CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

STRUCTURE OF ATOM

Numerical Examples

1. An atom of an element contains 2 electrons in the first shell (n=1), 8 electrons in the second shell (n=2) and 5 electrons in the third shell (n=3). There are 16 neutrons in the nucleus of the atom. From these data, find (1) the atomic no. of the element, (2) the no. of s and p-electrons int he atom, (3) mass no. of the element.

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2. Determine the number of protons present in 5.6 L of a sample of oxygen gas at STP, containing ^{16}O isotope only.

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3. Find the number of protons required to fill a sphere of $10cm^3$ volume. What is the mass of those number of protons?

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4. Determine the number of neutrons and their mass, present in 7 mg of $^{14}_{6}C$. Assume that the mass of 1 neutron=mass of 1 H-atom.

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5. (1) How many different types of HCl molecule can be produced from two natural isotopes of hydrogen $\left(^1H = 99\,\%\ \text{and}\ ^2H + 1\,\%\right)$ and

two natural isotopes of chlorine $\left({}^{35}Cl = 76\,\%\ \text{and}\ {}^{37}Cl = 24\,\%\right)$.

(2) Arrange the molecules obtained from (1) in the decreasing order of their availability.

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6. A sample of oxygen contains the isotope, ${}^{18}O$. How many neutrons are present in 11.2 L of the gas at STP?

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7. A sample contains two isotopes, ${}^{16}O\ \text{and}\ {}^{18}O$. How many protons are present in 11.2 L of the sample at STP. What would be the difference in the no. of protons, if the sample contains only one isotope?

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8. Yellow light emitted from a sodium lamp has wavelength 580 nm. Calculate the frequency nad wave number of yellow light.

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9. A radio station broadcasts at a frequency of 100 MHz. how long would it take to reach a receiving system at a distance of 300 km? calculate wavelength and wave number of these radiations.

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10. Calculate the wavelength of an electromagnetic radiation of frequency of 97.8 MHz.

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11. How long would it take a radio wave of frequency, $6.2 \times 10^3 s^{-1}$ to travel from Mars to Earth, the distance being $8.1 \times 10^7 km$?

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12. A ray of light of frequency 5000 Å is incident on a metal surface and thus, absorbs $10^{-7} J$ of energy. Calculate the number of photons incident on the metal surface.

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13. The threshold frequency, v_0 for a metal is $7.0 \times 10^{14} s^{-1}$. Calculate the kinetic energy of an electron emitted, when radiation of frequency $v = 1.2 \times 10^{15} s^{-1}$, strikes this metal.

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14. If a light with frequency $2.0 \times 10^{16} Hz$ emitted photoelectrons with double the kinetic energy as are emitted by the light of frequency $1.25 \times 10^{16} Hz$ from the same metal surface, calculate the threshold frequency of the metal.

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15. When a radiation of frequency $7.5 \times 10^{14} Hz$ strikes a metal surface, the maximum kinetic enegy attained by the emitted electrons is $1.6 \times 10^{-19} J$. Calculate the threshold frequency of the metal.

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16. Calculate the energy of each quantum of electromagnetic radiation having wavelength of 6000 Å [$h = 6.624 \times 10^{-27}$ erg.s]

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17. Calculate the energy of 1 mol of photons an electromagnetic radiation of frequency $2.5 \times 10^{14} Hz$. $\left[h = 6.626 \times 10^{-34} J \cdot s\right]$

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18. How many photons of light with wavelength 400 nm can provide 1 J energy? $\left[h = 6.626 \times 10^{-34} J \cdot s\right]$

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19. Find the wave number of and energy of each photon present in yellow light having wavelength 580 nm.

$\left[c = 3 \times 10^{8} m \cdot s^{-1} \text{ and } h = 6.626 \times 10^{-34} J \cdot s\right]$

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20. Calculate the frequency of light emitted when an electron drops from a higher to lower energy level of an atom and the difference between the two energy level is 35.64×10^{-13} erg. $\left[h = 6.626 \times 10^{-27} erg \cdot s\right]$

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21. An 80W bulb emits a monochromatic light of wavelenth 480nm. Calculate the number of photons emitted epr second by the bulb.

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22. Calculate the wavelength of a photon (in nm) having enerrgy of 1eV.

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23. Iodine molecule absorbs radiation of wavelength 450 nm to dissociate into iodine atoms. If each molecule of iodine absorbs 1

quantum of radiation, determine the kinetic energy of iodine atom. (Bond energy of $I_2 = 240kJ \cdot mol^{-1}$)

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24. Calculate the energy associate with 1 mol of photon corresponding to electromagnetic radiation having a frequency of $5 \times 10^{14} Hz$.

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25. Calculate the wavelengths of H_α and H_δ in the emission spectrum of hydrogen. [R=109678cm^{-1}].

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26. Identify the spectral line having wavelength of $4.863 \times 10^{-5} cm$ in the emission spectra of hydrogen.

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27. Determine the wavelength and frequency of the radiation having the longest wavelength in Lyman series of hydrogen atom.

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28. Wave number of a spectral line in the Lyman series of H-atom is 82260 cm^{-1}. Show that this line has appeared in this series due to the return of the electron from the second to the first orbit.

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29. Calculate the shortest and longest wavelength in Lyman series of hydrogen spectrum.

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30. Show that Balmer series appears between 3647Å and 6563Å in the hydrogen spectrum.

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31. Calculate the wavelength of the spectral line with $n_2 = 3$ in Lyman series of hydrogen atom.

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32. Calculate the energy assocaited with the fifth orbit of H-atom, if the energy associated with the first orbit is $2.17 \times 10^{18} J \cdot \text{atom}^{-1}$.

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33. The radius of the first orbit of H-atom is 0.53 Å. Find the radius of the fifth orbit.

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34. Will there the regular variations in the energy associated with successive principal quantum numbers of hydrogen-like atoms?

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35. Energy associated with the n-th orbit of H-atom is given by the expresion, $E_n = \frac{-13.6}{n^2} eV$. Show that $E_{(n+1)} - E_n = \frac{13.6 \times 2}{n^3} eV$, when 'n' is very large.

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36. If an electron is promoted from the third orbit of a hydrogen atom, they by how many times will the radius of the orbit be increased?

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37. If an electron drops from the third orbit (n=3) to the first orbit (n=1) of H-atom, what will be the frequency and wavelength of the radiation emitted? What would have happened if the electron jumped from the first orbit to the third orbit?

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38. Find the wavelength (in angstrom) of the photon emitted when an electron jumps from the second Bohr orbit to the first bohr orbit of hydrogen atom. Ionisation potential of hydrogen atom in its ground energy state $= 2.17 \times 10^{-11}$ erg $\cdot$ atom^{-1}

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39. Determine the wavelengths of H_α and H_β lines in the Balmer series. $[R = 109677 cm^{-1}]$

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40. Find the velocity of electron revolving in the third orbit of hydrogen atom. Also determine the number of revolutions of the electron per second around the nucleus.

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41. Prove the the velocity of electron revolving in the 1st orbit of H-atom is nearly 10^{-2} times that of light.

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42. If the energy of first Bohr orbit is -13.58eV, then what will be the energy of the third Bohr orbit?

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43. Velocity of an electron revolving in a certain orbit of H-atom is $\frac{1}{275}$ tiems the velocity of light. Find the orbit in which the electron is revolving.

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44. According to Bohr's theory, energy of electron in n-th orbit of H-atom, $E_n = -\frac{21.76 \times 10^{-19}}{n^2} J$. Find the longest wavelength of radiation required to remove one electron from the 3rd orbit of He^+ ion.

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45. Calculate the energy emitted when electron of 1.0g atom of hydrogen undergo transition emitting the spectral line of lowest energy in the visible region of its atomic spectrum $\left[R_H = 1.1 \times 10^7 m^{-1}\right]$

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46. The atomic spectrum of hydrogen contains a series of four lines havinng wavelengths 656.5, 486.3, 434.2 and 410.3 nm. Determine the wavelength of the next line in the same series $\left[R_H = 109678 cm^{-1}\right]$.

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47. The angular momentum of an electron in a Bohr's orbit of hydrogen atom is $3.1655 \times 10^{-34} kg \cdot m^2 \cdot s^{-1}$. Calculate the wavelength of the spectral line emitted when an electron falls from this level to the next lower level.

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48. Calculate the distance of separation between the second and third orbits of hydrogen atom.

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49. After absorbing an energy of $20.44 \times 10^{-19} J$, the electron of H-atom will jump to which orbit ?

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50. Calculate the wavelength of the de Broglie wave associated with an electron moving with a velocity of $2.05 \times 10^{7} m \cdot s^{-1}$.

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51. Calculate the velocity of an electron having de Broglie wavelength of 200 Å.

$\left[m = 9.11 \times 10^{-31} kg, h = 6.626 \times 10^{-34} J \cdot s\right]$.

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52. Calculate the ratio of velocities of a moving electron to that of a proton associated with the same de Broglie wavelength. $[m_e = 9.11 \times 10^{-31} kg, m_p = 1.67 \times 10^{-27} kg, h = 6.626 \times 10^{-34} J \cdot s$]

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53. Calculate the momentum of particle which has a de Broglie wavelength of 0.1 Å.

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54. Calculate the de Broglie wavelength of a proton which is moving with a kinetic energy of 5×10^{-23} J.

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55. Calculate the de Broglie wavelength of an electron moving with a speed that is 1% of the speed of light.

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56. Calculate the kinetic energy of an α-particle which has a de broglie wavelength 8 pm.

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57. Calculate the de Broglie wavelength of an electron accelerating in a particle accelerator through a potential difference of 110 million volt.

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58. Find de Broglie wavelength associated with a tennis ball of mass 60g moving with a velocity of 10 $m \cdot s^{-1}$.

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59. Calculate wavelength (in nm) associated with a beam of protons moving with velocity of $10^3 m \cdot s^{-1}$. [Mass of proton $1.67 \times 10^{-27} kg$, $h = 6.63 \times 10^{-34} J \cdot s$]

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60. Calculate the wavelength of an α-particle having an energy of $6.8 \times 10^{-18} J$.

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61. Calculate the wavelength of the wave associated with an electron beam, if the beam is accelerated by a potential difference of 5000 volt.

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62. The electron of H-atom in ground state absorbs energy equal to 1.5 times the minimum energy, required to remove the electron from the hydrogen atom. Calculate the wavelength of the electron emitted. [mass of electron $= 9.11 \times 10^{-31} kg$].

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63. Find the velocity of an electron so that its momentum is equal to that of a photon of wavelength 650 nm.

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64. The kinetic energy of a subatomic particle is 3.60×10^{-24}J. calculate the frequency of the corresponding particle wave.

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65. Calculate the mass of a photon with wavelength 3.6 Å.

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66. Calculate the uncertainty ini velocity $\left(m \cdot s^{-1}\right)$ of a moving object of mass 25g, if the uncertainty in its position be $10^{-5} m$. $\left[h = 6.6 \times 10^{-34} J \cdot s\right]$

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67. An electron has a velocity of $600 m \cdot s^{-1}$ [accuracy: 0.005%]. With what accuracy can we locate the position of this electron[mass of an electron=$9.1 \times 10^{-31} kg$, $h = 6.6 \times 10^{-34} J \cdot s$]

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68. The uncertainties in posiiton and velocity of a particle are 10^{-10}m and $5.27 \times 10^{-24} m \cdot s^{-1}$ respectively. Calculate the mass of the particle.

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69. If uncertainties in position and momentum of a moving object are same, find uncertanty in velocity.

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70. Calculate the uncertainty in velocity of an electron if the uncertainty in its possible is of the order ± 12 pm.

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71. Calculate the minimum uncertainty in the position of a bullet of mass 2.5 g having a probable velocity between 60,000,000 and 60,000,001 $m \cdot s^{-1}$.

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72. The uncertainty in the determination of velocity of a dust particle (of mass 0.1 mg) is $4.5 \times 10^{-20} m \cdot s^{-1}$. Calculate the least uncertainty in its position.

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73. In an exerperiment, the measured velocity of an electron is $50 m \cdot s^{-1}$. If this measurement of velocity involves 99.999% accuracy, find the uncertainty in the determination of its position.

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74. If uncertainties in the measurement of position and momentum of an electron are found to be equal in magnitude, then what is the uncertainty in the measurement of velocity? Comment on the result.

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75. Calculate the product of uncertainties in the position and velocity of an electron of mass $9.1 \times 10^{-31} kg$, according to Heisenberg's uncertainty principle.

