CHEMISTRY

BOOKS - CHETANA PUBLICATION

Structure of atoms and nuclei

Example

1. Name the first scientists to propose about atom in 5th century BC?

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2. How the word "Atom" was defined in the 5th century BC?

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3. Which Indian saint and philosopher, explain atom in early century BC?

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4. State assumption of Dalton's atomic theory.

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5. State drawback of Dalton's atomic theory.

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6. Why Thomson's atomic model was called as plum pudding model.

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7. John Dalton's model of atom was

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8. . Draw the labelled diagram of atomic model.

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9. Answer the following questions :

Write the name and the structure of monomer of polyacrylonitrile.

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10. What are alpha particles?

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11. Mention the name of scientist involved with alpha scattering experiment.

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12. Name the source used in alpha scattering experiment.

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13. Explain the Rutherford's model of an atom.

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14. State the difficulties faced by Rutherford atomic model?

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15. What are the drawbacks of Rutherford atomic model?

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16. What happens, when a metallic object is heated?

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17. What are four visible line spectra observed in hydrogen gas?

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18. Explain hydrogen spectrum with different series.

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19. What is a photon?

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20. Derive a dimension of 'h' Planck's constant.

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21. Obtain an expression for the radius of Bohr orbit for H-atom.

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22. Show that linear velocity of electron in Bohr's orbit is inversely proportional to principal quantum number.

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23. Determine the maximum angular speed of an electron moving in a stable orbit around the nucleus of hydrogen atom.

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24. Find the ratio of the diameters of 2nd Bohr orbit to 4th Bohr orbit.

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25. Find the velocity of the electron in the first orbit in hydrogen atom. Hence, find velocities when electron is in 3rd and 5th orbit.

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26. Find the linear momentum of the electron in the 2nd Bohr orbit. And hence find the angular momentum of the electron in hydrogen atom.

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27. Calculate the frequency of revolution of the electron in the first Bohr orbit of H-atom, if the radius of the 1st Bohr orbit is $0.50A^{\circ}$ and the velocity of electron in the first orbit =$2.24 \times 10^{6} m/s$.

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28. Find the angular speed of the electron in the first orbit of hydrogen atom.

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29. The angular speed of the electron in the nth Bohr orbit of the hydrogen atom is proportional to

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30. The time period of revolution of electron in its ground state orbit in a hydrogen atom is 1.6 × 10–16 s. The frequency of revolution of the electron in its first excited state (in s–1) is:

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31. Draw a neat and labelled energy level diagram for hydrogen atom

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32. Obtain expression for longest and shortest wavelength of spectral lines in ultraviolent region for hydrgen atom.

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33. State the name of the visible series in hydrogen series .Also obtain expression for longest and shortest wavelength o spectral lines.

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34. Derive the expression for the energy of an electron in the atom.

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35. Show that energy of the electron is inversely proportional to the square of principal quantum number.

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36. Starting from the formula for energy of an electron in the nth orbit of hydrogen atom, derive the formula for the wavelength of spectral lines.

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37. Explain the different series of spectral lines in hydrogen atom.

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38. Draw a neat and labelled energy level diagram for hydrogen atom

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39. Determine the energies of the first excited states of the electron in hydrogen atom. What are excitation energies of the electron in these orbits?

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40. Calculate the wavelength of the first line of Paschen series of hydrogen atom.

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41. Show that the frequency of the first line in Lyman series is equal to the difference between the limiting frequencies of Lyman and Balmer series.

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42. Determine the series limit of Balmer ,Paschen and Pfund series ,given the series limit for Lyman series is $912A^{\circ}$.

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43. The energy of an electron in an excited state of hydrogen atom is $-1.51eV$. Calculate the angular momentum of the electron in this state. $h = 6.63 \times 10^{-34} Js$

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44. What are the drawbacks of Bohr'sModel?

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45. What are the limitation of Bohr's model?

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46. Explain how De Broglie explanation gave theoretical basis for the second postulate made by Bohr?

