. Which of the following orbitals have a dumb bell shape?
A. $s$
B. $p$
C. d
D. $f$

## Answer: B

## D Watch Video Solution

9. The total number of orbitals in a shell having principal quantum $n$ is
A. $2 n$
B. $n^{2}$
C. $2 n^{2}$
D. $(\mathrm{n}+1)$

## Answer: B

## - Watch Video Solution

10. Bohr's radius for the H -atom $(\mathrm{n}=1)$ is approximately 0.53 Ã.... The radius of the first excited state $(\mathrm{n}=2)$ is :
A. 0.13 Ã...
B. 1.06 Ã...
C. 4.77 Ã...
D. 2.12 Ã...

## Answer: D

## - Watch Video Solution

11. The species which is not paramagnetic among the following is
A. $C l^{-}$
B. $B e^{-}$
C. $N e^{2+}$
D. $A s^{+}$

## Answer: A

## - Watch Video Solution

12. What is the wavelength of light . Given energy $=3.03 \times 10^{-19} J, h=6.6 \times 10^{-34} J S, c=3.0 \times 10^{8} \mathrm{~m} / \mathrm{s}$ ?
A. 6.54 nm
B. 654 nm
C. 0.654 nm
D. 65.4 nm

## Answer: B

## D Watch Video Solution

13. The following quantum numbers are possible for how many orbitals
$(s) n=3, l=2, m=+2 ?$
A. 1
B. 2
C. 3
D. 4

## Answer: A

## - Watch Video Solution

14. Azimuthal quantum number defines.
A. e/m ratio of electron
B. spin of electron
C. angular momentum of electron
D. magnetic momentum of electron .

## Answer: C

## D Watch Video Solution

15. The correct orders of increasing energy of atomic orbitals is
A. $5 p<4 f<6 s<5 d$
B. $5 p<6 s<4 f<5 d$
C. $4 f<5 p<5 d<6 s$
D. $5 p<5 d<4 f<6 s$.

## Answer: B

16. Isoelectronic species are :
A. $F^{-}, O^{2-}$
B. $F^{-}, O$
C. $F^{-}, O^{+}$
D. $F^{-}, O^{2+}$.

## Answer: A

## - Watch Video Solution

17. Quantum numbers $n=2, I=1$ represent :
A. 1s orbital
B. 2s orbital
C. $2 p$ orbital
D. 3d orbital

## Answer: C

## - Watch Video Solution

18. The quantum numbers ' $m$ ' of a free gaseous atom is associated with :
A. The effective volume of the orbital
B. The shape of the orbital
C. The spatial orientation of the orbital.
D. The energy of the orbital in the absence of the magnetic field.

## Answer: C

## - Watch Video Solution

19. The value of Planck's constant is $6.63 \times 10^{-34} \mathrm{Js}$. The velocity of light is $3.0 \times 10^{8} \mathrm{~ms}^{-1}$. Which value is closest to the wavelength in nanometers of a quantum of light with frequency $8 \times 10^{15} \mathrm{~s}^{-1}$ ?
A. $2 \times 10^{-25}$
B. $5 \times 10^{-18}$
C. $4 \times 10^{1}$
D. $3 \times 10^{7}$

## Answer: C

## - Watch Video Solution

20. For principal quantum number, $\mathrm{n}=4$, the toal number of orbitals having $\mathrm{I}=3$ is
A. 3
B. 7
C. 5
D. 9

## Answer: B

## - Watch Video Solution

21. The energy of second Bohr orbit of the hydrogen atom is $-328 \mathrm{kJmol}^{-1}$, hence the energy of fourth Bohr orbit would be.
A. $-41 \mathrm{kJmol}^{-1}$
B. $-82 \mathrm{kJmol}^{-1}$
C. $-164 k \mathrm{Jmol}^{-1}$
D. $-1312 \mathrm{kJmol}^{-1}$

## Answer: B

22. The orientation of an atomic orbital is governed by :
A. Principal quantum number
B. Azimuthal quantum number
C. Spin quantum number
D. Magnetic quantum number.

## Answer: D

## - Watch Video Solution

23. 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

## - Watch Video Solution

24. Consider the following sets of quantum numbers.
(i) $\begin{array}{llll}n & l & m & s \\ 3 & 0 & 0 & +1 / 2\end{array}$
(ii) $\begin{array}{llll}n & l & m & s \\ 2 & 2 & 1 & +1 / 2\end{array}$
(iii) $\begin{array}{llll}n & l & m & s \\ 4 & 3 & -2 & -1 / 2\end{array}$
(iv) $\begin{array}{llll}n & l & m & s \\ 1 & 0 & -1 & -1 / 2\end{array}$
(v) $\begin{array}{llll}n & l & m & s \\ 3 & 2 & 3 & +1 / 2\end{array}$

Which of the following sets of quantum number is not possible?
A. (i),(ii),(iii) and (iv)
B. (ii),(iv), and (v)
C. (i) and (iii)
D. (ii), (iii) and (iv)

## - Watch Video Solution

25. The measurement of the electron position is associated with an uncertainty in momentum, which is equal to $1 \times 10^{-18} \mathrm{gcms}^{-1}$. The uncertainty in electron velocity is (mass of an electron is $9 \times 10^{-28} g$ )
A. $1 \times 10^{8} \mathrm{cms}^{-1}$
B. $1 \times 10^{11} \mathrm{cms}^{-1}$
C. $1 \times 10^{9} \mathrm{cms}^{-1}$
D. $1 \times 10^{6} \mathrm{cms}^{-1}$

## Answer: C

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26. Which one of the following ions has electronic configuration $[\mathrm{Ar}] 3 d^{6}$ $?($ At. Nos. $\mathrm{Mn}=25, \mathrm{Fe}=26, \mathrm{Co}=27, \mathrm{Ni}=28)$
A. $N i^{3+}$
B. $M n^{3+}$
C. $F e^{3+}$
D. $\mathrm{Co}^{3+}$

## Answer: D

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27. Deuterium nucleus contains:
A. $1 p+1 n$
B. $2 p+0 n$
C. $1 p+p e^{-}$
D. $2 p+2 n$

## Answer: A

28. The line spectrum of $\mathrm{He}^{+}$ion will resemble that of :
A. Hydrogen atom
B. $L i^{+}$ion
C. Helium atom
D. Lithium atom

## Answer: A

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29. Maximum number of electrons in a sub-shell with $l=3$ and $n=4$ is.
A. 14
B. 16
C. 10
D. 12

## Answer: A

## - Watch Video Solution

30. Correct set of four quantum numbers for the valence (outermost) electron of rubidium $(Z=37)$ is
A. $5,1,1,+1 / 2$
B. $6,0,0,+1 / / 2$
C. $5,0,0,+1 / 2$
D. $5,1,0,+1 / 2$

## Answer: C

31. The orbital angular momentum of a p-electron is given as:
A. $\frac{h}{\sqrt{2} \pi}$
B. $\sqrt{3} \frac{h}{2 \pi}$
C. $\sqrt{\frac{3}{2}} \frac{h}{\pi}$
D. $\sqrt{6} \frac{h}{2 \pi}$.