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Warm Up Exercise

1. How will you prove that electrons are negatively charged particles with a definite mass?

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2. Explain the origin of cathode rays in the discharge tube.

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3. Calculate the number of particles present in 0.1g electron.

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4. Calculate the mass of 1 mol electron.

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5. Explain why cathode rays are produced only at very low pressure of a gas inside the discharge tube.

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6. mention two uses of cathode ray tube in our daily life.

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7. Calculate the charge of 1 mol electron.

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8. What happens when high velocity cathode rays strike a tungsten foil?

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9. The charge to mass ratio of an electron is 1836 times greater than that of a proton. Establish a mathematical relation to compare their masses.

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10. What is the source of anode rays in discharge tube?

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11. Two discharge tubes containing H_2 and O_2 gas respectively are subjected to electrical discharge at low pressure. Will there by any difference in the nature of cathode rays annd anode rays formed inside the tube?

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12. A discharge tube containing H_2 gas at low pressure is subjected to high voltage. Will there be emission of protons from the anode?

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13. Explain the generation of the positively charged particle in the discharge tube when hydrogen gas is used.

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14. How many protons will be needed to fill a spherical vessel of volume $10cm^3$? Also calculate the mass of these protons.

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15. Why was it necessary to consider the existence of neutrons in the nucleus of an atom?

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16. Who discovered neutrons?

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17. Between proton or neutron which one is heavier?

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18. Write the nuclear reaction for the emission of neutron. Indicate e/m value of neutron.

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19. Mention the symbol, charge and names of the discoverers of positron, π-meson and neutrino.

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20. Name the experiment that help us to determine the number of protons in the nucleus of an atom.

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21. What is the nuclear model of atom?

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22. Indicate the conclusions drawn by Rutherford from his α-particle scattering experiment.

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23. Explain why Rutherford did not mention the present of neutron in the proposed nuclear model of atom?

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24. From which experiment it was concluded that entire mass and positive charge are present at the centre of an atom?

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25. What is the relation between Cl^- and S^{2-}?

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26. Identify the isotopes and isobars from the following list of atoms with given number of protons and neutrons.

$A: 8p + 9n B: 8p + 8n C: 18p + 22n D: 20p + 20n.$

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27. An element has an isotope with mass number 14. it contains 8 neutrons. Identify the element.

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28. identify the relation between the nuclides ${}^{30}_{14}SI \& {}^{31}_{15}P$.

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29. A cation M^{3+} has 23 electrons. Find the atomic no. of M.

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30. Find and total number of electons present in 1 mol methane.

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31. Mass number of an ion with unit negative charge is 37. Number of neutrons present in the ionn is 10.6% more than that of electrons. Identify the ion.

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32. What are electromagnetic radiations? What is their velocity in vacuum?

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33. State the principle of formation of electromagnetic radiation.

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34. What do you mean by electromagnetic spectrum?

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35. What are microwaves? Why are they used in radars?

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36. Arrannge the various types of radiations constituting the electromagnetic spectrum, in the decreasing order of their frequencies.

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37. Arrange the following radiations in the order of their increasing frequencies- (i) the amber light of traffic signals, (ii) FM radio waves, (iii) X-rays & (iv) Cosmic rays.

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38. How would you increase the strength of photoelectric current?

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39. How are the following effected by the increase in intensity of the incident light?

(i) Threshold frequency. (ii) Kinetic energy of the emitted electrons. (iii) Strength of photoelectric current.

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40. Bonellia feeds with the help of

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41. What is photoelectric effect?

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42. What is black body radiation ?

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43. Out of red and blue light, which one is associated with photons possessing higher energy?

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44. Differentiate betweena quantum and a photon.

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45. Enegy associated with X-rays is higher than that of visible light- explain.

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46. Mention the property of electromagnetic radiation (wave nature or particle nature or both) that can best explain the following phenomena-

(i) photoelectric effect (ii) interference (iii) black body radiation (iv) diffraction (v)Planck's equation (E=hv) (vi) Einstein's equation (E=mc^2)

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47. Give examples of production of -(i) photons from electrons (ii) electrons from photons.

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48. (i) Mention the factors affecting the kinetic energy of the photoelectrons.

(ii) Does the maximum kinetic energy depend on the intensity of light?

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49. Why are the photoelectric work functions different for differet metals?

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50. Explain- The role of threshold frequency is photoelectric effect is ini agreeement withh the particle nature of light and in disagreement with the wave nature of light.

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51. An electron beam on hitting a ZnS screen produces scintillations on it. What do you conclude?

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52. An electron beam after hitting a nickel crystal produces a diffraction pattern. What do you conclude?

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53. Mention the property of electromagnetic radiation (wave nature or particle nature or both) that can best explain the following phenomena- (i) photoelectric effect (ii) interference (iii) black body radiation (iv) diffraction (v)Planck's equation (E=hv) (vi) Einstein's equation (E=mc^2)

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54. Give two examples of particle nature of electromangetic radiation.

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55. What type of spectrum will be obtained if the electron of H-atom approaches its nucleus in spiral pathhway?

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56. Name the series of spectral lines observed I the visible regionn of hydrogen spectrum.

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57. Indicate spectral regions corresponding to Lyman, Balmer, Paschen & brackett series in the line spectrum of hydrogen.

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58. Which electronic transitionn corresponds to the third line in the Balmer series of the hydrogen spectrum?

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59. Name the five series in the atomic spectrum of hydrogen.

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60. Why is the line spectrum of an element known as the fingerprint of its atoms?

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61. how would you obtain the line spectrum of hydrogen?

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62. Give Rydberg formula for the calculation of wave number of various spectral lines of the spectrum. What is the value of Rydberg constant?

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63. Name the series of spectral lines obtained, when electrons from various energy levels jump to the first orbit in hydrogen.

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64. Indicate all the possible pathways (involving one or more steps) for the transition of a excited electron from 4th-orbit to the ground state.

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65. What is ground state and excited state of an electron?

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66. What is meant by quantisation of energy of an electron?

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67. What is Bohr's postulated of angular momentum?

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68. Why electronic energy is negative?

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69. What do you understand by stationary states?

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70. What is the value of Plancks' constant in SI unit?

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71. Differentiate between Rydberg formula & Balmerr formula.

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72. Why do we consider each stationary state an an energy level with a definite value?

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73. How many photons are emitted in the transition of the electron from the fourth to the first energy level of H-atom?

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74. How is the radius of an electronic orbit related to principle quantum number?

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75. Prove that, velocity of an electron in the first orbit in twice of that revolving in the second orbit of H-atom.

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76. Which theory forms the basis of Bohr's atomic model?

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77. bohr's theory is not applicable to which of the following species? (i) H, (ii) He^{2+}, (iii) Be^{3+}, (iv) B^{4+}.

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78. Who proposed the concept of dual nature of electron?

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79. What are the Broglie waves?

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80. Write the Broglie equation for microscopic particles.

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81. What is the relation between wave nature and particle nature of moving particles?

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82. Derive a relation between kinetic energy and de Broglie wavelength associated with a moving electron.

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83. What happens to the de Broglie wavelength associated with a moving particle if its velocity is doubled?

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84. A hard struck cricket ball does not produce waves. Why?

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85. Two particles P and Q are moving with the same velocity, but de broglie wavelength of P is thrice that of Q. what do you conclude?

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86. Compare the wavelengths of a molecule of each O_2 and CO_2, travelling with the same velocity.

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87. Why is de Broglie wave termed as matter wave?

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88. Show the wavelength of de Broglie wave associated with a moving particle is inversely proportional to its momentum.

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89. What are the differences between electromagnetic waves annd matter waves?

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90. Show that the circumference of the electronic orbit is an integral multiple of the wavelength associated with the motion of electron.

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91. State Heisenberg's uncertainly principle.

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92. Write the mathematical expression for Heisenberg's uncertainty principle.

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93. For which particles is uncertainty principle applicable?

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94. Is there any significance of Heisenberg's uncertainty principle in our daily life?

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95. Why does Bohr's model contradict Heisenberg's uncertainty principle?

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96. Explain why the uncertainty principle is significant only for subatomic particles, but not for macroscopic object.

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97. Why is it not possible to overcome the uncertainty off Heisenberg's principle using devices having high precision?

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98. In Heisenberg's uncertainty principle applicable to a stationary electron? Explain.

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99. Write Schorodinger's wave equation, indicating the significance of the notations used.

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100. What is the basis of Schrodinger's wave equation?

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101. Schrodinger's wave equation does not give us any idea about which quantum number?

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102. What is the physical significance of ψ and ψ^(2)?

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103. Write Schrodinger's wave equation in briefest possible form.

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104. How many radial nodes are present in (i) 3s-orbital annd (ii) 2p-orbital?

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105. How many radial nodes and planar nodes are present in 3p-orbital?

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106. How many nodal planes are present in 5d-orbital.

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107. Write the expression for radial distribution fucntion?

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108. Calculate the number of radial nodes and planar nodes in $4d_{x^2-y^2}$ orbital.

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109. What do you mean by the (i) acceptable values of E and (ii) corresponding wave functions that are obtained by solving the Schrodinger wave equation for H-atom?

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110. Does atomic orbitals possess a sharp boundary? Explain.

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111. What will be the sign of ψ_{2p} along an axis on the two opposite sides of the nucleus?

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112. What will be the values of ψ_{2p_x}, ϕ_{2p_y} and ϕ_{2p_z} when the value of r=0?

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113. In which directionn the value of (i) ϕ_{2p_x}, (ii) ϕ_{2p_y} and (iii) ϕ_{2p_z} is the highest ?

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114. Why p-orbital possess directional properties?

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115. Why s-orbital does not possess directional properties?

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116. In which direction the value of $\phi_{d_{xy}}$ is zero?

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117. In which direction the value of $d_{x^2-y^2}$ is the highest?

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118. What do you mean by 'doughnut' ?

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119. How many angular nodes are present in d_{xy}-orbital identify them.

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120. In which direction the value of $d_{x^2-y^2}$ is zero?

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121. How many angular nodes are present in $d_{x^2-y^2}$ orbital? Identify them.

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122. How many angular nodes are possible for ann orbital?

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123. Does the number of angular nodes of an orbital depend on the principal quantum number?

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124. How many angular nodes are present in s-orbital?

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125. Indicate the subshells present in the M-shell. How many orbitals are present in this shell?

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126. Write the values of azimuthal quantum number 'l' in (i) third energy level and (ii) 3d-subshell of an atom.

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127. What is the maximum number of electrons that can be accommodated in the subshell with l=3?

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128. What is the maximum number of electrons that can be accommodated in an orbital with m=+3?

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129. Which of the following subshells have no real existence?

(i) 2d, (ii) 3f, (iii) 4g and (iv) 5d

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130. How many quantum number are needed to designate an orbital? Name them.

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131. Identify the subshells denoted by the following

(i) n=4, l=2

(ii+ n=5, l=3

(iii) n=6, l=4

(iv) n=4, l=0.

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132. An electron is described by magnetic quantum no. m=+3. indicate the lowest possible value of 'n' for this electron.

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133. Which quantum number is to be mentioned to distinguish between the electrons present in the K-shell?

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134. Write the values of the magnetic quantum number 'm' for the '3d'-orbitals.

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135. Write the values of n, l and m for 3p-subshell.

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136. Which of the following two orbitals is associated with a higher energy?

(i) n=3, l=2, m=+1

(ii) n=4, l=0, m=0.

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137. Is there any difference between the angular momentum of 3p and 4p-electrons?

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138. 4f-subshell of an atom contains 10 electrons. How many of these electrons will have parallel spin?

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139. Write the expresion for orbital angular momentum of a revolving electron.

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140. Mention the sequence in which the following orbitals are filled up by electrons: 3d and 4p.

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141. What is the maximum number of 4d-electrons with spin quantum number $s = -\frac{1}{2}$?

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142. is it possible for atoms with even atomic number to contain unpaired electron?

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143. Write the electronic configurations of Cu and Cr-atoms?

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144. Write the electronic configurations of Fe^{2+} and Cu^{+} ions.

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145. Which of the following has maximum number of unpaired electrons?

(i) Mn^{2+}

(ii) Fe^{2+}

(iii) Cu^{2+}

(iv) Cr.

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146. Calculate the number of unpaired electrons in N-atom.

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147. How many electrons of Ne-atom have clockwise spin?

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148. Why an electron pair in an orbital have opposite spin?