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47. What is nucleus? Discuss the composition and size of the nucleus.

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48. Define Atomic Number, Atomic Mass.

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49. Define Isotopes, Isobars and Isotones.

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50. Define unified atomic mass unit. Express it in MeV/c^2.

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51. Give the values of Electron, proton and neutron in terms of united atomic mass unit(U).

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52. Explain Einstein's mass-energy relation with suitable examples.

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53. Write the formula for radius R% of a nucleus X.

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54. Prove that density of all the nuclei is same.

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55. The radius of the nucleus is of the order of ...

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56. What is nuclear forces?

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57. State the properties of nuclear forces.

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58. Define mass defect.

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59. Define: Nuclear binding energy.

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60. Define :Binding energy per nucleon. Express binding energy per nucleon in terms of mass defect.

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61. Calculate the binding energy of the mass of Lithium atoms being 7.016u respectively.

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62. Calculate the binding energy of an alpha particle Whose given mass is 4.00151u.

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63. Obtain the binding energy in MeV of a nitrogen nucleus $(7_{14}N)(Given: mass of (7_{14}N) = 14.00307$ a.m.u.)

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64. What is meant by radioactivity?

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65. Define radioactive decay. State the types of decay and write down the formulae for energies.

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66. Write down the formulae Q value.

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67. Calculate the energy released in the following reactions, the masses given are:, $^{223}_{88}Ra \rightarrow ^{209}_{82}Pb + ^{14}_{6}C$

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68. Complete the following equation describing nuclear decays: $'\,'^{226}_{88}R_a$ emits alpha particles.

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69. Complete the following equation $'\,'^{19}_{8}O$ undergoes beta decay.

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70. Complete the following equation: $'\,'^{228}_{90}Th$ undergoes alpha decay.

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71. Complete the following equation: ' ${}_{7}^{12}N$ undergoes beta decay.

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72. Calculate the energy released in the following reactions, the masses given are:, ${}_{88}^{223}Ra \rightarrow {}_{82}^{209}Pb + {}_{6}^{14}C$

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73. Calculate the energy released in the following reactions, the masses given are: ' ${}_{92}^{236}U \rightarrow {}_{56}^{140}Ba + {}_{36}^{94}Kr + 2n$

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74. State the law of radioactive decay. Hence derive the expression $N = N_0\left(e^{-\lambda}t\right)$.If where symbols have their usual meanings.

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75. What do you mean by "Activity" in radioactivity state its different units?

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76. Define Half-life of radioactive material. Derive an expression for half-life period

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77. The half-life of a nuclear species $''^{N}X$ is 3.2 days calculate its:decay constant

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78. The half-life of a nuclear species $''^{N}X$ is 3.2 days calculate its:Average life

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79. The activity of a radioactive sample decreased from $350 s^{-1}$ to $175 s^{-1}$ in one hour. Determine the half-life of the species

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80. Sample of carbon obtained from any living organism has a decay rate of 15.3 decays per gram per minute. A sample of carbon obtained from very old charcoal shows a disintegration rate of 12.3 disintegrations per gram per minute. Determine the age of the old sample given the decay constant of carbon to be $3.839 \times 10^{-12} per \sec ond$

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81. The half-life of is $'^{90}_{38}Sr$ Is 28 years. Determine the disintegration rate of its 5 mg sample.

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82. What is the amount of $'^{60}_{27}Cu$ necessary to provide a radioactive source of strength $10.0mCi$, its half-life being 5.3years?

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83. Disintegration rate of a sample is 10^{10} per hour at 20 hrs from the start. It reduces to6.3×10^9per hour after 30 hours. Calculate its half life andthe initial number ofradioactive atoms in the sample.