## Answer: A

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32. What is the maximum number of electrons that can be associated
with a following set of quantum numbers ?
( $n=3, l=1$ and $m=-1$ ).
A. 2
B. 10
C. 6
D. 4

## Answer: A

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33. Based on equation $E=-2.178 \times 10^{-18} J\left(\frac{Z^{2}}{n^{2}}\right)$, certain conclusions are written. Which of them is not correct ?
A. For $\mathrm{n}=1$, the electron has a more negative energy than it does for $\mathrm{n}=6$ which means that the electron is more loosely bound in the smallest allowed orbit.
B. The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.
C. Larger the value of $n$, the larger is the orbit radius.
D. Equation can be used to calculate the change in energy when the electron changes orbit.

## Answer: A

## D Watch Video Solution

34. The value of Planck's constant is $6.63 \times 10^{-34} \mathrm{Js}$. The speed of light is $3 \times 10^{17} n m s^{-1}$. Which value is the closed to the wavelength in nanometers of a quantum of light with frequency $6 \times 10^{10} s^{-1}$ ?
A. 75
B. 10
C. 25
D. 50

## Answer: D

35. $B e^{2+}$ is iso electronic with which of the following ions?
A. $H^{+}$
B. $\mathrm{Li}^{+}$
C. $\mathrm{Na}^{+}$
D. $M g^{2+}$

## Answer: B

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36. The number of d-electrons in $F e^{2+}(\mathrm{Z}=26)$ is not equal to the number of electrons in which one of the following ?
A. d-electrons in $\mathrm{Fe}(\mathrm{Z}=26)$
B. p-electrons in $\mathrm{Ne}(Z=10)$
C. s-electrons in $M g(Z=12)$
D. p-electrons in $\mathrm{Cl}(\mathrm{Z}=17)$

## Answer: D

## - Watch Video Solution

37. The orbital angular momentum of an electron in a d-orbital is:
A. 4
B.
.
C.
D.

## Answer: C

## - Watch Video Solution

38. Gadolinium belongsd to 4 f series. It's atomic number is 64 . which of the following is the correct electronic configuration of gadolinium?
A. $[X e] 4 f^{9} 5 s^{1}$
B. $[X e] 4 f^{7} 5 d^{1} 6 s^{2}$
C. $[X e] 4 f^{6} 5 d^{2} 6 s^{2}$
D. $[X e] 4 f^{8} 6 d^{2}$

## Answer: B

## - Watch Video Solution

39. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium ? (At. No. $Z=22$ )
A. 4 s 3 s 3 p 3 d
B. 3 s 3 p 3 d 4 s
C. 3 s 3 p 4 s 3 d
D. 3 s 4 s 3 p 3 d

## Answer: C

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40. Which of the following sets of quantum numbers is not possible?
A. $n=3, l=3, m_{l}=-3, m_{s}=+1 / 2$
B. $n=3, l=1, m_{l}=2, m_{s}=-1 / 2$
C. $n=2, l=0, m_{l}=0, m_{s}=+1 / 2$
D. $n=1, l=0, m_{l}=0, m_{s}=0$

## Answer: C

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41. Two electrons occupying the same orbital are distinguished by :
A. spin quantum number
B. Principal quantum number
C. Magnetic quantum number
D. Azimuthal quantum number.

## Answer: A

## D Watch Video Solution

42. How many electrons can fit in the orbital for which $\mathrm{n}=3$ and $\mathrm{I}=1$ ?
A. 14
B. 2
C. 6
D. 10

## Answer: B

## Select The Correct Answers

1. The electronic configuration of an atom/ion can be defined by the following
A. Aufbay principle
B. Hund's rule
C. Pauli's Exclusion principle
D. All the above

## Answer: D

## - Watch Video Solution

2. The number of electrons in 3d shell for element with atomic number 26
A. 4
B. 6
C. 8
D. 10

## Answer: B

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3. Negative electron gain energy for hydrogen atom means that
A. the energy of an electron in an atom is lower than the energy of free electron at rest which is taken as zero.
B. when the electron is free from the influence of nucleus, it has a negative value which becomes more negative.
C. when the electron is attracted by the nucleus, the energy is absorbed which means a negative value.
D. energy is released by hydrogen atom in the ground state .

## Answer: C

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4. The ground state configuration of $F e^{3+}$ ion in gaseous state is: (At.

No. of $\mathrm{Fe}=26$ )
A. $[A r]^{18} 3 d^{3} 4 s^{2}$
B. $[A r]^{18} 3 d^{6} 4 s^{2}$
C. $[A r]^{18} 3 d^{5}$
D. $[A r]^{18} 3 d^{6}$

## Answer: C

5. Which of the following has non-spherical sub-shell of electron?
A. He
B. B
C. Be
D. Li

## Answer: B

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6. The set of quantum number not applicable to an electron
A. $1,1,1,+1 / 2$
B. $1,0,0,+1 / 2$
C. $1,0,0,-1 / 2$
D. $2,0,0,+1 / 2$

## D Watch Video Solution

7. The first emission line of Balmer series in H spectrum has the wave number equal to :
A. $\frac{9 R}{400} \mathrm{~cm}^{-1}$
B. $\frac{7 R}{144} \mathrm{~cm}^{-1}$
C. $\frac{3 R}{4} c m^{-1}$
D. $\frac{5 R}{36} \mathrm{~cm}^{-1}$

## Answer: D

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8. Which of the following set of quantum number belongs to highest
A. $n=4, l=0, m=0, s=+1 / 2$
B. $n=3, l=0, m=0, s=+1 / 2$
C. $n=3, l=1, m=+1, s=+1 / 2$
D. $n=3, \mathrm{l}=2, \mathrm{~m}=+1, \mathrm{~s}=+1 / 2$

## Answer: D

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9. Which of the following expression respresents the electron probability function $(D)$ ?
A. $4 \pi r d r \Psi^{2}$
B. $4 \pi r^{2} d r \Psi$
C. $4 \pi r^{2} d r \Psi^{2}$
D. $4 \pi d r \Psi$