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149. Write the names and symbols of an atom, a cation and an anion with the electronic configuration $1s^2$.

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150. Which quantum numbers specify the size and the shape of electronic orbital?

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151. Write down the values of four quantum numbers of the electron in the outermost shell of sodium.

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152. How many nodes are there in 3s-orbital?

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153. how many nodal points are there in 3p-orbital?

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154. Indicate principal annd azimuthal quantum numbers for the subshells: (i) 4s (ii) 5d (iii) 2p (iv) 6f

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155. Which is the lowest principal energy level that permits the existence of f-subshell?

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156. An element (symbol M) has 26 protons in the nucleus. Write the electronic configuration of $M^{2+}a \cap dM^{3+}$.

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157. There are 8 electrons in 3d-subhsell of an atom. Among these, what will be the maximum number of electrons with similar spin? What is the number of odd electrons?

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Question Answer Zone For Board Examination Very Short Answer Type

1. What are the fundamental constituents of atom?

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2. Name the element containing no neutron.

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3. Name the anode ray particle with highest $\frac{e}{m}$ value.

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4. What is the consequence when cathode rays strike a hard metal surface like tungsten?

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5. Why is an electron called universal particle?

Watch Video Solution

6. What is the value of fundamental unit of electrocity?

Watch Video Solution

7. Besides electron proton and neutron, name two other subatomic particles.

Watch Video Solution

8. A cation M^{3+} has 23 electrons. Find the atomic no. of M.

Watch Video Solution

9. Bohr's theory is not applicable to which of the following species? (1) H, (2) H^+, (3) He^+, (4) Li^{2+}.

Watch Video Solution

10. Balmer series of hydrogen spectrum lies in which region?

Watch Video Solution

11. Mention the most important application of de-Broglie concept.

Watch Video Solution

12. how are frequency and wave number of electromagnetic radiation related to each other?

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13. A electron beam after passing through a thin foil of gold produces a diffraction patternn (consisting of a number of concentric rings). What do you conclude?

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14. What is a quantum?

Watch Video Solution

15. What happens when an electron hits a zinc sulphide screen and what does it prove?

Watch Video Solution

16. Write an expression for the wavelength acquired by an electron accelerated by a potential of V volts.

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17. Out of X-rays, γ-rays and microwaves which one has the highest and which one has the lowest frequency?

Watch Video Solution

18. What is the unit of Planck's constant in S.I. ? What other physical quantity has the sme unit?

Watch Video Solution

19. Arrange the given subshells in the increasing order of their energies: $3d$, $4p$, $4s$, $5p$, $4d$, $6s$, $4f$.

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20. What is the main difference between wave emitted by an electric bulb and that associated with a tiny particle moving with very high speed?

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21. Do atomic orbitals have sharp boundaries?

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22. At what distance from the nucleus is the radial probability maximum for 1s-orbital of hydrogen atom? What is this distance called?

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23. In which shell (s), there is no existence of d-subshell?

Watch Video Solution

24. Write the values of the four quantum numbers of the electron(s) in the outermost shell of Cr-atom.

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25. Out of the four quantum number which one does not results from the solution of schrodinger wave equation?

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26. Which is most paramagnetic among Cu^{2+}, Fe^{2+} and Cr^{3+} and why?

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27. Why splitting of spectral lines is observed when the source producing the atomic spectrum is placed in a magnetic field?

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28. The 4f-subshell of an atom contains 12 electrons. What is the maximum number of electrons having spin in the same direction?

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Question Answer Zone For Board Examination Short Answer Type

1. Why is the cahrge on an electron cosidered as the smallest measurable unit of electricity?

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2. State two differences between cathode & anode rays.

Watch Video Solution

3. Calculate the mass and charge of 1 mol electrons.

Watch Video Solution

4. Compare the values of e/m of electron and proton.

Watch Video Solution

5. If an electron is promoted from the first orbit to the third orbit of a hydrogen atom, by how many times will the radius of the orbit be increased?

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6. The ionisation energy for the H-atom in the ground state is $x J \cdot \text{atom}^{-1}$. Show that the energy requried for the process, $He^{+}(g) \rightarrow He^{2+} + e$, is $4x \quad J \cdot \text{atom}^{-1}$.

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7. What does the statement "electronic orbits at stationary state" mean? Does an electronn remain stationary in a stationary orbit? Explain.

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8. if rahe radius of the first Bohr orbit is x, then find the de Broglie wavelength of electron in third orbit.

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9. A photon of wavelength λ collides with an electron. After collision, the wavelength of the photon changes to λ'. Calculate energy of the scattered electron.

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10. Find the condition under which de Broglie wave-length of a moving electron becomes twice that of a moving proton? Givenn that a proton is 1836 times heavier than an electron.

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11. If the kinetic energy of an electron increases by nine times, the wavelength of the de Broglie wave associated with it will increase by how many times?

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12. mention three differences betweenn wave and particle.

Watch Video Solution

13. Discuss the limitation of Bohr's theory on the basis of Heisenberg's uncertainty principle.

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14. What is the difference between the notations L & l.

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15. How many quantum number are required to identify an orbital? Explain it with the help of specific example.

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16. Give the electronic configurationn of $^{24}Cr^{3+}$. Find the no. of unpaired electrons present in its ion.

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17. Write down the electronic configurations of Ni and Ni^{2+} (atomic number of Ni=28). How many odd electrons do each of them contain?

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18. Which orbit of Be^{3+} ion has the same radius as that of the 1st orbit of H-atom?

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19. Explain why Fe^{3+} is more stable than Fe^{2+} ion.

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20. Electronic configuration of the electrons in the outer shells of Cu & Cr are $3d^{10}4s^1 \& 3d^5 4s^1$ respectively and not $3d^9 4s^2$ and $3d^4 4s^2$- exaplain why.

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21. "All atoms having even number of electrons always contain paired electrons"- is the statement true? If so, they by what principle or rule the above statement can be explained?

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22. Find the total numbe of orbitals present in the principal quantum number '3' of an atom. Write the symbols of different types of orbitals and also indicate the number of orbitals in each type.

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23. Find the number of waves formed by a Bohr electron in one complete revolution in its second orbit.

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24. Show that an orbital cannot accommodate more than two electrons in it.

Watch Video Solution

25. Mention the similarity and dissimilarity that exist in the significance, conveyed by the given two sets of quantum numbers.

View Text Solution

26. Write the values of quantum number of all the electrons in $_3Li$-atom.

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27. Identify all the quantum numbers of the electrons in p-subshell of carbon atom.

Watch Video Solution

28. Identify the orbitals having the following quantum numbers using the symbols s,p,d,f:

(1) n=4, l=2

(2) n=3, l=1

(3) n=2, l=0

(4) n=5, l=3,

(5) n=1, l=0

(6) n=3, l=2

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29. Explain why 1p and 3f-orbitals do not exist.

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30. If the uncertainty in position and momentum of a particle of mass 'm' are equal, then ascertain the minimum uncertainty in its velocity.

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31. (1) Isotopes of a certain element are identical in their chemical properties-why?

(2) Atomic spectra of elements are called finger-prints-why?

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32. Which of the following relationships directly express bohr's concept of hydrogen atom?

(i) $E = hv$,

(ii) $mvr = \frac{nh}{2\pi}$

(iii) $E = mc^2$,

(iv) $E_2 - E_1 = hv$,

(v) $\lambda = \frac{h}{mv}$.

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33. (1) Calculate the no. of electrons, protons & neutrons present in (i) ammonium iono (ii) phosphate ion.

(2) Name a species which is isosteric with N_2O.

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34. "Electron is an essential constituent of atoms of all elements"-explain.

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35. (1) What is meant by line spectra of atom ?

(2) How many lines are observed in the visible region of hydrogen spectrum?

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36. (1) Write three differences between electromagnetic wave and matter wave.

(2) Show that the circumference of the 'n' th electronic orbit is 'n' times the de Broglie wavelength of the wave associated with the mostion of electron i.e., $2\pi r_n = n\lambda$.

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37. (1) Give electronic configuration of the following species and show which of these contain same number of electrons: $Cl^-, N^{3-}, P^{3-}, K^+, Na^+, Mg^{2+}, Ar, S^{2-}, Ne, O^{2-}, Al^{3+}, Ca^{2+}$.

(2) In an atom of an inert gas, the difference between the number of p-electrons and s-electrons is equal to the number of d-electrons present in that atom. identify the inert gas and indicate its atomic number.

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38. What is the maximum number of electrons present in subshell, (s), for which n+l=3?

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39. How would you show that the maximum number of electrons that can be accommodated in an orbit with principal quantum number 'n' is $2n^2$?

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40. One predicts the following sets of quantum numbers for some of the electrons present in an atom. State with reasons, which are permissible and which are not.

 .

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41. Why 2p-subhsell has the capacity to accommodate more electrons than 2s-subshell?

(2) Arrange the followinng sets of electrons in order of decreasingg energy.

(a) n=4, l=0, m=0, s=$+\frac{1}{2}$

(b) $n=3, l=1, m=1, s=-\frac{1}{2}$

(c) $n=3, l=2, m=0, s=+\frac{1}{2}$

(d) n=3,l=0, m=0, $s=-\frac{1}{2}$.

(3) Which is the lowest principal energy level that permits the existence of 'g' sub-shell?

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42. (1) Give sets of quantum numbers for describing all the electrons present in 3p-subshell.

(2) what do you mean by nucleon?

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43. (i) In neon (Ne) atom, how many electrons are there which spin in anti-clockwise direction?

(2) For how many electrons of Cl-atom, n+l=3?

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44. Electronic configuration of the outermost shell of the atoms of some element are givenn below. From these identify the element and write their atomic numbers.

(1) $3s^2$

(2) $3p^4$.(3) $2p^4$.

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45. Calculate the difference in radius between the first and third orbit of hydrogen atom.

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Solved Wbchse Scanner

1. (i) State Pauli's exclusion principle.

(ii) Of atomic theories of Rutherford and Bohr, which one can explain the line spectrum of hydrogen atom?

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2. (i) What is the orbital angular momentum of a p-electron in $\frac{h}{2\pi}$ unit?

(ii) (a) Atomic number of two elements X and Y are 15 and 27 respectively. Write down the electronic configuration of X^{3-} and Y^{3+} ions-

(b) State two limitations of Bohr's theory of H-atom.

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3. (i) Write two differences between orbit and orbital.

(ii) Two sets of four quantum numbers of an electron are:

(n=4 , l=3, m=3, $s = \frac{1}{2}$) and n=3, l=2, m=-2, s=0). Which one of these sets is not correct and why?

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4. Write the electronic configuration of Cu^{+} and Cr^{2+} ions (atomic number of Cu, and Cr are 29 and 24 respectively).

Watch Video Solution

5. (i) Write the possible values of 'm' for a 4f-electron.

(ii) Mention one demerit of Rutherford's atomic model.

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6. (i) State the postulates of bohr's atomic theory.

(ii) Write the symbols of two anions isoelectronic with K^+.

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7. (i) The electronic configuration of an atom is [Z](n-2)$f^{14}(n-1)d^1ns^2$. What is the minimum position of the atom in the periodic table and correspondingly what is the atomic number of Z?

(ii) Find the number of unpaired electrons in the atom of the element having atomic number 16.

(iii) Which of the following ions does not obey Bohr's atomic theory? $He^{2+}, Li^{2+}, B^{3+}, Be^{3+}$.

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8. There are nine electrons in the 5f-orbital of an atom of an element. Mention the maximum number of electrons which have the same spin and number of unpaired electrons.

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9. (i) Which rule is followed in determining the arrangement of unpaired electrons in P-atom? State the rule.

(ii) Explain whether 3f-orbital is present in P-atom.

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10. (i) What is stationary energy level of an electron?

(ii) State one difference between Rutherford and Bohr's model of atomic structure.

(iii) Write the electronic configurations of Co^{2+} and As^{3+} ions. (Atomic number of Co is 27 and As is 33).

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11. In bohr's models of atom the lowest angular momentum, that an electron may have is-

A. h

B. 0

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

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

Answer: C

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12. Calculate the de Broglie wavelength associated with an electron moving with velocity of $1.0 \times 10^{7} m/s$. (mass of an electron: $9.1 \times 10^{-31} kg$)

Watch Video Solution

13. Write down the electronic configuration of ${}_{14}Si$ and ${}^{25}Mn$. Which of the following orbitals are not possible 1p, 2d, 3s, 3f

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14. Which one of the following is correct among the following sets of quantum number-

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

B. n=3, l=1, m=0, $s = \frac{1}{2}$

C. n=5, l=1, m=2, $s = \frac{1}{2}$

D. n=4, l=1, m=-2, $s = \frac{1}{2}$

Answer: B

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15. State the Pauli exclusion principle. Write the electronic configurations of $_{24}Cr^{3+}$ and $_{27}Co^{3+}$.