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84. The isotopes ^{57}Co decays by electrons capture to ^{57}Fe with a half - life pf 272d. The ^{57}Fe nucleus is produced in an excited state, and it almost instantaneously emits gamma rays: Find the mean lifetime and decay constant for $''_C o^{58}$

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85. The isotopes ${}_{C}o^{57}$ decays by electrons capture to ${}^{57}Fe$ with a half - life 272d. The ${}^{57}Fe$ nucleus is produced in an excited state, and it almost instantaneously emits gamma rays. If the activity of a radiation source ${}^{57}Co$is 2.0 μCi now, how many ${}_{C}o^{57}$ nuclei does the sorce contains?

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86. The isotopes ${}^{57}Co$ decays by electrons capture to ${}^{57}Fe$ with a half - life pf 272d. The ${}^{57}Fe$ nucleus is produced in an excited state, and it almost instantaneously emits gamma rays: Find the mean lifetime and decay constant for ${}''{}_{C}o^{58}$

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87. Before the year 1900 the activity per unit mass of atmospheric carbon due to the presence pf ${}''C^{14}$ averaged about 0.2555 bqper gram of carbon: What fraction of carbon atoms were ${}''{}^{14}C$?

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88. Before the year 1900 the activity per unit mass of atmospheric carbon due to the presence pf $''C^{14}$ averaged about 0.2555 bqper gram of carbon: What fraction of carbon atoms were $''^{14}C$?

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89. In the following table, seven elements P,Q,R,S,T,U and V (here letters are not the usual symbol of the elements)of the modern periodic table with their atomic numbers are given

3	4	5	6	7	8	9	10
P					T		V
11	12	13	14	15	16	17	18
Q	R		S			U	

Which of these is an inert gas? Name it.

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90. What is nuclear energy? Explain two process of obtaining nuclear energy.

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91. Explain Nuclear fission process with examples.

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92. Write a note on nuclear reactor.

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93. Answer the following questions in detail:

How is nuclear fission reaction carried out in nuclear power plants?

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94. Explain Nuclear fusion process with examples.

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95. What are the harmful effect of nuclear reaction.

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96. Calculate the energy released in the fusion reaction taking place inside the Sun, $4p \rightarrow \alpha + 2e^{+} +$ neutrinos, neglecting the energy given to the neutrinos. Mass of of alpha particle being 4.001506 u.

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97. How much mass of ^{235}U is required to undergo fission each day to provide 3000 MW of thermal power? Average energy per fission is 202.79 Mev?

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98. Distinguish between Nuclear fission and Nuclear fusion.

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99. Distinguish between Nuclear reactor and Nuclear bomb?

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Exercise

1. The radius of 3rd Bohr's orbit in hydrogen atom is $4.782 \times 10^{-10} m$

Calculate the radius of the 5th Bohr orbit.

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2. Find the ratio of the diameters of 1st Bohr orbit to 3rd Bohr orbit.

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3. Calculate the linear velocity and angular momentum of an electron in the 1st Bohr orbit of hydrogen atom. Given radius of second Bohr orbit= $2.12\overset{\circ}{A}, \varepsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{Nm^{-2}} 10^{-34} J - s, e = 1.6 \times 10^{-19} C.$

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4. Angular speed of the electron in the 1st Bohr orbit is $4.08 \times 10^{16} rad/\sec.$ Find the angular speed of the electron in the 3rd orbit.

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5. Find the period of revolution of electron in the second orbit in the hydrogen atom and hence find period of revolution of the electron in the third orbit of hydrogen atom.

$\varepsilon_0 = 8.85 \times 10^{-12} C^2 / Nm^2, h = 6.63 \times^{-34} J - s, m = 9. \times 10^{-31} kg, e =$

.

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6. The angular momentum of the electron in the second Bohr orbit is $2.112 \times 10^{-34} kgm^2 / s$. Find the angular momentum of the electron in the third Bohr orbit.

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7. Find the energy of the electron in eV in the third Bohr orbit of the hydrogen atom. ($Rydberg'scons\tan tR$ = 1.097 xx10^7 m^-1 $Planck'scons\tan t(h) =$ 6.63xx10^-34 J.S, $velocityoflight \in air(c) =$ 3xx 10^8 m//s)`

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8. Energy of an electron in the first Bohr orbit is -13.6eV. Hence calculate the energy of the electron in second orbit.