## Answer: C

10. The total number of electrons present in all $s$ orbitals, all the $p$ orbitals, and all the $d$ orbitals of cesium ion are, respectively,
A. $8,26,10$
B. 10, 24, 20
C. $8,22,24$
D. $12,20,22$

## Answer: B

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11. Uncertainty in position of mass 25 g in space is $10^{-5} \mathrm{~m}$. The uncertainty in it's velocity (in $m s^{-1}$ is :
A. $2.1 \times 10^{-34}$
B. $0.5 \times 10^{-34}$
C. $2.1 \times 10^{-28}$
D. $0.5 \times 10^{-23}$

## Answer: C

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12. The de-Broglie wavelength of the tennis ball of mass 60 g moving with a velocity of $10 \mathrm{~m} / \mathrm{s}$ is approx.: (Plank's constant $h=6.63 \times 10^{-34} \mathrm{Js}$ )
A. $10^{-16}$ metres
B. $10^{-25}$ metres
C. $10^{-33}$ metres
D. $10^{-31}$ metres.

## Answer: C

13. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)} \frac{h}{2 \pi}$. What is the momentum of an s-electron?
A. $h / 2 \pi$
B. $\sqrt{2} h / \pi$
C. $+\frac{1}{2} h / 2 \pi$
D. zero.

## Answer: D

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14. 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?
(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) $\quad n=3, l=2, m=0$
A. (i) and (ii)
B. (ii) and (iii)
C. (iii) and (iv)
D. (iv) and (v)

## Answer: D

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15. According to Bohr's theory, the angular momentum of electron in the fifth Bohr orbit is:
A. $25 \frac{h}{\pi}$
B. $1.0 \frac{\mathrm{~h}}{\pi}$
C. $10 \frac{h}{\pi}$
D. $2.5 \frac{h}{\pi}$
16. A Photon of red light having wavelength 600 nm has energy equal of $\left(h=6.6 \times 10^{-34} \mathrm{Js}\right):$
A. $3.3 \times 10^{-19} J$
B. $1.0 \times 10^{-19} \mathrm{~J}$
C. $3.0 \times 10^{-18} \mathrm{~J}$
D. $1 \times 10^{19} J$

## Answer: A

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17. The wavelength of a radiation having frequency 1000 Hz is :
A. $3 \times 10^{13} \mathrm{~cm}$
B. $3.0 \times 10^{7} \mathrm{~cm}$
C. 3000 Ã...
D. 300 nm

## Answer: B

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18. In photoelectric effect, the energy of the photon striking a metallic surface is $5.6 \times 10^{-19} \mathrm{~J}$. The kinetic energy of the ejected electrons is $12.0 \times 10^{-20} J$. The work function is:
A. $6.4 \times 10^{-19} \mathrm{~J}$
B. $6.8 \times 10^{-19} \mathrm{~J}$
C. $4.4 \times 10^{-19} J$
D. $6.4 \times 10^{-20} J$

## Answer: C

19. Calculate the wavelength of the radiations in nanometers emitted when an electron in hydrogen atom jumps from third orbit to the ground state. $\left(R_{H}=109677 \mathrm{~cm}^{-1}\right)$
A. 103 nm
B. 216 nm
C. 110 nm
D. 246 nm

## Answer: A

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20. Calculate the first excitation energy of electron in the hydrogen atom.
A. $9.84 \times 10^{5} \mathrm{Jmol}^{-1}$
B. $5.64 \times 10^{6} \mathrm{Jmol}^{-1}$
C. $9.84 \times 10^{7} \mathrm{Jmol}^{-1}$
D. $6.32 \times 10^{7} \mathrm{Jmol}^{-1}$

## Answer: A

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21. Identify the incorrect statement among the following.
A. $4 f$ and $5 f$ orbitals are equally shielded
B. d-Block elements show irregular and erratic chemical properties among them-selves.
C. La and Lu have partially filled d-orbitals and no other partically filled orbitals
D. The chemistry of various lanthanoids is similar .

## Answer: A

22. Which of the following sets of quantum numbers represents highest energy of an atom ?
A. $n=3, \mathrm{l}=0, \mathrm{~m}=0, \mathrm{~s}=+1 / 2$
B. $n=3, l=1, m=1, s=+1 / 2$
C. $n=3,1=2, m=1, s=+1 / 2$
D. $\mathrm{n}=4, \mathrm{l}=0, \mathrm{~m}=0, \mathrm{~s}=+1 / 2$

## Answer: C

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23. The ionization enthalpy of hydrogen atom is $1.312 \times 10^{6} \mathrm{Jmol}^{-1}$. The energy required to excite the electron in the atom from $n=1$ to $n=2$ is:
A. $9.84 \times 10^{5} \mathrm{Jmol}^{-1}$
B. $8.51 \times 10^{5} \mathrm{Jmol}^{-1}$
C. $6.56 \times 10^{5} \mathrm{Jmol}^{-1}$
D. $7.56 \times 10^{5} \mathrm{Jmol}^{-1}$

## Answer: A

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24. Ionisation energy of $\mathrm{He}{ }^{+}$is $19.6 \times 10^{-18} \mathrm{Jatom}^{-1}$. The energy of the first stationary state ( $n=1$ ) of $L i^{2+}$ is.
A. $8.82 \times 010^{-17} \mathrm{Jatom}^{-1}$
B. $4.41 \times 10^{-16} \mathrm{Jatom}^{-1}$
C. $-4.41 \times 10^{-17} \mathrm{Jatom}^{-1}$
D. $-2.2 \times 10^{-15} \mathrm{Jatom}^{-1}$

## Answer: C

25. The energy required to break one mole of $\mathrm{Cl}-\mathrm{Cl}$ bonds in $\mathrm{Cl}_{2}$ is $242 \mathrm{kJmol}^{-1}$. The longest wavelength of light capable of breaking a since $C l-C l$ bond is
A. 494 nm
B. 594 nm
C. 640 nm
D. 700 nm

## Answer: A

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26. Ground state electronic configuration of Cr atom is :
A. $[A r] 3 d^{4} 4 s^{2}$
B. $[A r] 3 d^{5} 4 s^{1}$
C. $[A r] 3 d(6) 4 s^{0}$
D. $[A r] 3 d^{5} 4 s^{2}$

## Answer: B

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27. The wave number of the spectral line in the emission spectrum of hydrogen will be equal to $\frac{8}{9}$ times the Rydberg's constant if the electron jumps from $\qquad$
A. $n=3$ to $n=1$
B. $\mathrm{n}=10$ to $\mathrm{n}=1$
C. $n=9$ to $n=1$
D. $n=2$ to $n=1$