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16. Number of total electrons in the n-th orbit of an atom is-

A. n

B. n^2

C. $2n^2$

D. $n - 1$

Answer: C

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17. Calculate the uncertainty of velocity of an electron which have an uncertainty in position of 1 Å.

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18. If the energy of first Bohr's orbit is -13.58 eV of a hydrogen atom, calculate the energy of third Bohr's orbit of that atom.

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19. (i) State Hund's rule.

(ii) Between two ions Fe^{2+} and Fe^{3+}, which one is more stable and why?

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20. Maximum how many number of electrons of Cl atom follow the relation n+l=3-

A. 3

B. 8

C. 10

D. 16

Answer:

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21. Determine the wavelengths of H_α and H_β lines in the Balmer series. $[R = 109677 cm^{-1}]$

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22. When an electron jumps down from 5th Bohr orbit to 3rd Bohr orbit in H-atom, then how many numbers of spectral lines will be formed?

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23. (i) State Pauli's exclusion principle.

(ii) How many number of electrons are present in one $HClO_4$ molecule?

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24. Which o the following is the ground state electronic configuration of Cr (atomic number of Cr is 24)-

A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$

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

C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$

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

Answer: b

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25. State Heisenberg uncertainty principle. What is the shape of a s orbital ?

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26. (i) Write with an example the condition for two atoms to be considered as isobars.

(ii) Why is Fe^{3+} more stable than Fe^{2+} ?

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27. (i) What are the quantum number by which an electron in an atom can be designated?

(ii) What is the maximum number of quantum numbers that may be the same for two electrons ofo an atom?

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Solved Ncert Exercise

1. Calculate the number of electrons which will together weigh one gram.

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2. Calculate the total number of electrons present in one mole of methane.

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3. How many neutrons and protons are there in the following nuclei?

$^{13}_{6}C, ^{16}_{8}O, ^{24}_{12}Mg, ^{56}_{26}Fe, ^{88}_{38}Sr.$

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4. Write the complete symbol for the atom with the given atomic number (Z) and atomic mass (A)

(1) Z=17, A=35

(2) Z=92, A=233

(3) Z=4, A=9

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5. Yellow light emitted from a sodium lamp has a wavelength (λ) of 580 nm. Calculate the frequency (v) and wave number $(\bar{v})$ of the yellow light.

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6. Find energy of each of the photons which

(1) correspond to light of frequency 3×10^{15} Hz.

(2) Have wavelength of 0.50 Å

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7. Calculate the wavelength, frequency and wave-number of a light wave whose period is $2.0 \times 10^{-10} s$.

Watch Video Solution

8. What is the number of photons of light with a wavelength of 4000 pm that provide 1J of energy?

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9. A photon of wavelength $4 \times 10^{-7} m$ strikes on metal surface, the work function of the metal being 2.13 eV.

Calculate (1) the energy of the photon (eV).

(2) The kinetic energy of the emission.

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10. Electromagnetic radiatio of wavelength 242 nm is just sufficient to ionise the sodium atom. Calculate the ionisation energy of sodium in $kJ \cdot mol^{-1}$.

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11. A 25 watt bulb emits monochromatic yellow light of wavelength of $0.57 \mu m$. Calculate the rate of emissionn 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 Å. Calculate threshold frequency (v_0) and work function (W_0) of the metal.

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13. What is the wavelength of llight emitted when the electron in a hydrogen atom undergoes transition from an energy level with n=4 to an energy level with n=2 ?

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14. How much enerrgy is needed to ionise a H-atom if the electron occupies n=5 orbit? Compare your answer with the ionisation enthalpy 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 drops to the ground state?

Watch Video Solution

16. (1) The energy associated with the first orbit in the hydrogen atom is $-2.18 \times 10^{-18} J \cdot \text{atom}^{-1}$. What is the energy associated with the fifth orbit?

(2) Calculate the radius of Bohr's fifth orbit for hydrogen atom.

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17. Find the wave number for the longest wavelength transition in the Balmer series of atomic hydrogen.

Watch Video Solution

18. What is the energy in joules, requried to shift the electron of the hydrogen atom from the first Bohr orbit to the fifth Borh orbit and what is the wavelength of the light emitted when the electron returns to the ground state? The ground state electron energy is -2.18×10^{-11} erg.

Watch Video Solution

19. The electron energy is hydrogen atom is given by $E(n) = \left(-2.18 \times 10^{-18}\right) J$. 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?

Watch Video Solution

20. Calculate the wavelength of an electron moving with a velocity of $2.05 \times 10^{7} m \cdot s^{-1}$.

Watch Video Solution

21. The mass of an electron is $9.1 \times 10^{-31} kg$. If its K.E. is $3.0 \times 10^{-25} J$, calculate its wavelength.

Watch Video Solution

22. Which of the following are isoelectronic species i.e., those having the same number of electrons?

$Na^+, K^+, Mg^{2+}, Ca^{2+}, S^{2-}, Ar.$

Watch Video Solution

23. Write the electronic configurations of the following ions: (a) H^-

(b) Na^+,

(c) O^{2-}

(d) F^-

Watch Video Solution

24. What is the lowest value of n that allows g-orbials to exist?

Watch Video Solution

25. An electron is in one of the 3d orbitals. Give the possible values on n, l and m_l for this electron.

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26. An atom of an element contains 29 electrons and 35 neutrons. Deduce (1) the number of protons and (2) the electroniic configuration of the element.

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27. Give the number of electrons in the species H_2^+, H_2 and O_2^+.

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28. (1) an atomic orbital has n=3. what are the possible values of l and m_l ?

(2) List the quantum numbers (m_l and l) of electrons for 3d orbital.

Watch Video Solution

29. Using s,p,d notations, describe the orbital with the following quantum numbers. (1) n=2, l=0, (2) n=3, l=1 (3) n=4, l=2, (4) n=4, l=3

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30. Explain, given reasons, which of the following sets of quantum numbers are not possible. (1) $n = 0, l = 0, m_l = 0, m_S + \frac{1}{2}$

(2) $n = 1, l = 0, m_l = 0, m_S = -\frac{1}{2}$

(3) $n = 1, l = 1, m_l = 0, m_S = +\frac{1}{2}$

(4) n=2, l=1, $m_1 = 0, m_S = -\frac{1}{2}$

(5) n=3, l=3, $m_l = -3, m_S = +\frac{1}{2}$

(6) n=4, l=1, $m_l = 0, m_S = +\frac{1}{2}.$

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31. How many electrons in an atom may have the following quantum numbers?

(1) n=4, $m_S = -\frac{1}{2}$

(2) 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.

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

Watch Video Solution

34. Calculate the energy required for the process

$He^+(g) \rightarrow He^{2+}(g) + e$

The ionisation energy of the H-atom in the ground state is $2.18 \times 10^{-18} J \text{atom}^{-1}$.

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35. If the diameter of a carbon atom is 0.15 nm, calculate the number of carbon atoms which can be placed side by side in a straight line across length of scale of length 20 cm long.

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36. 2×10^8 atoms of carbon are arranged side by side. Calculate the radius of carbon atom if the length of this arrange is 2.4 cm.

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37. The diameter of zinc atom is 2.6 Å. Calculate (1) radius of zinc atom in pm and (2) 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 $2.5 \times 10^{-16} C$ of static electric charge. Find the no. of electrons present in it.

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39. In Millikan's experiment, static electric charge on the oil drops has been obtained by shining X-rays. If the static charge on the oil drop is $-1.282 \times 10^{-18} C$, calculate the number of electrons present on it.

Watch Video Solution

40. In Rutherford' experiment, generaly the thin foil of heavy atoms, like gold, paltinum etc. have been used to e bombarded by the α-particles. If the thin foil of light atoms like aluminium etc. is used, what difference would be observed from the above results?

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41. Symbols ${}_{35}^{79}Br$ and ${}^{79}Br$ can be written, whereas symbols ${}_{79}^{35}Br$ and ${}^{35}Br$ are not acceptable. Answer briefly.

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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 off negative charge. If the ion contains 11.1% more neutrons than electrons, find the 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 than electrons. Assign the symbol to this ion.

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45. Arrange the following radiations in increasing order of frequency: (1) radiation from microwave oven (2) amber light from traffic signal (3) radiation from FM radio (4) cosmic ray from outer space (5) X-rays.

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46. Nitrogen laser produces a radiatio at a wavelength of 337.1 nm. If the number of photons emitted is 5.6×10^{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 (1) the frequency of emission, (2) distance travelled by this radiation in 30s (3) energy of quantum and (4) number of quanta present if it produces 2 J of energy.

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48. In astronomical observations, signals observed from the distant stars are generally weak. If the photon detector receives a total of $3.15 \times 10^{-18} J$ 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 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 source is 2.5×10^{15}, calculate the energy of the source.

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

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51. The work function for cesium atom is 1.9 eV.

Calculate the threshold wavelength.

Watch Video Solution

52. Following results are observed when sodium metal is irradiated with different wavelengths. Calculate threshold wavelength.

$\lambda(\text{nm})$	500	450	400
$v \times 10^{-5}(\text{cm}\cdot\text{s}^{-1})$	2.55	4.35	5.35

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53. The ejection of the photoelectron from the silver metal in the photoelectric effect experiment cann be stoped 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 $1.5 \times 10^7 m \cdot s^{-1}$, 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= $3.29 \times 10^{15}(Hz)\left[1/3^2 - 1/n^2\right]$. Calculate the value of n if the transition is observed at 1285 nm. 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 and 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 the discovery of electron microscope often used for the highly magnified images of biological molecules and other types of material. If the velocity of the electron in this microscope is $1.6 \times 10^6 m \cdot s^{-1}$, calculate de Broglie wavelength associated with this electron.

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

Watch Video Solution

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

Watch Video Solution

60. The velocity associated with a proton moving in a potential difference of 1000 V is $4.37 \times 10^{5} m \cdot s^{-1}$. 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 ± 0.002nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of he electron is $h/(4\pi_{m} \times 0.05) nm$, is there any problem is defining this value.

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62. The quantum numbers of six electrons are give below. Arrange them in order of increasing energies. List if any of these combination(s) has/have the same

energy: (1) n=4,l=2,$m_l = 2, m_S = -\frac{1}{2}$

(2) $n = 3, l = 2, m_l = 1, m_S = +\frac{1}{2}$

(3) n=4,l=1,$m_l = 0, m_S = +\frac{1}{2}$

(4) $n = 3, l = 2, m_l = -2, m_S = -\frac{1}{2}$

(5) $n = 3, l = 1, m_l = -1, m_S = +\frac{1}{2}$

(6) n=4, l=1, $m_l = -1, m_S = +\frac{1}{2}.$

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63. The bromine atom possesses 35 electrons. It contains 6 electrons in 2p orbital. 6 electrons in 3p orbital and 5 electron in 4p orbital. Which of these electron experiences the lowest effective nuclear charge?

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64. Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge?

(1) 2s and 3s.

(2) 4d and 4f,

(3) 3d and 3p.

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65. The unpaired electrons in Al and Si are present in 3p orbital. Which electrons will experience more effective nuclear charge from the nucleus?

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66. Indicate the number of unpaired electrons in (1) P,

(2) Si,

(3) Cr,

(4) Fe and (5) Kr.

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67. (1) How many subshells are associated with n=4?

(2) How many electrons will be present in the subshells having m_s value of $-\frac{1}{2}$ for n=4?

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Higher Order Thinking Skill Hots Questions

1. Which one of the following is associated with a de Broglie wave of longer wavelength-a proton or an electron moving with same velocity ?

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2. Mention the difference in angular momentum of the electron belonging to 3p and 4p-subshell.

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3. Are the differences in energy between successive energy levels of a hydrogen-like atom same ? Explalin.

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4. Energy associated with nth orbit of H-atom is given by the expression, $E_n = -\frac{13.6}{n^2} eV$. Show that `E_((n+l))-E_(n)=(13.6xx2)/(n^(3))eV~, when 'n' in very large.