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9. What is rolling kinetic energy ?

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10. Calculate the difference in energies of two levels between which a transition of wavelength $4000^{o}A$ takes place.

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11. An electron in the ground state jumps to 4th state by absorption of energy $-13.6eV$.Determine a wavelength and frequency of the photon, $\left(e=1.6\times10^{-19}C, h=6.63\times10^{-34}J-s, c=3\times10^{8}m/s\right)$

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12. Calculate the wavelength of a microwave of frequency 8 GHz

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13. The H_a line of the Balmer series of hydrogen spectrumhasa wavelength $6560 \times 10^{-10} m$.Calculate the wavelength ofH_b line of the Balmar series.

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14. Calculate the energy radiated by the electron in the hydrogen atom during its transition from the fourth Bohr orbit to the first Bohr orbit. Hence determine frequency, wavelength and wave number of corresponding spectral line. Given: $E_1 = -13.6eV, h = 6.6 \times 10^{-34} J - s, c = 3 \times 10^8 m/s \ldots$

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15. Find the series limit of Paschen series $R = 1.097 \times 10^7 m^{-}1$.

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16. Find the ratio of the longest wavelength to the shortest wavelength in Balmer series.

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17. If the shortest wavelength in Paschen series is 8203 A°, find the longest wavelength in Balmer series.

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18. John Dalton's model of atom was

A. positively charged sphere with electrons embedded in it.

B. positively charged nucleus at the centre and electrons revolving around it.

C. positively charged nucleus at the centre and electrons revolving around it in fixed orbit.

D. none of these.

Answer:

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19. Bohr's theory applicable to

A. directly proportional to principal quantum number.

B. inversely proportional to the principal quantum number.

C. inversely proportional to square of principal quantum number.

D. directly proportional to the square of principal quantum number.

Answer:

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20. If the radius of 1st Bohr orbit in hydrogen atom is $0.5A^\circ$ 'then radius of 3rd Bohr orbit is

A. $0.25A^\circ$

B. $0.40A^\circ$

C. $4.5A^\circ$

D. $0.45A^\circ$

Answer:

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21. Which of the following quantities are inversely proportional to the cube of principal quantum number?

A. frequency

B. periodic time

C. angular velocity

D. (A) and(c) both

Answer:

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22. Bohr's second postulate equation is $mvr = n\frac{h}{2\pi}$. In this relation n represents.

A. principal quantum number

B. frequency

C. number pf turns

D. frequency of radiation emitted by an atom

Answer:

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23. According to Bohr's theory, the angular momentum for an electron in 5th orbit is

A. directly proposal to n

B. inversely proportional to n

C. directly proporational to n^2

D. inversely proporational to n^2

Answer:

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24. Let 'P' and 'E' denote the linear momentum and energy of emitted photon, respectively. If wavelength of incident radiation is increased.....

A. both P and E

B. P increases and E decreases

C. P increases and E decreases

D. both P and E decreases

Answer:

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25. The radius of the nucleus is of the order of ...

A. $10^{-6}cm$

B. $10^{-10}m$

C. $10^{-17} \rightarrow 10^{-21}m$

D. $10^{-14} \rightarrow 10^{-15}m$

Answer:

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26. The energy of an electron in n^th orbit is proporational to.....