## Answer: A

28. The electrons identified by quantum numbers n and I :-
(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. $(4)<(2)<(3)<(1)$
B. $(2)<(4)<(1)<(3)$
C. $(1)<(3)<(2)<(4)$
D. $(3)<(4)<(2)<(1)$

## Answer: A

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29. Number of electrons present in the 3d sub-shell of an element having atomic number 37 is :
A. 7
B. 5
C. 9
D. 3

## Answer: A

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30. For a ' $f$ ' electron the orbital angular momentum is
A. $\frac{1.5 h}{\pi}$
B. $\frac{\sqrt{6} h}{\pi}$
C. $\frac{\sqrt{3} h}{\pi}$
D. $\frac{\sqrt{3} h}{2 \pi}$

## Answer: C

31. The emission spectrum of hydrogen discovered first and the region of the electromagnetic spectrum to which it belongs, respectively are :
A. Lyman, ultraviolet
B. Lyman, visible
C. Balmer, ultra violet
D. Balmer, visible

## Answer: A

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32. The statement that in NOT correct is
A. angular quantum number signifies the shape of the orbital.
B. energies of stationary states in hydrogen like atoms is inversely
proportional to the square of the principal quantum number.
C. total number of nodes for 3 s orbital is three.
D. The radius of the first orbit of $\mathrm{He}^{+}$is half that of the first orbit of hydrogen atom.

## Answer: C

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33. The Balmer series for atomic hydrogen is observed in the following spectral region :
A. Infrared
B. Ultraviolet
C. Visible
D. Far IR

## Answer: C

34. Which of the following is the energy of a possible excited state of hydrogen?
A. -3.4 eV
B. +6.8 eV
C. +13.6 eV
D. -6.8 eV

## Answer: A

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35. 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 greater energy than Q
B. P and Q represent the same electron
C. P and $Q$ have same energy
D. $P$ has less energy than $Q$

## Answer: A

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36. Schrodinger wave equation for a particle in a one-dimension box is
A. $\frac{\delta^{2} \Psi}{\delta x^{2}}+\frac{2 m}{h}(E+\infty) \Psi=0$
B. $\frac{\delta^{2} \Psi}{\delta x^{2}}+\frac{8 \pi^{2} m}{h^{2}}(E-V)=0$
C. $\frac{\delta^{2} \Psi}{\delta x^{2}}+\frac{2 m}{h}(E-V) \Psi=0$
D. $\frac{\delta^{2} \Psi}{\delta x^{2}}+\frac{8 \pi^{2} m}{h^{2}}(E-\infty)=0$

## Answer:

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37. Television picture tubes are :
A. Cathode-rays tubes
B. $\alpha$-particle tubes
C. $\lambda$-ray tubes
D. X-ray tubes

## Answer: A

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38. The minimum values of uncertainties involved in the determination of both the position and velocity of a particle are respectively $1 \times 10^{-10} \mathrm{~m}$ and $1 \times 10^{-10} \mathrm{~ms}^{-1}$, Then, the mass (in kg ) of the particle is
A. $5.270 \times 10^{-15}$
B. $5.270 \times 10^{-20}$
C. $5.270 \times 10^{-10}$
D. $5.270 \times 10^{-14}$

## Answer: A

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39. Consider the ground state $C r$ atom $(Z=24)$. The number of electron with the azimuthal number $l=1$ and 2 ,respectively are
A. 16,5
B. 16,4
C. 12,4
D. 12,5

## Answer: D

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40. 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 $h / \lambda$ (where $\lambda$ is wavelength associated with electron wave) is given by :
A. meV
B. 2 meV
C. $\sqrt{m e V}$
D. $\sqrt{2 m e V}$

## Answer: D

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41. Time taken by an electrons to complete one revolution in the Bohr orbit of the $H$ atom is
A. $\frac{4 m^{2} \pi r^{2}}{n^{2} h^{2}}$
B. $\frac{n^{2} h^{2}}{4 m r^{2}}$
C. $\frac{4 \pi^{2} m r^{2}}{n h}$
D. $\frac{n h}{4 \pi^{2} m r^{2}}$

## Answer: C

## - Watch Video Solution

42. What is the atomic number of the element with symbol Uus?
A. 117
B. 116
C. 115
D. 114

## Answer: A

43. In which of the following, the porduct of uncertainty in velocity and uncertainty in position of a microparticle of mass $m$ is less than
A. $h \times \frac{3 \pi}{m}$
B. $\frac{h}{3 \pi} \times m$
C. $\frac{h}{4 \pi} \times \frac{1}{m}$
D. $\frac{h}{4 \pi} \times m$

## Answer: C

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## Comprehension Linked Mcqs

1. According to Louis de Broglie, a French physicist, every moving material particle has a dual nature i.e., wave and particle nature. The two characters are co-related by de Broglie relation $\lambda=\frac{h}{m v(p)}$. Here $\lambda$ represents wave nature while p or $m v$ accounts for the particle nature.

Since $h$ is constant, the two characters are inversely proportional to each other. This relationship or equation is valid mainly for microscopic particles such as electrons, protons, atoms, ions, molecules etc. It does not apply to semi-micro or micro particles.

If travelling at equal speeds, the longest wavelength of the following matter waves is for
A. an electron
B. a proton
C. a neutron
D. an $\alpha$-particle $\left(H e^{2+}\right)$.

## Answer: A

## - Watch Video Solution

2. According to Louis de Broglie, a French physicist, every moving material particle has a dual nature i.e., wave and particle nature. The two characters are co-related by de Broglie relation $\lambda=\frac{h}{m v(p)}$. Here $\lambda$
represents wave nature while p or $m v$ accounts for the particle nature.
Since $h$ is constant , the two characters are inversely proportional to each other. This relationship or equation is valid mainly for microscopic particles such as electrons, protons, atoms, ions, molecules etc. It does not apply to semi-micro or micro particles.

Which of the following is not correct ?
A. All electromagnetic radiations travel with the same velocity.
B. Matter waves have generally velocity less than electromagnetic waves.
C. Matter waves are emitted by material particles.
D. Electromagnetic waves are associated with electric and magnetic fields but matter waves are not.

## Answer: C

## - Watch Video Solution

3. According to Louis de Broglie, a French physicist, every moving material particle has a dual nature i.e., wave and particle nature. The two characters are co-related by de Broglie relation $\lambda=\frac{h}{m v(p)}$. Here $\lambda$ represents wave nature while p or $m v$ accounts for the particle nature.

Since $h$ is constant , the two characters are inversely proportional to each other. This relationship or equation is valid mainly for microscopic particles such as electrons, protons, atoms, ions, molecules etc. It does not apply to semi-micro or micro particles.