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5. de Broglie wavelength of the wave asociated with a moving electron and a proton are equal. Show the velocity of electron is greater than that of the proton.

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6. Calculate the accelerating potential that must be applied on a proton beam to give it an effective wavelenth of 0.005 nm.

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7. The second line of Lyman series of H-atom coincides with the sixt line of Paschen series of an ionic species 'X'. Identify 'X'. (Suppose the value of Rydberg constant, R is same in both cases)

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8. An element of atomic weight Z consists of two isotopes of mass number (Z-1) and (Z+2). Calculate the % of higher isotope.

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9. (1) Show that the sum of energies for the transition from n=3 to n=2 and from n=2 to n=1 is equal to the energy of transition from n=3 to n=1 in case of an H-atom. (2) Are wavelength and frequencies of the emitted spectrum also additive as their energies?

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10. In Case of a ${}_{15}X$ atom, five valence electrons are $A\overset{3x}{B}P\overset{3p}{Q}R$. If the spin quantum number of B and R is $+\frac{1}{2}$ then find the group(s) of electrons with three of the quantum numbers same.

Watch Video Solution

11. The Schrodinger wave equation for the 2s electron of a hydrogen atom is,

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

There is a radial node at the point, where $r = r_0$ find the relation between r_0 and a_0.

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12. I fthe uncertainty in position of a moving electron is equal to its de Broglie wavelength, prove that its velocity is completely uncertain.

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13. The electron revolving in the n-th orbit of Be^{3+} ion has the same speed as that of the electron in the ground state of hydrogen atom. Find the value of n.

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14. When Be is bombarded with α-particles, a grew element viz carbon is formed whereas, when gold is bombarded with α-particles, no new elements are formed. Explain.

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15. Why are atomic spectra not continuous?

Watch Video Solution

16. With the help of Bohr's theory, how will you determine the kinetic energy of hydrogen or hydrogen-like atoms?

Watch Video Solution

17. What is precessional motion of the orbit?

Watch Video Solution

18. Name the noble gas and give its atomic number if the number of d-electrons present in this atom is equal to the difference in the no. of electrons present in the p and s-subshells.

Watch Video Solution

19. There is a wavelength limit beyond which the spectrum of any givenn series of the H-atom becomes continuous. Why?

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Entrance Question Bank

1. The electronic transition from n=2 to n=1 will produce shortest wavelength in (where n=principal quantum state)-

A. Li^{2+}

B. He^{2+}

C. H

D. H^{+}

Answer: A

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2. The representation of the ground state electronic configuration of He by box-diagram as $\uparrow \uparrow$ is wrong because it violets-

A. Heisenberg's Uncertainty principle

B. Bohr's Quantization theory of Angular momentum

C. Pauli exclusion principle

D. Hund'r rule

Answer: C

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3. The energy of an electron if first Bohr orbit of H-atom is -13.6eV. The possible energy value of electron in the excite statre of Li^{2+} is-

A. $-122.4eV$

B. $30.6eV$

C. $-30.6eV$

D. $13.6eV$

Answer: C

Watch Video Solution

4. Which of the following does not represent the mathematical expression for the Heisenberg's uncertainty principle-

A. $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

B. $\Delta x \cdot \Delta p \geq \frac{h}{4\pi m}$

C. $\Delta E \cdot \Delta t \geq \frac{h}{4\pi}$

D. $\Delta E \cdot \Delta x \geq \frac{h}{4\pi}$.

Answer: D

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5. Identify the correct statement-

A. Quantum numbers (n,l,m,s) are obtained arbitrarily

B. all the quantum numbers (n,l,m,s) for any pair of electrons in an atom can be identical under special circumstance

C. All the quantum numbers (n,l,m,s) may not be required to describe an electron of an atom completely

D. all the quantum numbers (n,l,m,s) are required to describe an electron of an atom completely.

Answer: D

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6. The electronic configuration of Cu is-

A. $[Ne]3s^2 3p^6 3d^9 4s^2$

B. $[Ne]3s^2 3p^6 3d^{10} 4s^1$

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

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

Answer: B

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7. As per de Broglie's formula a macroscopic particle of mass 100 gm and moving at a velocity of 100 cm/s will have a wavelength of

A. $6.6 \times 10^{-29} cm$

B. $6.6 \times 10^{-30} cm$

C. $6.6 \times 10^{-31} cm$

D. $6.6 \times 10^{-32} cm$

Answer: C

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8. The emission spectrum of hydrogen discovered first an the region of the electromagnetic spectrum in which it belongs, respectively are-

A. Lyman, ultraviolet

B. Lyman, visible

C. Balmer, ultraviolet

D. Balmer, visible

Answer: D

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9. $\left({}_{32}Ge^{76}, {}_{34}Se^{76}\right)$ and $\left({}_{14}Si^{30}, {}_{16}S^{32}\right)$ are examples of-

A. isotopes and isobars

B. isobars and isotones

C. isotones and isotopes

D. isobars and isotopes

Answer: B

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10. The atomic number of cerium (Ce) is 58. the correct electronic configuration of Ce^{3+} ions is-

A. $[Xe]4f^1$

B. $[Kr]4f^1$

C. $[Xe]4f^{13}$

D. $[Kr]4d^{1}$

Answer: A

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11. The time taken for an electron to complete one revolution in Bohr orbit of hydrogen atom is-

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

B. $\frac{n^2h^2}{4mr^2}$

C. $\frac{4\pi^2mr^2}{nh}$

D. $\frac{nh}{4\pi^2mr^2}$

Answer: C

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12. The energy required to break one mole of hydrogen-hydrogen bonds in H_2 is 436 kJ. What is the longest wavelength of light required to break a single hydrogen-hydrogen bond-

A. 68.5 nm

B. 137 nm

C. 274 nm

D. 548 nm

Answer: C

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13. Identify the correct statement(s): the findings from the Bohr model of H-atom are-

A. angular momentum of electron is expressed as integral multiples of $\frac{h}{2\pi}$

B. the first Bohr radius is 0.529 Å

C. the energy of the n-th level E_n is proportional to $\frac{1}{n^2}$

D. the spacing between adjacent levels increases with increase in 'n'.

Answer: A::B::C

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14. Which one of the following corresponds to a photon of highest energy-

A. $\lambda = 300nm$

B. $v = 3 \times 10^8 s^{-1}$

C. $\bar{v} = 30cm^{-1}$

D. $\in = 6.626 \times 10^{-27} J$

Answer: A

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15. Which of the following sets of quantum numbers represents the 19th electron of Cr(Z=24)-

A. $\left(4, 1, -1, +\frac{1}{2}\right)$

B. $\left(4, 0, 0, +\frac{1}{2}\right)$

C. $\left(3, 2, 0, -\frac{1}{2}\right)$

D. $\left(3, 2, -2, +\frac{1}{2}\right)$

Answer: B

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16. If the given four electronic configuration

(i) n=4, l=1

(ii) n=4, l=0

(iii) n=3, l=2

(iv) n=3, l=1

ara arranged in order of increasing energy, then the order will be-

A. $iv < ii < iii < i$

B. $ii < iii < i < iv$

C. $i < iii < ii < iv$

D. $iii < i < iv < ii$

Answer: A

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17. The number of unpaired electrons in Ni (atomic number=28) are-

A. 0

B. 2

C. 4

D. 8

Answer: B

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18. Which of the following electronic configuration is not possible-

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

B. $n = 3, l = 1, m = -1$

C. $n = 2, l = 0, m = -1$

D. $n = 2, l = 1, m = 0$

Answer: C

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19. The nucleus $^{64}_{29}Cu$ accepts an orbital electron to yield-

A. $^{65}_{28}Ni$

B. $^{64}_{30}Zn$

C. $^{64}_{28}Ni$

D. $^{65}_{30}Zn$

Answer: C

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20. Outer electronic configuration of Gd (atomic no: 64) is-

A. $4f^8 5d^0 6s^2$

B. $4f^4 5d^4 6s^2$

C. $4f^7 5d^1 6s^2$

D. $4f^3 5d^5 6s^2$

Answer: C

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

(a) n=4,l=1

(b) n=4, l=0

(c) n=3, l=2

(d) n=3,l=1 can be placed in order of increasing energy as-

A. $d < b < c < a$

B. $b < d < a < c$

C. $a < c < b < d$

D. $c < d < b < a$

Answer: A

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22. Energy of electron is given by $E = -2.178 \times 10^{-18}\left(\frac{Z^2}{n^2}\right)$ J.

Wavelength of light required to excited an electron in an hydrogen atom

from level n=1 to n=2 will be $(h = 6.62 \times 10^{-34} J \cdot s \text{ and } c = 3.0 \times 10^{8} m \cdot s^{-1})$-

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

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

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

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

Answer: B

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23. The correct set of four quantum numbers of the valence electrons of rubidium atom (Z=37) is-

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

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

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

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

Answer: B

Watch Video Solution

24. Which of the following is the energy of a possible excited state of hydrogen-

A. $-3.4eV$

B. $+6.8eV$

C. $+13.6eV$

D. $-6.8eV$

Answer: A

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

A. meV

B. $2meV$

C. $\sqrt{meV}$

D. $\sqrt{2meV}$

Answer: D

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26. The radius of the second Bohr orbit for hydrogen atom is [Planck's constant $(h) = 6.6262 \times 10^{-34} \cdot s$, mass of electron=$9.1091 \times 10^{-31} kg$, charge of electron $= 1.60210 \times 10^{-19} C$, permittivity of vacuum $(\in_0) = 8.854185 \times 10^{-12} kg^{-1} \cdot m^{-3} \cdot A^2$]-

A. 0.529 Å

B. 2.12 Å

C. 1.65Å

D. 4.76Å

Answer: B

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27. If n=6, correct sequence for filling of electrons will be-

A. $ns \to (n-2)f \to (n-1)dtonp$

B. $ns \to (n-1)dto(n-2)f \to np$

C. $ns \to (n-2)f \to np \to (n-1)d$

D. $ns \to np \to (n-1)dto(n-2)f$

Answer: A

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28. The energies E_1 and E_2 of two radiations are 25eV and 50eV respectively. The relation between their wavelengths i.e., λ_1 and λ_2 will be-

A. $\lambda_1 = \lambda_2$

B. $\lambda_1 = 2\lambda_2$

C. $\lambda_1 = 4\lambda_2$

D. $\lambda_1 = \frac{1}{2}\lambda_2$

Answer: B

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29. Total number of orbitals in 4th energy level of an atom is-

A. 8

B. 16

C. 32

D. 4

Answer: B

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30. According to Bohr's theory, which of the following transition is H-atom will gie the least energetic photon-

A. $n = 6$ to n=1

B. n=5 to n=4

C. n=6 to n=5

D. n=5 to n=3

Answer: C

Watch Video Solution

31. The correct set of four quantum numbers for the valence electron of rubidium atom (Z=37) is-

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

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

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

D. $6,0,0,+\frac{1}{2}$

Answer: A

Watch Video Solution

32. What is the maximum number of electrons that can be associated with the following set of quantum numbers n=4 and l=3-

A. 10

B. 12

C. 14

D. 16

Answer: C

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33. The value of Planck's constant is $6.63 \times 10^{-34} J \cdot s$. The speed of light is $3 \times 10^{17} nm \cdot s^{-1}$. Which value is closest to the wavelength in nanometer of a quantum of light with frequency of $6 \times 10^{15} s^{-1}$-

A. 50

B. 75

C. 10

D. 25

Answer: A

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34. Based on equation $E = -2.178 \times 10^{-18}\left(\frac{z^2}{n^2}\right)J$, certain conclusions are written, which of them is not correct-

A. equation can be used to calculate the change in energy when the electron changes orbit

B. for n=1, the electron has a more negative energy than it does for n=6 which means that the electron is more loosely bound in the smallest allowed orbit

C. the negative sign in equation simply means that the energy of electron bound to the nucleus is lower than that it would be if the electrons were at the infinite distance form the nucleus

D. larger the value of n, larger is the orbit radius

Answer: B

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35. What is the maximum number of electrons that can be associated with the following set of quantum numbers n=3, l=1 and m=-1 -

A. 4

B. 2

C. 10

D. 6

Answer: B

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36. Calculate the energy in joule corresponding to light of wavelength 45 nm. (plancks constant, $h = 6.63 \times 10^{-34} J \cdot s$, speed of light $c = 3 \times 10^{8} m \cdot s^{-}$))-

A. 6.67×10^{15}

B. 6.67×10^{11}

C. 4.42×10^{-15}

D. 4.42×10^{-18}

Answer: D

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37. What is the maximum number of orbitals that can be identified with the following quantum number n=4, l=0

A. 1

B. 2

C. 3

D. 4

Answer: A

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38. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium-

A. $3s4s3p3d$

B. $4s3s3p3d$

C. $3s3p3d4s$

D. $3s3p4s3d$

Answer: D

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39. Gadolinium belongs to 4f-series. Its atomic number is 64. which of the following is the correct electronic configuration of gadolinium-

A. $[Xe]4f^8 6d^2$

B. $[Xe]4f^9 5s^1$

C. $[Xe]4f^7 5d^1 6s^2$

D. $[Xe]4f^{6}5d^{2}6s^{2}$

Answer: C

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40. Which of the following pairs of d-orbitals witll have electron density along the axis-

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

B. d_{z^2}, d_{xz}

C. d_{xz}, d_{yz}

D. $d_{z^2}, d_{x^2-y^2}.$

Answer: D

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41. How many electrons can fit in the orbital for which n=3 and l=1-

A. 14

B. 2

C. 6

D. 10

Answer: B

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42. Two electrons occupying the sme orbital are distinguished by-

A. spin quantum number

B. principal quantum number

C. magnetic quantum number

D. azimuthal quantum number

Answer: A

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43. Which one is a wrong statement?