A. n^2

B. n

C. $1/n$

D. $\frac{1}{n^2}$

Answer:

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27. Energy of the electron in$n = \infty$ is

A. E =$-13.6eV$

B. E =$-\infty eV$

C. E = $-0eV$

D. E =$+13.6eV$

Answer:

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28. Relation between K.E. and P.E. for an electron revolving in n^th bohr orbit is

A. K.E. = P.E.

B. K.E. = -P.E.

C. K.E. = -2 P.E.

D. 2 K.E. = -P.E.

Answer:

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29. When an electron in hydrogen atom is raised from the ground state to an excited state its

A. P.E. increases and K.E. decreases

B. P.E. decreases and K.E. increases

C. both the energies decreases

D. both the energies increases

Answer:

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30. If the P.E. of an electron in hydrogen atom is $-27.2eV$, then its T.E. is

A. $+27.2eV$

B. $-13.6eV$

C. $+13.6eV$

D. $-27.2eV$

Answer:

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31. The energy of an electron in the 1st Bohr orbit of hydrogen atom is

A. zero

B. maximum

C. mininum

D. infinite

Answer:

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32. The energy of an electron in the 2nd orbit is -3.4 eV. So the energy of an electron in the 4th orbit is

A. 0.84eV

B. $-0.85eV$

C. 8.5eV

D. 5.8eV

Answer:

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33. The ionisation potential of H_2 atom is

A. $-10.36eV$

B. 13.6eV

C. 8.24V

D. 14V

Answer:

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34. The ratio of radii of the first three Bohr orbits is

A. $3:2:1$

B. $1:2:3$

C. $9:4:1$

D. $1:4:9$

Answer:

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35. The radius of first Bohr orbit is$0.53A^{\circ}$. The value of n if the radius of n^th bohr orbit is $53A^{\circ}$, is

A. 10

B. 30

C. 40

D. 20

Answer:

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36. The relation between force acting on the electron and principle quantum number in hydrogen atom is

A. $F \propto n^4$

B. $F \propto \frac{1}{n^2}$

C. $F \propto \frac{1}{n^4}$

D. $F \propto n^2$

Answer:

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37. The unit of Rydberg's constant is

A. per metre

B. per second

C. per metre square

D. per kg

Answer:

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38. The shortest wavelength of Balmer series is given by

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

B. $\frac{4}{R}$

C. $\frac{36}{5}R$

D. $\frac{R}{4}$

Answer:

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39. The longest wavelength in Paschen series is obtained when an electron jumps from

A. 4th to 2nd orbit

B. 4th to 3rd orbit

C. 3rd to 4th orbit

D. $n_\infty \rightarrow 3rd$

Answer:

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40. The Lyman series involves

A. largest changes of energy

B. smallest changes of energy

C. largest changes of potential energy

D. smallest changes in potential energy

Answer:

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41. In an atom, two electrons move around the nucleus in circular orbits taking time f and 8f to complete one revolution. The ratio of their radii is.....

A. $1:4$

B. $8:1$

C. $4:1$

D. $1:8$

Answer:

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42. The energy in the ground state of hydrogen atom is $-13.6eV$, then energy of 1st excited state is

A. $-6.5eV$

B. `-3.4 eV

C. $-1.51eV$

D. $0.27eV$

Answer:

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43. The De Broglie wavelength associated with a particle of mass m and velocity v is given by

A. $\lambda = h(mV)$

B. $\lambda = mv/h$

C. $\lambda = h/mv$

D. $\lambda = \lambda / mv$

Answer:

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44. In which of the following systems will the radius of the first orbit of the electron be smallest?

A. hydrogen

B. singly ionized helium

C. deuterium

D. tritium

Answer:

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45. The radius of the 4th orbit of the electron will be smaller than its 8th orbit by a factor of

A. 2

B. 4

C. 8

D. 16

Answer:

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46. In the spectrum of hydrogen atom which transition will yield longest wavelength?

A. n=2 to n=1

B. n=5 to n=4

C. n=7 to n=6

D. n=8 to n=7

Answer:

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47. Which of the following properties of a nucleus does not depend on its mass number?

A. radius

B. mass

C. volume

D. density

Answer:

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48. If the number of nuclei in a radioactive sample at a given time is N, what will be the number at the end of two half-lives?