A particle A moving with a certain velocity has a de Broglie wavelength of 1 Ã.... If a particle B has the mass $25 \%$ that of $A$ and velocity $75 \%$ that of $A$, the de Broglie wavelength of $B$ will be approximately .
A. 1 Ã...
B. 5.3 Ã...
C. 3 Ã...
D. $0.2 \tilde{A}$...

## Answer: C

4. A body of mass 10 mg is moving with a velocity of $100 \mathrm{~ms}^{-1}$. The wavelength of the de Broglie wave associated with it would be
A. $6.63 \times 10^{-35} m$
B. $6.63 \times 10^{-31} \mathrm{~m}$
C. $6.63 \times 10^{-37} m$
D. $6.63 \times 10^{-34} m$

## Answer: B

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5. According to Louis de Broglie, a French physicist, every moving material particle has a dual nature i.e., wave and particle nature. The two characters are co-related by de Broglie relation $\lambda=\frac{h}{m v(p)}$. Here $\lambda$ represents wave nature while p or $m v$ accounts for the particle nature.

Since $h$ is constant, the two characters are inversely proportional to each other. This relationship or equation is valid mainly for microscopic particles such as electrons, protons, atoms, ions, molecules etc. It does not apply to semi-micro or micro particles.

For particles having same kinetic energy, the de Broglie wavelength is :
A. directly proportional to velocity
B. inversely proportional to velocity
C. independent of velocity and mass
D. meaningless

## Answer: A

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6. We can pin point an aeroplane moving in the sky, whatever may be its speed i.e., we can locate both its exact position as wellas direction . However, it is not possible to doso in case of a moving microscopic particle such as electron. In fact, we cannot see any such particle without
disturbing it. This has been stated by Heisenberg in the form of uncertainty principle. The mathematical form of this principle is $: \Delta x . \Delta P \geq \frac{h}{4 \pi}$ (constant). Since the product of $\Delta x$ and $\Delta p(m \Delta v)$ is constant, if one is very small, the other is bound to be large. The principle as such has no significance in daily life since it applies to those particles which we can not see.

Heisenberg's uncertainty principle rules out the exact simultaneous measurement of
A. probability and intensity
B. energy and velocity
C. charge density and radius
D. position and momentum

## Answer: D

## - Watch Video Solution

7. We can pin point an aeroplane moving in the sky, whatever may be its speed i.e., we can locate both its exact position as wellas direction . However, it is not possible to doso in case of a moving microscopic particle such as electron. In fact, we cannot see any such particle without disturbing it. This has been stated by Heisenberg in the form of uncertainty principle. The mathematical form of this principle is : $\Delta x . \Delta P \geq \frac{h}{4 \pi}$ (constant). Since the product of $\Delta x$ and $\Delta p(m \Delta v)$ is constant, if one is very small, the other is bound to be large. The principle as such has no significance in daily life since it applies to those particles which we can not see.

If the uncertainty in the position of electron is zero, the uncertainty in its momentum would be
A. zero
B. greater than $h / 4 \pi$
C. less than $h / 4 \pi$
D. infinite

## Answer: D

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8. It is not possible to determine preciselt both the position and momentum (or velocity) of a small moving particle such as electron, proton etc. This is known as Heisenber uncertainty principle. The mathemactical form of this principle is :
$\Delta x . \Delta p \geq \frac{h}{4 \pi}$ (constant)
However this principle is irrevalent in case of bigger particles such as a cup, ball, car etc., that we come across in our daily life.

Given that the mass of electron is $9.1 \times 10^{-31} \mathrm{~kg}$ and velocity of electron is $2.2 \times 10^{6} \mathrm{~ms}^{-1}$, if uncertainty in its velocity is $0.1 \%$, the uncertainty in position would be
A. 26 nm
B. 32 nm
C. 48 nm
D. 50 nm

## Answer: A

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9. We can pin point an aeroplane moving in the sky, whatever may be its speed i.e., we can locate both its exact position as wellas direction . However, it is not possible to doso in case of a moving microscopic particle such as electron. In fact, we cannot see any such particle without disturbing it. This has been stated by Heisenberg in the form of uncertainty principle. The mathematical form of this principle is $: \Delta x . \Delta P \geq \frac{h}{4 \pi}$ (constant). Since the product of $\Delta x$ and $\Delta p(m \Delta v)$ is constant, if one is very small, the other is bound to be large. The principle as such has no significance in daily life since it applies to those particles which we can not see.

If uncertainty in position and momentum are equal , then the uncertainty in velocity is :
A. $\frac{1}{2 m} \sqrt{\frac{h}{\pi}}$
B. $\sqrt{\frac{h}{2 \pi}}$
C. $\sqrt{\frac{h}{\pi}}$
D. None of these

## Answer: A

## D Watch Video Solution

10. An electron in an atom can be completely designated with the help of four quantum numbers. Out of these, the first three i.e., principal ( n ), azimuthal $(\mathrm{I})$ and magnetic $(\mathrm{m})$ quantum number are obtained from the solution of Shrodinger wave equation while the spin(s) quantum number arises from the spin of the electron around its axis clockwise or antiaclockwise. Ot of these principal quantum number tells about the size, azimuthal quantum number about the shape and magnetic quantum signifies the orientation of the electron orbital.

The maximum number of electrons in a subshell having the same value of spin quantum number is given by
A. $1+2$
B. $21+1$
C. $I(I+1)$
D. $\sqrt{l(l+l)}$

## Answer: B

## - Watch Video Solution

11. An electron in an atom can be completely designated with the help of four quantum numbers. Out of these, the first three i.e., principal (n), azimuthal (I) and magnetic (m) quantum number are obtained from the solution of Shrodinger wave equation while the spin(s) quantum number arises from the spin of the electron around its axis clockwise or antiaclockwise. Ot of these principal quantum number tells about the size, azimuthal quantum number about the shape and magnetic quantum
signifies the orientation of the electron orbital.

The electronic configuration of P in $\mathrm{H}_{3} \mathrm{PO}_{4}$ is
A. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{3}$
B. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2}$
C. $1 s^{2} 2 s^{2} 2 p^{6}$
D. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 4 s^{1}$

## Answer: C

## - Watch Video Solution

12. An electron in an atom can be completely designated with the help of four quantum numbers. Out of these, the first three i.e., principal ( $n$ ), azimuthal (I) and magnetic (m) quantum number are obtained from the solution of Shrodinger wave equation while the spin(s) quantum number arises from the spin of the electron around its axis clockwise or antiaclockwise. Ot of these principal quantum number tells about the size, azimuthal quantum number about the shape and magnetic quantum
signifies the orientation of the electron orbital.