A. the uncertainty principle is $\Delta E \times \Delta t \geq \frac{h}{\pi}$

B. half-filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement

C. the energy of 2s-orbital is less than the energy of 2p-orbital in case of hydrogen-like atoms

D. de Broglie's wavelength is given by $\lambda = \frac{h}{mv}$, where m=mass of the particle, v=group velocity of the particle

Answer: C

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44. Which one is a wrong statement-

A. the value of m and m_{z^2} is zero

B. total orbital angular momentum of electron in 's' orbital is equal to zero

C. the electronic configuration of N-atom is

D. an orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers

Answer: C

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45. Which of the following is wrong for Bohr model-

A. it establishes stability of atom

B. it is incosistent with Heisenberg's uncertainty principle

C. it examplains the concepts of spectral lines for hydrogen likes species

D. electrons behave as particle and wave

Answer: D

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46. Smallest wavelength occurs for--

A. Lyman series

B. Balmer series

C. Paschen series

D. Brackett series

Answer: A

Watch Video Solution

47. In bohr's orbit, $\frac{nH}{2\pi}$ indicates-

A. momentum

B. kinetic energy

C. potential energy

D. angular momentum

Answer: D

Watch Video Solution

48. Threshold frequency of a metal is $5 \times 10^{13} s^{-1}$ upon which $1 \times 10^{14} s^{-1}$ frequency light is focused. Then the maximum kinetic energy of emitted electron is-

A. $3.3 \times 10^{-21} J$

B. $3.3 \times 10^{-20} J$

C. $6.6 \times 10^{-21} J$

D. $6.6 \times 10^{-20} J$

Answer: B

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49. A particle is moving 3 times faster than the speed of electron. If the ratio of wavelength of a particle and electron is 1.8×10^{-4}, then particle is

A. neutron

B. α-particle

C. deuteron

D. tritium

Answer: A

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50. Which of the following pairs presents isotones-

A. ${}^{77}_{33}As, {}^{78}_{34}Se$

B. ${}^{195}_{78}Pt, {}^{190}_{76}Os$

C. ${}^{108}_{47}Ag, {}^{112}_{48}Cd$

D. ${}^{178}_{71}Hf, {}^{137}_{56}Ba$

Answer: A

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51. α-particle can be detected using-

A. thin aluminium sheet

B. barium sulphate

C. zinc sulphide screen

D. gold foil

Answer: C

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52. In a decay process ${}_{Z}^{A}X$ changes into ${}_{Z-1}^{A}Y$. Which of the following process represents this-

A. $\beta -$ decay

B. β^{+}-decay

C. α-decay

D. $\gamma -$ decay

Answer: B

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53. According to Bohr's theory, which of the following correctly represents the variation of energy and radius of an electron in nth orbit of H-atom-

A. $E_n \propto \frac{1}{n^2}, r \propto \frac{1}{n^2}$

B. $E_n \propto \frac{1}{n^2}, r \propto n^2$

C. $E_n \propto n^2, r \propto n^2$

D. $E_n \propto n, r \propto \frac{1}{n}$

Answer: B

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54. Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atom in ground state is excited by monochromatic light of energy 12.1 eV. The spectral lines emitted by hydrogen according to Bohr's theory will be-

A. one

B. two

C. three

D. four

Answer: C

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55. Wavelength of a particular transition of H atom is 400 nm. What an be the wavelength of He^{+} for the same transition-

A. 400nm

B. 100nm

C. 1600nm

D. 200nm

Answer: B

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56. What is the maximum wavelength of line of Balmer series of hydrogen spectrum $\left(R = 1.09 \times 10^{7} m^{-1}\right)$-

A. 400nm

B. 660nm

C. 486nm

D. 434nm

Answer: B

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57. Calculate the velocity of an electron placed in the second orbit of Li^{2+} ion-

A. $0.521 m \cdot s^{-1}$

B. $3.27 \times 10^{6} cm \cdot s^{-1}$

C. $4.23 \times 10^3 m \cdot s^{-1}$

D. $3.27 \times 10^6 m \cdot s^{-1}$

Answer: D

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Mcq Hotspot Single Correct Type

1. Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atom is ground state is excited by monochromatic light of energy 12.1 eV. The spectral lines emitted by hydrogen according to bohr's theory will be-

A. one

B. two

C. three

D. four

Answer: C

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2. The number of waves made by a bohr electron in an orbit of maximum magnetic quantum number +3 is-

A. 4

B. 3

C. 2

D. 1

Answer: A

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3. which of the following orbitals has zero probability of finding the electron in xy plane

A. xz and yz-planes

B. xy and yz-planes

C. z-direction, yz and xz-planes

D. xy and xz-planes

Answer: A

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4. An electron beam with a de Broglie wavelength of P Å is accelerated till its wavelength is halved. By what factor will kinetic energy change-

A. 2

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

C. 4

D. none

Answer: C

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5. If Aufbau rule is not followed then percent change in total (n+l) vlaue for unpaired electrons in $_{25}Mn$ is-

A. 60

B. 50

C. 40

D. 30

Answer: C

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6. if the shortest wavelength of H-atom in Lyman series is X, then longest wavelength in Paschen series of He^{+} is-

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

B. $\frac{36X}{7}$

C. $\frac{7X}{36}$

D. $\frac{6X}{5}$

Answer: B

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7. The atomic numbers of elements X, Y, Z are 19, 21 and 25 respectively. The number of electron present in the 'M' shells of these elements follow the order-

A. $Z > Y > X$

B. $X > Y > Z$

C. $Z > X > Y$

D. $Y > Z > X$

Answer: A

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8. Hydrogen atoms are excited on n=4 state. In the spectrum of emitted radiation, number of lines in the unltraviolet and visible regions are respectively-

A. $2:3$

B. $3:1$

C. $1:3$

D. $3:2$

Answer: D

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9. Which orbital has only positive value of wave function at all distances from the nucleus-

A. 3d

B. 2p

C. 2s

D. 1s

Answer: D

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10. The number of photons of light having wave number 'a' in 3J of energy source is-

A. $\frac{hc}{3a}$

B. $3hca$

C. $\frac{3}{hca}$

D. $\frac{3a}{hc}$

Answer: C

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11. The wavelength of de Broglie wave of the electron in the sixth orbit of H-atom is- (r_0=Bohr's radius)

A. πr_0

B. $12\pi r_0$

C. $6\pi r_0$

D. $24\pi r_0$

Answer: B

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12. In an orbit, velocity of an electron in excited state of H-atom is $1.093 \times 10^6 cm \cdot s^{-1}$. The circumference of this orbit is-

A. 13.3 Å

B. 6.65 Å

C. 3.33 Å

D. 26.65 Å

Answer: A

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13. Which have the largest number of unpaired electrons in p-orbitals in their ground state electronic configuration-

A. Te, I, Xe

B. F, Cl, Br

C. Ne, Ar, Kr

D. N, P, As

Answer: D

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14. answer any one question : (ii) find the equation of the plane passing through the intersection of the planes $2x+y+2z=9$ and $4x-5y-4z=1$ and through the point (3,2,-1).

A. d

B. p

C. s

D. none

Answer: A

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15. Compared to the mass of lightest nuclei, the mass of an electron is only-

A. $\frac{1}{80}$

B. $\frac{1}{800}$

C. $\frac{1}{1800}$

D. $\frac{1}{2800}$.

Answer: C

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16. Among the following sets of quantum numbers, which one is incorrect for 4d-electrons-

A. 4,3,2,$+\frac{1}{2}$

B. 4,2,1,0

C. 4,2,-2,$-\frac{1}{2}$

D. 4,2,1,$\frac{-1}{2}$

Answer: B

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17. Which d-orbitals has different shape from rest of all d-orbitals-

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

B. d_{xz}

C. d_{z^2}

D. d_{yz}

Answer: C

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18. Which element possesses non-spherical shells-

A. He

B. B

C. Be

D. Li

Answer: B

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19. Which have the samme number of s-electrons as the d-electrons in Fe^{2+}-

A. Li

B. Na

C. N

D. F

Answer: D

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20. An anion X^{3-} has 36 electrons and 45 neutrons. What is the mass number of the element X-

A. 81

B. 84

C. 78

D. 88

Answer: C

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21. Consider the set of quantum number 3,2,-2,$+\frac{1}{2}$, if the given subshell is completely filled. The next electron will enter orbital with n and l value-

A. n=3, l=3

B. n=4, l=1

C. n=1, l=1

D. n=2, l=1

Answer: B

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22. Given that an orbital is symmetric about the nucleus, then the value of azimuthal quantum number and magnetic quantum number are respectively-

A. $-1, +1$

B. $+1, +1$

C. $0, 0$

D. $1, 0$

Answer: C

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23. A certain F.M. station broadcasts at wavelength equal to 3.5 m. how many photons per second correspond to transmission of one kilowatt-

A. 2.24×10^{27}

B. 1.76×10^{28}

C. 2.26×10^{28}

D. 1.43×10^{26}

Answer: B

Watch Video Solution

24. A Bohr orbit in H-atom has a radius of 8.464 Å. How many transitions may occur from this orbit to the ground state-

A. 10

B. 3

C. 6

D. 15

Answer: A

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25. Angular momentum of the electron in the 4f-orbital of a one-electron species according to wave mechanics is-

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

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

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

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

Answer: A

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26. Consider the ground state of Cr atom (Z=24). The number of electrons with the azimuthal quantum numbers, l=1 and 2 are respectively-

A. 12 and 4

B. 12 and 5

C. 16 and 4

D. 16 and 5

Answer: B

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27. Which of the following radial distribution graphs correspond to l=2 the H-atom-

A. 

B. 

C. 

D. 