A. $\frac{N}{2}$

B. $\frac{N}{4}$

C. $3N/4$

D. $\frac{n}{8}$

Answer:

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49. The volume of the nucleus is proportional to

A. A

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

C. $A^{\frac{1}{3}}$

D. $A^{\frac{1}{4}}$

Answer:

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50. What is the relation between the radius of the nucleus and the mass number?

A. isotopes

B. isobar

C. isotones

D. excited

Answer:

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51. The nucleus having same mass number is called

A. isotones

B. isobar

C. isotopes

D. all of them

Answer:

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52. The energy of an electron moving with the velocity of light is given by

A. $0.511MeV$

B. $5.11MeV$

C. $51.1MeV$

D. $511MeV$

Answer:

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53. Radioactivity is a phenomenon associated with

A. emission of b particles

B. emission of a particles

C. decay of nucleus

D. decay of proton

Answer:

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54. The emission of beta particles is from

A. the nucleus due to the nuclear conversion neutron $\rightarrow$ proton +electron

B. the inner shell of an atom

C. the valence shell of an atom

D. the nucleus due to the nuclear conversion proton $\rightarrow$ neutron + electron

Answer:

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55. The radiations which are not affected by electric or magnetic field is

A. a-particles

B. b-particles

C. g-rays

D. x-rays

Answer:

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56. Which of the following radiation has maximum ionization power and minimum penetrating power

A. $\alpha - rays$

B. $\beta - rays$

C. $\gamma - rays$

D. cathode rays

Answer:

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57. In Davission and Germer experiment, crystal used to produce scattering of electrons is

A. sodium

B. nickel

C. calcium

D. potassium

Answer:

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58. Geiger - Marsden's experiment confirmed the theoretical predictions of.....

A. Rutherford

B. Bohr

C. Thomsan

D. Newton

Answer:

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59. In the spectrum of hydrogen atom which transition will yield shortest wavelength?

A. n=2 to n=1

B. n=5 to n=4

C. n=7 to n=6

D. n=8 to n=7

Answer:

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60. If the number of nuclei in a radioactive sample at a given time is N, what will be the number at the end of two half-lives?

A. $\frac{N}{2}$

B. $\frac{N}{T}$

C. 3N

D. $n/8$

Answer:

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61. If the number of nuclei in a radioactive sample at a given time is N, what will be the number at the end of two half-lives?

A. 2

B. 4

C. 8

D. 16

Answer:

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62. Energy of the electron in$n = \infty$ is

A. $E = -13.6eV$

B. E = ∞eV

C. $E = 0eV$

D. $E = +13.6eV$

Answer:

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63. Which of the two has greater ionizing power, alpha or beta particle?

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64. What is the relation between the radius of the nucleus and the mass number?

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65. State the name of the visible series in hydrogen spectrum?

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66. Find the shortest wavelength of the Paschen series, given that the longest wavelength of the Balmer series in the hydrogen spectrum is $6563A^{\circ}$.

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67. Find the energy of the electron in eV in the third Bohr orbit of the hydrogen atom. ($Rydberg'scons\tan t$R = 1.097 xx10^7 m^-1 $Planck'scons\tan t(h) =$ 6.63xx10^-34 J.S, $velocityoflight \in air(c) =$ 3xx 10^8 m//s)`

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68. The velocity of the electron in the 1st Bohr orbit has a radius$0.53A^{\circ}$ is $2200km/s$. Calculate the frequency of revolution of the electron in the same orbit.

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69. How many spectral series are possible in the hydrogen spectrum?

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70. State the properties ofβ -particles?

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71. What are isobars? State an example

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72. State the law of radioactive decay. Hence derive the expression $N = N_0\left(e^{-\lambda}t\right)$.If where symbols have their usual meanings.

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73. Find the shortest wavelength of the Paschen series, given that the longest wavelength of the Balmer series in the hydrogen spectrum is $6563A^{\circ}$.

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74. Derive an expression for the total energy of an electron in the nth orbit. Define B.E.

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75. Derive an expression $N = N_0 e^{-\lambda t}$ in Radioactivity

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