How many electrons in a given atom have the following set of quantium numbers?
$n=3, l=2, m=+2, s=-1 / 2$
A. 1
B. 18
C. 14
D. not possible

## Answer: A

## - Watch Video Solution

13. The hydrogen -like species $L i^{2+}$ 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 sate $S_{1}$ is
A. 1 s
B. 2 s
C. $2 p$
D. 3 s

## Answer: B

## - Watch Video Solution

14. The hydrogen -like species $L i^{2+}$ 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. 0.75
B. 1.50
C. 2.25
D. 4.50

## Answer: C

## - Watch Video Solution

15. The hydrogen -like species $\mathrm{Li}^{2+}$ 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

16. A p-orbital can accommodate upto :
A. four electrons
B. six electrons
C. two electrons with parallel spins
D. two electrons with opposite spins.

## Answer: D

## - Watch Video Solution

17. The principal quantum number of an atom is related in the
A. size of the orbital
B. spin angular momentum
C. orientation of the orbital in space
D. orbital angular momentum .

## Answer: A

## - Watch Video Solution

18. Rutherford's scattering experiment is related to the size of the
A. nucleus
B. atom
C. electron
D. neutron

## Answer: A

## - Watch Video Solution

19. The increasing order (lowest first) for the values of $e / m$ (charge//mass) for electron ( $e$ ), proton ( $p$ ), neutron ( $n$ ), and alpha particle $(\alpha)$ is
A. e, $\mathrm{p}, \mathrm{n}, \alpha$
B. n, p,e, $\alpha$
C. n, p, $\alpha$, e
D. $\mathrm{n}, \alpha, \mathrm{p}, \mathrm{e}$

## Answer: D

## - Watch Video Solution

20. Correct set of four quantum numbers for the valence (outermost) electron of rubidium $(Z=37)$ 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

## - Watch Video Solution

21. Which electronic level would allow the hydrogen atom to absorbs a photon but not to emit a photon
A. 3 s
B. $2 p$
C. 2s
D. 1s

## Answer: D

22. Electromagnetic radiation with maximum wavelengths is :
A. ultra violet
B. radio wave
C. X-ray
D. infra-red

## Answer: B

## - Watch Video Solution

23. Rutherford's $\alpha$ particle scattering experiment eventually led to the conclusion that
A. mass and energy are related.
B. electrons occupy the space around the nucleus
C. electrons are buried deep in the nucleus
D. the point of impact with matter can be precisely determined

## D Watch Video Solution

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

| A. | n | l | m |
| :--- | :--- | :--- | :--- |
| 3 | 2 | -2 | s |
| B. |  |  |  |
| n | l | m | s |
| 4 | 0 | 0 | $1 / 2$ |
| n | l | m | s |
| 3 | 2 | -3 | $1 / 2$ |
| C | l | m | s |
| D. |  |  |  |
| 5 | 3 | 0 | $-1 / 2$ |

## Answer: C

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25. The ratio of the energy of a photon of $2000 \AA \begin{aligned} & \text { wavelength radiation to }\end{aligned}$ that of $4000 \AA$ radiation is
A. $1 / 4$
B. 4
C. $1 / 2$
D. 2

## Answer: D

## - Watch Video Solution

26. Which of the following relates to photons both as wave motion and as a stream of particles?
A. Interference
B. $E=m c^{2}$
C. Diffraction
D. $E=h v$

## Answer: D

27. What is the orbital angular momentum of an electron in 2 s orbital ?
A. $+\frac{1}{2} \frac{h}{2 \pi}$
B. zero
C. $\frac{h}{2 \pi}$
D. $\sqrt{2} \frac{h}{2 \pi}$

## Answer: B

## Watch Video Solution

28. Which out of the following has maximum number of unpaired electrons?
A. $M g^{2+}$
B. $T i^{3+}$
c. $V^{3+}$
D. $\mathrm{Fe}^{2+}$

## Answer: D

## - Watch Video Solution

29. The energy of an electron in the first Bohr orbit of H atom is -13.6 eV The potential energy value (s) of excited state(s) for the electron in the Bohr orbit of hydrogen is(are)
A. $-3.4 e \mathrm{~V}$
B. -4.2 eV
C. -6.8 eV
D. +6.8 eV

## Answer: A

30. The electrons identified by quantum numbers n and I :-
(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. $(i v)<(i i)<(i i i)<(i)$
B. $(i i)<(i v)<(i)<(i i i)$
C. $(i i i)<(i i i)<(i i)<(i v)$
D. $(i i i)<(i)<(i v)<(i i)$

## Answer: A

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31. The wavelength associated with a golf ball weighing $200 g$ and moving at a speed of $5 m h^{-1}$ is of the order
A. $10^{-10} m$
B. $10^{-20}$
C. $10^{-30}$
D. $10^{40} \mathrm{~m}$

## Answer: C

## - Watch Video Solution

32. Rutherford's scattering experiment, which established the nuclear model of the atom, used a beam of
A. $\beta$-particles which impinged on a metal foil and got absorbed
B. $\lambda$-rays which impinged on a metal foil and ejected electrons
C. helium atoms which impinged on a metal foil and got reflected
D. helium nuclei which impinged on a metal foil and got scattered.

## Answer: D

33. The radius of which of the following orbit is same as that of the first Bohr's orbit of Hydrogen atom?
(a). $H e^{+}(n=2)$
(b) $L i^{2+}(n=2)$
(c). $L i^{2+}(n=3)$
(d). $B e^{3+}(n=2)$
A. $H e^{+}(n=2)$
B. $L i^{2+}(n=2)$
C. $L i^{2+}(n=3)$
D. $B e^{3+}(n=2)$

## Answer: D

## - Watch Video Solution

34. The number of radial nodes fo $3 s$ and 2 p orbitals are respectively:
A. 2, 0
B. 0,2
C. 1,2
D. 2, 1

## Answer: A

## - Watch Video Solution

35. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is [ $a_{0}$ is Bohr radius] :
A. $\frac{h^{2}}{2 \pi^{2} m a_{0}^{2}}$
B. $\frac{h^{2}}{16 \pi^{2} m a_{0}^{2}}$
C. $\frac{h^{2}}{32 \pi^{2} m a_{0}^{2}}$
D. $\frac{h^{2}}{64 \pi^{2} m a_{0}^{2}}$
36. In an atom, the total number of electrons having quantum numbers
$n=4,\left|m_{l}\right|=1$ and $m_{s}=-\frac{1}{2}$ is
A. 3
B. 4
C. 6
D. 8

## Answer: A

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37. $P$ 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 $4 \pi r^{2} d r$. The qualitative sketch of the dependence of $P$ on $r$ is
A.
B.
C.
D.