Answer: C

View Text Solution

28. The magnetic moment of M^{x+} (atomic number of M=25) is $\sqrt{15}BM$.

The number of unpaired electrons and the value of x respectively are-

A. 5,2

B. 3,2

C. 3,4

D. 4,3

Answer: C

Watch Video Solution

29. Which of the following graphs correspond to one node-

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

30. Radial part of the wave function depends upon quantum numbers-

A. n and s

B. l and m

C. l and s

D. n and l

Answer: A

Watch Video Solution

31. Which of the following pairs of nuclides are isodiaphers-

A. ${}_{6}^{13}C$ and ${}_{8}^{16}O$

B. ${}_{1}^{1}H$ and ${}_{1}^{2}H$

C. ${}_{1}^{3}H$ and ${}_{2}^{4}He$

D. ${}_{25}^{55}Mn$ and ${}_{30}^{65}Zn$

Answer: D

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32. The dissociation energy of H_2 is 430.53 $kJ \cdot mol^{-1}$. If hydrogen is dissociated by illumination with radiation of wavelength 253.7 nm, the

fraction of the radiant energy which will be converted into kinetic energy is given by-

A. 1

B. 0.0876

C. $2.22\ \%$

D. $1.22\ \%$

Answer: B

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33. The correct order of penetrating power of 3s, 3p, 3d electrons is-

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

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

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

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

Answer: C

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34. Hund's rule pertains to the distribution of electrons in-

A. principal enegy shell

B. an orbital

C. degenerate orbitals

D. none of these

Answer: C

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35. A principal shell having the highest energy subshell to the 'g' can accommodate electrons to a maximum of-

A. 18

B. 32

C. 25

D. 50

Answer: D

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36. When an electron of H-atom jumps from a higher to lower energy state, then-

A. its potential energy increases

B. its kinetic energy increases

C. its angular momentum remains unchanged

D. its de Broglie wavelength increases

Answer: B

Watch Video Solution

37. What will be the number of spectral lines(N) observed if an electron undergoes transition from n_2 excited level to n_1 excited level in an atom of hydrogen-

A. $N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

B. $N = \frac{(n_1 + n_2)(n_2 - n_1 + 1)}{2}$

C. $N = \frac{(n_2 + 1)(n_1 + n_2 + 1)}{2}$

D. $N = 2(n_1 - n_2)(n_2 + n_1 - 1).$

Answer: A

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38. Electromagnetic radiation with maximum wavelength is-

A. ultraviolet

B. radioactive

C. X-ray

D. infrared

Answer: B

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39. Brackett series are produced when the electrons from the outer orbits jumps to-

A. 2nd orbit

B. 3rd orbit

C. 4th orbit

D. 5th orbit

Answer: C

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40. Of the following sets which one does NOTZ contain isoelectronic species-

A. $BO_3^{3-}, CO_3^{2-}, NO_3^-$

B. $SO_3^{2-}, CO_3^{2-}, NO_3^-$

C. CN^-, N_2, C_2^{2-}

D. $PO_4^{3-}, SO_3^{2-}, ClO_4^-$

Answer: B

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41. The hydrogen like species Li^{2+} is in a psherically symmetric state S_1 with one radial node. Upon absorbing light, the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

Q. The state S_1 is-

A. 1s

B. 2s

C. 2p

D. 3s

Answer: B

Watch Video Solution

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

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

A. 0.75

B. 1.5

C. 2.25

D. 4.5

Answer: C

Watch Video Solution

43. The hydrogen like species Li^{2+} is in a psherically symmetric state S_1 with one radial node. Upon absorbing light, the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

Q. Orbital angular quantum number of the state S_2 is-

A. 0

B. 1

C. 2

D. 3

Answer: B

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44. In an atom, an electron is moving with a speed at 600 m/s with an accuracy of 0.005% certainty with which the position of the electron can be located is $\left(h = 6.6 \times 10^{-34} kg \cdot m^2 \cdot s^{-1}, \quad \text{mass of electron}, \quad m_e = 9.1 \times 10^{-31} kg\right)$ -

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

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

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

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

Answer: B

Watch Video Solution

45. The ionisation enthalpy of hydrogen atom is $1.312 \times 10^6 J \cdot mol^{-1}$. The energy required to excited the electron in the atom from n=1 to n=2 is-

A. $7.56 \times 10^5 J \cdot mol^{-1}$

B. $9.84 \times 10^5 J \cdot mol^{-1}$

C. $8.51 \times 10^5 J \cdot mol^{-1}$

D. $6.56 \times 10^5 J \cdot mol^{-1}$

Answer: B

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46. If we apply potential difference so that an electron is accelerated continuously in a vaccum tube such that a decrease of 10% occurs in its de-Broglie wavelength. In such a case the change observed in kinetic energy of electron will be approximately-

A. a decrease of 11%

B. an increase of 11.1%

C. an increase of 10%

D. an increase of 23.4%

Answer: D

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47. An electron has wavelength $1A^{\circ}$ the potential by which the electron is accelerated will be

A. 123 pm

B. 12.3 pm

C. 1.23 pm

D. 0.123 pm

Answer: A

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48. If two particles are associated with same kinetic energy, then the de Broglie's wavelength (λ) of these particles is-

A. directly proportional to the velocity

B. inversely proportional to the velocity

C. independent of mass and velocity

D. cannot be predicted.

Answer: A

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49. The ratio of magnetic moments of $Fe(III)$ and $CO(II)$ is-

A. $\sqrt{3}:\sqrt{7}$

B. $\sqrt{7}:\sqrt{3}$

C. $7:3$

D. $3:7$

Answer: B

Watch Video Solution

50. It is were possible for hydrogen atom to exist with a position as the extra-nuclear particle, then the energy of position in first excited state will be-

A. 13.6 eV

B. 3.4 eV

C. $-3.4eV$

D. 6.8 eV

Answer: B

Watch Video Solution

51. The direction cosines of a line satisfy the relations $\lambda(l+m) = nandmn + nl + lm = 0$. The value of λ, for which the two lines are perpendicular to each other, is a. 1 b. 2 c. $1/2$ d. none of these

A. $\Delta z \times \Delta p_z \geq \frac{h}{4\pi}$

B. $\Delta E \times \Delta t \geq \frac{h}{4\pi}$

C. $\Delta x \times \Delta p_y \geq \frac{h}{4\pi}$

D. $\Delta p_y \geq \Delta p_z \geq \frac{h}{4\pi}$

Answer: A::B

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52. Identify the orbitals for which n=4 and l=1-

A. $4p_y$

B. $4p_x$

C. $4d_{xy}$

D. $4d_{x^2-y^2}$

Answer: A::B

Watch Video Solution

53. The orbital which have samme number of nodes are-

A. 2s,3p

B. 3p,3d

C. 2s,2p

D. 3s,4d

Answer: B::C

Watch Video Solution

54. In the ground state, an element has 13 electrons in its M-shell. The element is-

A. Mn

B. Cr

C. Ni

D. Fe

Answer: A::B

Watch Video Solution

55. Angular momentum of an electron may have the values-

A. $0.5\frac{h}{\pi}$

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

C. $0.2\frac{h}{\pi}$

D. $2.5\frac{h}{2\pi}$

Answer: A::B

Watch Video Solution

56. The line spectrum is noticed during the transition of electron from higher excited state to lower one in H-atom only whe it falls from-

A. $2s \rightarrow 1s$

B. $2p \rightarrow 1s$

C. $3s \rightarrow 2p$

D. $4p \rightarrow 2p$

Answer: B::C

Watch Video Solution

57. Select the pair of atoms having the same no. of electrons in their outermost shell-

A. Na, Ca

B. Mg, Fe

C. As, Bi

D. Rb, Sb

Answer: B::C

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58. Which consists of particle of matter-

A. α – rays

B. β-rays

C. γ-rays

D. X-rays

Answer: A::B

Watch Video Solution

59. Which have two radial nodes-

A. 2p

B. 3s

C. 4p

D. 3p

Answer: B::C

Watch Video Solution

60. The ratio of λ_α and λ_β for Balmer series of hydrogen spectra is given by-

A. $\frac{108}{80}$

B. $\frac{108}{90}$

C. $\frac{54}{40}$

D. $\frac{27}{20}$

Answer: A::C

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61. Indicate the conditions under which the ratio of de Broglie wavelengths of an α-particle and a proton will be-

A. when the ratio of their velocities is 4:1

B. when the ratio of their velocities is 1:8

C. when the ratio of their energies is 128:1

D. when the ratio of their velocities is 1:16

Answer: B::C

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62. Which of the following ions is/are paramagnetic-

A. Zn^{2+}

B. Cu^{2+}

C. He_2^+

D. O_2^{2-}

Answer: B::C

Watch Video Solution

63. The energy of an electron in the first Bohr orbit of H-atom is -13.6 eV. Then, which of the following statement(s) is/are correct for He^+ -

A. energy of electron in second Bohr orbit is -13.6eV

B. kinetic energy of electron in the first orbit is 54.46eV

C. kinetic energy of electron in second orbit is 13.6eV

D. speed of an electron in the second orbit is $2.19 \times 10^6 m \cdot s^{-1}$.

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

View Text Solution

64. For which of the following species, the expression for the energy of electron in nth orbit, $E_n = \frac{13.6Z^2}{n^2} eV \cdot \text{atom}^{-1}$ has the validity-

A. He^{2+}

B. Li^{2+}

C. deuterium

D. tritium

Answer: B::C::D

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65. According to Bohr's atomic theory, which of the following relations are correct-

A. kinetic energy of electron $\propto Z^2/n^2$

B. the product of velocity of electron and the principal quantum number $\propto Z^2$

C. Frequency of revolution of electron in an orbit $\propto Z^2/n^3$

D. coulombic force of attraction on electron $\propto Z^2/n^4$

Answer: A::C::D

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66. Which is correct in case of p-orbitals-

A. they are spherically symmetrical

B. they have strong directional character

C. they are three fold degenerate

D. their charge density along x,y and z-axes are zero

Answer: B::C

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67. An isotope of $^{76}_{32}Ge$ is-

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

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

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

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

Answer: B::D

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68. Which of the following are correct-

A. Only lyman series is observed in both emission and absorption spectrum

B. the continuum in line spectrum is noticed after a certain value of n

C. the wavelength of mth line of Balmer series is $\frac{1}{2} = R_H Z^2 \left[\frac{1}{2^2} - \frac{1}{m^2}\right]$

D. the number of spectral lines given when electron drops from 5th to 2nd shell are six

Answer: A::B::D

View Text Solution

Exercise Very Short Type Question

1. What is the value of e/m of an electron?

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2. How manytimes a proton is heavier than an electron?

Watch Video Solution

3. Mention one similarity between isobar and isotone-

Watch Video Solution

4. What is wave number?

Watch Video Solution

Watch Video Solution

5. Arrange in order of increasing wavelength: UV, γ, X, IR- rays.

Watch Video Solution

6. What is meant by stationary orbit?

Watch Video Solution

7. Who proposed the quantum theory of radiation?

A. M. planck.

B. Rutherford

C. Thomson

D. None

Answer: A

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8. What is the value of Plancks' constant in SI unit?

A. 6.626×10^{-30}Js.

B. 6.626×10^{-34}Js.

C. 6.626×10^{-24}Js.

D. 6.626×10^{-27}Js.

Answer: B

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9. What is the value of angular momentum of an electron occupying the second orbit in an atom?

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10. Mention the symbol and the mass number of an element which contains two neutrons in the nucleus.

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11. Why is the spectrum of H^+ not obtained?

Watch Video Solution

12. How many proton(s)& electron(s) are in H^- ion?

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13. From which principal energy state, the excited electron comes down the yield spectral lines in the Balmer series?

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14. How many neutrons are present in ${}^{40}_{20}Ca^{2+}$ ion?

Watch Video Solution

15. What is the nature of hydrogen spectra?

Watch Video Solution

16. Mention one ion that obeys Bohr's theory.

Watch Video Solution

17. Write the relationship between wavelength and momentum of a moving microscope particle. Who proposed this relationship?

Watch Video Solution

18. Indicate the limitation of de Broglie equation.

Watch Video Solution

19. Is the uncertainty principle applicable to stationary electron?

Watch Video Solution

20. Energy associated with which of the following waves is not quantised? (i) Electromagnetic wave (ii) Matter wave.

Watch Video Solution

21. What is an orbital according to quantum mechanical model?

Watch Video Solution

22. How do you specify an electron in an atom?

Watch Video Solution

23. What is the maximum number of electrons in the 'n' th orbit?

Watch Video Solution

24. Which is the lowest energy level containing 'g' sub-shell?

Watch Video Solution

25. Identify the orbital with n=4 and l=0.

Watch Video Solution

26. Which 'd'-orbital does not contain four lobes?

Watch Video Solution

27. Which quantum number describes the shape of an electron?

Watch Video Solution

28. Write the electronic configuration of Mn^{2+} ion.

Watch Video Solution

29. What is the total number of nodes in 3d-orbital?

Watch Video Solution

30. Which subshell has the lowest screening power?

Watch Video Solution

31. Which quantum number is used to distinguish between the electron present in a single orbital?

Watch Video Solution

32. What are the quantum numbers used to indicate size and shape of orbitals?

Watch Video Solution

33. State the condition under which electronic energy is considered to be negative.

Watch Video Solution

Exercise Fill In The Blanks

1. The cgs uit of Planck's constant is____ and its SI unit is____.

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2. Angular momentum of an electron in the 'n' the orbit is____.

Watch Video Solution

3. If an α-particle and two β-particles are emitted from from a radioactive element, the element produced becomes an ___of the parent element.

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4. With help of Bohr's atomic model, the idea of ___ quantum number was first obtained.