## Answer: C

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38. An isotone of.${ }_{32}^{76} G e$ is-
(a) $\cdot{ }_{32}^{77} G e$
(b). ${ }_{33}^{77} A s$
(c). ${ }_{34}^{77} S e$
(d). ${ }_{34}^{78} S e$
A..$_{32}^{77} G e$
B. ${ }_{33}^{77} A s$
C. ${ }_{34}^{77} S e$
D. ${ }_{34}^{78} \mathrm{Se}$

## Answer: B::D

## - Watch Video Solution

39. Many elements have non-integral atomic masses because
A. they have isotopes
B. their isotopes have non-integral masses
C. their isotopes have different masses
D. the constituents neutrons, protons and electrons, combine to given fractional masses

## Answer: A::C

40. When alpha particle 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 particle are positively charged
C. most part of the atom is empty space
D. alpha particles move with high velocity

## Answer: A::C

## - Watch Video Solution

41. The atomic nucleus contains:
A. protons
B. neutrons
C. electrons
D. photons

## D Watch Video Solution

42. Which of the following statement (s) is (are) correct ?
A. The electronic configuration of Cr is
$[A r] 3 d^{5} 4 s^{1}$ (Atomic number of $\mathrm{Cr}=24$
B. The magnetic quantum number may have a negative value
C. In silver atom 23 electrons have a spin of one type and 24 of the
opposite type. (Atomic number of $\mathrm{Ag}=47$ )
D. The oxidation state of nitrogen in $H N_{3}$ is - 3 .

## Answer: A::B::C

## - Watch Video Solution

1. Assertion : Photoelectric effect is most readily shown by ceasium metal.

Reason : Photon have easiest access to the surface of ceasium metal .
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: C

## - Watch Video Solution

2. Assertion (A) : An orbital cannot have more than two electrons, more over if an orbital has two electrons they must have opposite spins.

Reason (R) : No elements in an atom can have same set of all four quantum numbers.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

3. Assertion : Both position and momentum of an electron can not be determined simultaneously with maximum accuracy .

Reason : This is because of microscopic nature of electron.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

4. Assertion : The energy of an electron is mainly determined by principal quantum number.

Reason : The principal quantum number is the measure of the most probable distance of finding the electron around the nucleus.
A. if both assertion and reason are correct and reason is correct explanation for assertion.
B. If both assertion and reason are correct but reason in not correct
explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

5. Assertion (A) : $\mathrm{Fe}^{3+}(\mathrm{g})$ ion is more stable than $F e^{2+}(g)$ ion. Reason (R) : $\mathrm{Fe}^{3+}$ ion has more number of unpaired electrons than $\mathrm{Fe}^{2+}$ ion.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: C

## - Watch Video Solution

6. Assertion : An orbital cannot have more than two electrons.

Reason : The two electrons in an orbital create opposite magnetic fields.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: C

7. Assertion : The 19th electron in potassium atom enters 4 s -orbital and not 3d orbital.

Reason : The energies of the orbitals can be compared with the help of ( $\mathrm{n}+\mathrm{I}$ ) rules.
A. if both assertion and reason are correct and reason is correct explanation for assertion.
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

8. Assertion : Configuration of helium is $1 s^{2}$

Reason : Hund's rule demands that the configuration should display maximum stability.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

9. Assertion: $\mathrm{Cu}^{2+}$ ion is a coloured ion.

Reason : Every ion with unpaired electron is coloured.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: C

## - Watch Video Solution

10. Assertion : The electronic configuration of K ) (19) is $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 4 s^{1}$.

Reason : Energy of $4 s<3 d$. This is decided by Aufbau principle.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct
explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: A

## - Watch Video Solution

11. Assertion : X -rays are used to study the interior of objects .

Reason : X-rays have very short wavelengths and possess electromagnetic character.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: B

## - Watch Video Solution

12. Assertion : The outer electronic configuration of Cr and Cu are $3 d^{5} 4 s^{1}$ and $3 d^{10} 4 s^{1}$ respectively .

Reason : Electrons are filled in orbitals in order of increasing energies given by $(\mathrm{n}+\mathrm{I})$ rule.
A. if both assertion and reason are correct and reason is correct explanation for assertion .
B. If both assertion and reason are correct but reason in not correct explanation for assertion.
C. If assertion is correct but reason is incorrect.
D. If both assertion and reason are incorrect.

## Answer: B

## - Watch Video Solution

13. Statement 1. An electron can never be found in the nucleus.

Statement 2. Uncertainty in the position of an electron is greater than $10^{-15} \mathrm{~m}$.
A. Statement- 1 is true , Statement-2 is also true.

Statement-2 is the correct explanation of Statement-1
B. Statement-1 is true , Statement-2 is also true.

Statement-2 is not correct explanation of Statement-1
C. Statement -1 is true, Statement- 2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: A

14. Statement 1. An atom is electrically neutral .

Statement 2. Number of electrons is equal to number of neutrons.
A. Statement- 1 is true, Statement- 2 is also true.

Statement-2 is the correct explanation of Statement-1
B. Statement-1 is true, Statement-2 is also true.

Statement-2 is not correct explanation of Statement-1
C. Statement -1 is true, Statement- 2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: C

## - Watch Video Solution

15. Statement 1. In potassium atom, 19th electron enters 4 s orbital and not 3d orbital.

Statement 2. Orbital energies are compared by ( $\mathrm{n}+\mathrm{l}$ ) rule.
A. Statement- 1 is true , Statement- 2 is also true.

Statement-2 is the correct explanation of Statement-1
B. Statement-1 is true, Statement- 2 is also true.

Statement-2 is not correct explanation of Statement-1
C. Statement -1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: A

## - Watch Video Solution

16. Statement 1. $F e^{2+}$ ion has 24 electrons and its electronic configuration represents that of $\mathrm{Cr}(\mathrm{Z}=24)$.

Statement 2. All the five unpaired electrons, in the 3d sub shell give stability to the ion.
A. Statement- 1 is true, Statement- 2 is also true.

Statement-2 is the correct explanation of Statement-1
B. Statement-1 is true, Statement-2 is also true.

Statement-2 is not correct explanation of Statement-1
C. Statement -1 is true, Statement -2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: D

## D Watch Video Solution

## Reason Type Questions

1. Statement 1.4 s orbital has lower energy than 3d orbital.

Statement 2. s-orbital is spherically symmetrical and remains closer to the nucleus and has lower energy than d-orbital.
A. Statement-1 is true , Statement-2 is also true.

Statement-2 is the correct explanation of Statement-1
B. Statement-1 is true, Statement-2 is also true.

Statement-2 is not correct explanation of Statement-1
C. Statement -1 is true, Statement -2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: B

## - Watch Video Solution

## Others

1. Give the relation between wavelength and momentum of a moving microscopic particle. What is the relation known as?

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2. Derive an expression for the de Broglie relationship.
3. Give the equation which gives the relationship between wavelength $(\lambda)$ and momentum ( p ) of the particle.

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4. Derive a relationship between wavelength (almbda) associated with particle of mass (m) moving with a velocity $(v)$. Give the importance of this relation.

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5. Give the main points of distinction between electromagnetic waves and matter waves.

## - Watch Video Solution

6. How does Davisson and Germer's experiment verify the wave nature of electrons?

## - Watch Video Solution

7. Do all matter waves also travel with the same speed just like electromagnetic waves?

## - Watch Video Solution

8. Give the relation between wavelength and momentum of a moving microscopic particle. What is the relation known as ?

## - Watch Video Solution

9. How does the change in velocity of a moving particle alter the wavelength related to the particle ?
10. Name and derive the relation between wavelength and momentum of an electron or electron like particle.

## - Watch Video Solution

11. Explain how an electron can be considered to have a particle as well as a wave nature. Using Planck's equation, E=hv and Einstein's equation $E=m c^{2}$, deduce de Broglie relation for a photon.

## - Watch Video Solution

12. When moving with the same velocity which of the following particles has the largest de Broglie wavelength and why ?
(i) Electron (ii) Proton (iii) $\alpha$-particle.
13. State Heisenberg's uncertainty principle. Give mathematical expression for the same

## - Watch Video Solution

14. It is not possible to determine simultaneously the exact position and the exact momentum of a fast moving micro particle. Explain.

## - Watch Video Solution

15. We can not see a moving microscopic particle without disturbing it. Do you agree ? Name the principle on which this statement is based.

## - Watch Video Solution

16. Define an orbital. How does it differ from an orbit?
17. If the uncertainty in the position of a moving electron is equal to its de Broglie wavelength, then its velocity will be completely uncertain. Explain.

## - Watch Video Solution

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

## - Watch Video Solution

19. On the basis of Heisenbergs uncertainty principle show that the electron cannot exist within the nucleus.

## - Watch Video Solution

20. The effect of uncertainty principle is significant only for motion of microscopic particles and is negligible for the macroscopic particles.

Justify the statement with the help of a suitable example.

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21. Which quantum number specifies the shape of an orbital ?

## - Watch Video Solution

22. How many sub-shells are present in M-shell ?

## - Watch Video Solution

23. Name the orbitals possible for $\mathrm{n}=4$ and $\mathrm{l}=2$.

## - Watch Video Solution

24. In which plane is the probability of finding the py- electron zero?
25. Which of the following orbitals are not possible ?

2s, 2p, 3f, 3d.

## - Watch Video Solution

26. Give the designation of orbital when Itbr. (i) $n=2, I=0$
(ii) $\mathrm{n}=3, \mathrm{l}=2$
(iii) $\mathrm{n}=5, \mathrm{l}=1 \quad$ (iv) $\mathrm{n}=4, \mathrm{l}=3$.

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27. The electronic configuration of copper is $[A r] 4 s^{1} 3 d^{10}$ and not $[A r] 4 s^{2} 3 d^{9}$. Justify.

## - Watch Video Solution

28. Copper (I) is diamagnetic while copper (II) is paramagnetic . Explain.
29. What values of $m$ are permitted for electron having angular quantum number $\mathrm{l}=2$ ?

## - Watch Video Solution

30. With what neutral molecule is $C I O^{\ominus}$ isoelectronic?

## - Watch Video Solution

31. Define atomic orbital. Give the shapes of $s$ and $p$ orbitals.

## - Watch Video Solution

32. An element has an electronic configuration $[A r]^{3 d}$ in its +3 oxidation state. What will be the electronic configuration of its atom?
33. How are $d^{x y}$ and $d_{x^{2}-y^{2}}$ orbitals related to each other ?

## - Watch Video Solution

34. What are the values of quantum numbers $n, I$ and $m$ for the electron with highest energy for sodium atom ( $\mathrm{Z}=11$ ) ?

## - Watch Video Solution

35. Write down all the four quantum numbers for (i) 19th electron of
${ }_{\cdot 24} C r$ (ii) 21st electron for ${ }_{21} S c$.

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36. $d_{z^{2}}$ orbital has zero electron density in xy-plane. Comment.
37. Which of the two is paramagnetic : $\mathrm{V}(\mathrm{IV})$ or $\mathrm{V}(\mathrm{V})$ and why ?

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38. How many unpaired electrons are present in $\mathrm{Pd}(\mathrm{Z}=46)$ ?

## - Watch Video Solution

39. What is the ground state electronic configuration of oxygen in $O F_{2}$ ?

## - Watch Video Solution

40. What is the angular momentum of 5th orbit according to Bohr's theory?
41. What are the values of m and I for $4 p_{x}$ orbital ?

## - Watch Video Solution

42. Name a dipositive metal ion with configuration : $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2} 3 p^{6} 3 d^{5}$

## - Watch Video Solution

43. What are the values of $\mathrm{n}, \mathrm{I}$ and m for $2 p_{x}$ and $3 p_{z}$ orbitals ?

## - Watch Video Solution

44. What designations are given to orbitals with $n=4, I=1$ and $n=4, I=3$
45. (a) Define Pauli Exclusion Principle .
(b) Write the electronic configuration and the number of unpaired electrons in $\mathrm{Fe}^{2+}$ ion.

## - Watch Video Solution

46. Correct set of four quantum numbers for the valence (outermost) electron of rubidium $(Z=37)$ is

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47. Explain why :
(i) The three electrons present in $2 p$ sub-shell of nitrogen remain unpaired.
(ii) In potassium , the $19^{\text {th }}$ electron enters 4 s sub-shell instead of 3 d subshell.
(iii) Chromium has configuration $3 d^{5} 4 s^{1}$ and not $3 d^{4} 4 s^{2}$.
48. Write the values of all the four quantum numbers of the last electron of $\mathrm{Ca}(\mathrm{Z}=20)$.

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49. What is Hund's rule of maximum multiplicity ? Explain by taking example of nitrogen.

## - Watch Video Solution

50. Why does in the building of an atom, the filling of 4 s orbital takes place before filling in 3d orbital ?