Watch Video Solution

5. Bohr's atomic model ignored____structure of atom.

Watch Video Solution

6. The unit of Rydberg's constant in CGS unit is____.

Watch Video Solution

7. The range of wavelength of visible light is____.

Watch Video Solution

8. The ionisation potential of hydrogen is _____.

Watch Video Solution

9. Unlenbeck and Goudsmit introduced the concept of ___quantum number.

Watch Video Solution

10. The product of uncertainties in position and momentum of an electron is always equal to or greater than____.

Watch Video Solution

11. The number of orbitals present in 3s-subshel is____.

Watch Video Solution

12. The number of magnetic quantum numbers required to describe the electrons of 'd'-subshell is_____.

Watch Video Solution

Exercise Short Type Questions

1. Atomic number determines the characteristic properties of an element-explain.

Watch Video Solution

2. How did Rutherford arrive at the conclusion that the volume occupied by the nucleus is negligibly small as compared to the total volume of the atom?

Watch Video Solution

3. What is mass number? How is it related to atomic number?

Watch Video Solution

4. How does mass number differ from atomic mass?

Watch Video Solution

5. Indicate the number of electrons, protons and neutrons present in ${}_{9}^{19}F$. Will these numbers remain same in F^- ion?

Watch Video Solution

6. Frequency of a photon is $1.2 \times 10^{15} Hz$. Calculate its energy in J.

Watch Video Solution

7. Write three differences between rugherford's atomic model and Bohr's atomic model.

Watch Video Solution

8. Calculate the wavelength of the spectral line having minimum energy in the Lyman series of hydrogen atom.

Watch Video Solution

9. The total energy of an electron in an atom is negative'-what does it signify?

Watch Video Solution

10. The number of electrons in K, L and M-shell of an atom are 2.8 and 5 respectively. Calculate (i) the number of protons,

(ii) Number of electrons in the s-and p-sub-shell and (iii) the valency of the element.

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11. Indicate one application of wave property of electron.

Watch Video Solution

12. Heisenberg's uncertainty principle is not applicable to particles having medium or large size. Explain.

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13. Write Schrondinger's wave equation and indicate the significance of different notations.

Watch Video Solution

14. Half-filled and fully filled orbitals have extra stability. Explain.

Watch Video Solution

15. Copper(I) is diamagnetic but copper(II) is paramagnetic-why?

Watch Video Solution

16. An element has the electronic configuration $[Ar]3d^4$ at its +3 oxidation state. Identify the element.

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17. Calculate the numbe of unpaired electrons in Pd(Z=46).

Watch Video Solution

18. Show that the third shell may contain a maximum of 18 electrons.

Watch Video Solution

19. Is there any existence of 3f-subshell in any atom?

Watch Video Solution

20. How many electrons in the Cl-atom at the most can have value, n+l=3?

Watch Video Solution

21. Between Cu^{2+} and Fe^{2+}, which one is more paramagnetic?

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22. In the atom of an inert gas, the difference between the number of p-electrons and s-electrons in equal to the number of d-electrons present in it. Mention the name of the inert gas and its atomic number.

Watch Video Solution

23. Which atoms are indicated by the following configurations?

(i) $[He]2s^1$

(ii) $[Ne]3s^23p^3$

(iii) $[Ar]4s^23d^1$.

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24. Atomic number of the element M is 29. write the electronic configuration of M^+ and M^{2+}.

Watch Video Solution

25. How many types of sub-shells are present in the fourth energy level of an atom? Write the total number of orbitals.

Watch Video Solution

26. What is the maximum number of electrons that can be accommodated in the 2p-sub-shell? Give reason in favour of your answer.

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Exercise Numerical Problems

1. A sample of gaseous oxygen contains only ^{18}O isotopes. How many neutrons are preent in 11.2 L of the gas at STP?

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2. Calculate the energy required for promotion of electrons from the 1st to 5th Bohr orbit of all the atoms present in 1 mole of H-atoms.

Watch Video Solution

3. Calculate the velocity $\left(cm \cdot s^{-1}\right)$ and frequency of revolution of electron present in the 3rd orbit of H-atom.

Watch Video Solution

4. Calculat ethe wave length and frequency associated with the spectral line having longest wave lengthin the Pfund series of hyrogen spectra.

Watch Video Solution

5. Calculate the energy of 1 mol of photons associated with a frequency of $5 \times 10^{10} s^{-1}$.

Watch Video Solution

6. The wavelength associated with a moving particle of mass 0.1 mg is 3.3×10^{-29}m. find its velocity $\left[h = 6.6 \times 10^{-34} kg \cdot m^2 \cdot s^{-1}\right]$.

Watch Video Solution

7. Calculate the kinetic energy of a moving electron associated with a wavelength of 4.8 pm.

Watch Video Solution

8. Calculate the frequency nad wave length of the energy emitted when the electron jumps from 4th orbit to 1st orbit of a H-atom.

Watch Video Solution

9. The wave number of the first line in the Balmer series of H-atom is $15200 cm^{-1}$. Calculate the wave number of the first line in the same series of Li^{2+} ion.

Watch Video Solution

10. The ionisationn potential of sodium is $4.946 \times 10^2 kJ \cdot mol^{-1}$. Calculate the wavelength of the radiation required to ioinise a sodium atom.

Watch Video Solution

11. The wavelength range of the visisble spectrum extends from violet (400 nm) to red (750 nm). Express these wavelengths in frequencies (Hz) (1nm=$10^{-9} m$).

Watch Video Solution

12. Calculate the energies $(E_1 \text{ and } E_2)$ of radiations with wave lengths 800 pm and 400 pm. Also compare their energies.

Watch Video Solution

13. Calculate the velocity and wave length of an α-particle moving with kinetic energy of $1.602 \times 10^{-12} J$. (Mass of α-particle $= 6.64 \times 10^{-24} g$).

Watch Video Solution

14. The ionisation potential of H-atom is 13.6 eV. Calculate the ionisation potential of He^{+} and Li^{2+} ions.

Watch Video Solution

15. Which orbit of Be^{3+} ion has the same radius as that of the 1st orbit of H-atom?

Watch Video Solution

16. The angular momentum of the electron in a Boh'r orbit of hydrogen atom is $4.2178 \times 10^{-34} kg \cdot m^2 \cdot s^{-1}$. Calculate the wavelength of the

spectral line when the electrton falls from this level to the next lower level

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17. Calculate the minimum amount of energy requried to remove the electron from a hydrogen atom in its ground state.

Watch Video Solution

18. Energy of an electron in the n-th orbit of H-atom, $E_n = \frac{-2.17 \times 10^{-11}}{n^2} erg$. How much energy is required to remove the electron from its second orbit? Also calculate the wavelength of the light used for this process?

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19. A ball of mass 100g moves with a velocity of $100m \cdot s^{-1}$. Find the wavelength of the wave associated with the moving ball.

Watch Video Solution

20. Calculate the uncertainty in the position of an electron if uncertainty in the measurement of it's momentum be $1.0 \times 10^{-5} kg \cdot m \cdot s^{-1}$.

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21. Calculate the energy of each quantum of an electromagnetic radiation of wavelength 5000 Å $[h = 6.626 \times 10^{-34} J \cdot s]$.

Watch Video Solution

22. If one electron has a velocity of $500m \cdot s^{-1}$ with an uncertainty of 0.02%. What is the uncertainty in locating location?

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23. The uncertainty in position and velocity of a particle are 1.0×10^{-5} m and $4.28 \times 10^{-20} m \cdot s^{-1}$ respectively. Calculate the mass of the particle.

Watch Video Solution

24. A proton is accelerated to a velocity of one tenth times that of the velocity of light. If the uncertainty in the determination of its velocity be $\pm 0.5\,\%$, calculate the uncertainty in locating its position. [mass of proton $= 1.675 \times 10^{-27} kg$].

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25. The longest wavelength transitoin in one of the spectral series of hydrogen atom is 6563 Å. Identify the series to which the spectral line

belongs.

Watch Video Solution

26. The momentum of a moving particle 'A' is twice that of another particle 'B' if the wavelength associated with the motion of A be $5 \times 10^{-8} m$, find the wavelength associated with the motion of B.

Watch Video Solution

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

Watch Video Solution

28. Calculate the energy (in eV units) required to ionised 1 mol of hydrogen atoms.

Watch Video Solution

29. To which orbit the electron in the hydrogen atom (ground state) will jump of absorbing $2.044 \times 10^{-18} J$ of energy.

Watch Video Solution

30. Calculate the de Broglie wavelength of an electron that has been accelerated from rest through a potential difference of 5000 volt.

Watch Video Solution

31. Calculate the numbe of complete waves formed when an electron makes one complete revolution in the 3rd Bohr orbit.

Watch Video Solution

32. Calculate the amount of energy released for transition of electrons associated with 1 gram atom of hydrogen so that lowest frequency spectral line is formed in the visible region of the spectrum. $\left[R_H = 1.1 \times 10^7 m^{-1}\right]$.

Watch Video Solution

33. An electron in a hydrogen atom in the ground state absorbs energy equal to 1.5 time the energy required to remove the electron completely from the hydrogen atom. Calculate the velocity and wavelength of the electron emitted.

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34. Iodine molecule dissociates into atoms by absorbing light of wave length 450 nm. Calculate the kinetic energy of iodine atom if each iodine

molecule absorbs one quantum radiation. (Bond energy of $I_2 = 240kJ \cdot mol^{-1}$).

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35. What is the velocity of an electron so that its momentum is equal to the momentum of a photon associated with radiation of wave length 650 nm?

Watch Video Solution

36. A sub-atomic particle has a kinetic energy of $3.6 \times 10^{-24} J$. Calculate the frequency of the wave associated with the motion of this particle.

Watch Video Solution

37. The angular momentum of an electron present in a Bohr orbit is $3.1655 \times 10^{-34} kg \cdot m^2 \cdot s^{-1}$. What will be the wavelength of the

spectral line produced when the electron jumps to the adjacent orbit with lowest radius?

Watch Video Solution

38. Calculate the velocity of an electron in the first Bohr obit. Also calculate the de Broglie wavelength (in 'm') of the electron. Find the orbital angular momentum (in $\frac{h}{2\pi}$ units) of 3p orbital of hydrogen atom.

Watch Video Solution

Practice Set

1. What accelerating potential is needed to produce an electron beam with an effective wavelength of 0.090Å-

A. $1.86 \times 10^4 eV$

B. $1.86 \times 10^2 eV$

C. $2.86 \times 10^4 eV$

D. $2.86 \times 10^2 eV$

Answer:

Watch Video Solution

2. Which of the following sets of quantum number is restricted-

A. n=3,l=1,m=+2

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

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

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

Answer:

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3. What is the atomic number of the element with M^{2+} ion having electronic configuration $[Ar]3d^8$-

A. 25

B. 28

C. 27

D. 26

Answer:

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4. Magnitude of kinetic energy of an electron in a Boh'r obit of H-atom is equal to-

A. half of the potential energy

B. twice of the potential energy

C. one fourth of the potential energy

D. none of the above

Answer:

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5. The velocities of two particles A and B are 0.05 and 0.02 $m \cdot s^{-1}$ respectively. The mass of B is five times the mass of A. the ratio of their de Broglie wavelength is-

A. $2:1$

B. $1:4$

C. $1:1$

D. $4:1$

Answer:

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6. Prove that the velocity of the electron revolving in the first orbit is twice to that of the electron revolving in the second orbit of the hydrogen atom.

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7. 2×10^8 atoms of carbon are arranged side by side. Calculate the radius of carbon atom if the length of this arrange is 2.4 cm.

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8. Explain why 2d and 3f orbitals do not exist?

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9. How many quantum numbers are required to identify an orbital?

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10. An 80 watt bulb emits monochromatic light of wavelength 480 nm. Calculate the number of photons emitted per second by the bulb?

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11. Why is it not possible to overcome the uncertainty of Heisenberg's principle using devices having high precision?

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12. Write edown the electronic configuration of $_{14}Si$ and $'_{25}Mn.$

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13. Show that an orbital cannot accommodate more than two electrons in it. For how many electrons of Cl atom, n+l=3.

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14. Neon gas is generally used in sign boards. If it emits strongly at 616 nm, calculate (a) the frequency of emission (b) distance travelled by this radiation at 30 s (c) no. of quantum present if it produces 2J of energy.

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15. (a) Write two differences between electromagnetic wave and matter wave. (b) show that the circumference of the 'n' th electronic orbit is n times the de Broglie wavelength of the wave associated with the motion of electron i.e., $2\pi r_n = n\lambda$.

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