

Structure of Matter

1. Which isotope is used both in medical science and agriculture?

(a) ^{131}I (b) ^{125}I
(c) ^{32}P (d) ^{153}Sm

More information about this question

- In Isotopes, the Number of protons are the same but number of neutrons are different - Number of neutrons in ^{32}P is - 17
- Both ^{131}I and ^{125}I are isotopes of - Iodine.

2. Z is an element of proton number 111 and neutron number 141. Which of the following can be used to express the atom?

(a) $^{111}_{141}\text{Z}$ (b) $^{141}_{111}\text{Z}$
(c) $^{252}_{111}\text{Z}$ (d) $^{141}_{30}\text{Z}$

More information about this question

- 111 is the atomic number of - the Roentgenium.
- The atomic number of a fundamental element indicates the proton number of - nucleus
- Elements with high atomic number are - radioactive.
- The element with atomic number 111 is - radioactive.

3. What is the relative atomic mass of the element X?

5. What is the mass number of Deuterium? [Dhaka Board 2015]

(a) 4 (b) 3
(c) 2 (d) 1

6. When was the Rutherford's atom model discovered? [Dhaka Board 2015]

(a) 1811 (b) 1813
(c) 1911 (d) 1913

7. What is the number of electrons in Ca^{2+} ion? [Rajshahi Board 2015]

(a) 22 (b) 20
(c) 18 (d) 16

8. Which is used while placing a pacemaker in the heart? [Rajshahi Board 2015]

(a) ^{32}P (b) ^{60}Co
(c) Plutonium-238 (d) ^{106}Ru

9. In the electron distribution of Zinc the last electron enters in which shell? [Rajshahi Board 2015]

(a) s (b) p
(c) d (d) f

10. The isotope $^{32}_{15}\text{P}$ of which case is used? [Dinajpur Board 2015]

(a) In order to diagnose the expansion of bone
(b) To determine the presence of tumor
(c) In treatment of blood leukemia
(d) To prevent the growth of thyroid glands

Isotope	% Abundant
^{146}X	25
^{154}X	75

[Here X is used as symbol, not as the symbol of any regular element]

(a) 148 (b) 150
(c) 152 (d) 153

More information about this question

- Atomic mass of an element is the sum of the numbers of - protons and neutrons
- Isotopes of the same element are found - in different quantities in nature
- Isotopes are basically the atoms of - the same element with different mass number

4. $^{56}_{26}\text{Y}$ the element in the stem has -

i. more than one valency
ii. different numbers of proton and neutron
iii. regular electronic configuration.

Which one of the following is correct?

(a) i and ii (b) ii and iii
(c) i and iii (d) i, ii and iii

More information about this question

- The element with atomic number 26 is - Iron
- Electronic configuration of each isotopes of same element is - identical
- Chemical properties of each isotope of the same element are - the same
- Number of neutrons of two elements having $Z = 26$ and $A = 56$ neutron number are 30
- Iron has two valences - 2 and 3.

11. What is the relative molecular mass of CuSO_4 ?

[Dinajpur Board 2015]

(a) 111.5 (b) 125.0
(c) 143.5 (d) 159.5

12. What is the neutron number of the element of $^{35}_{17}\text{Cl}$?

[Dinajpur Board 2015]

(a) 17 (b) 18
(c) 35 (d) 70

13. How many electrons are present in the third energy level of $\text{Cr}(24)$? [Dinajpur Board 2015]

(a) 12 (b) 13 (c) 14 (d) 18

14. What is the relative molecular mass of Oxygen?

[Comilla Board 2015]

(a) 8 (b) 16
(c) 32 (d) 64

15. What is the electron distribution in the last shell of Cu? [Comilla Board 2015]

(a) $3s^2$ (b) $4s^1$
(c) $4s^0$ (d) $3d^{10}$

16. What is the real mass of an electron? [Comilla Board 2015]

(a) $9.67 \times 10^{-24}\text{g}$ (b) $1.675 \times 10^{-24}\text{g}$
(c) $9.11 \times 10^{-28}\text{g}$ (d) $1.6 \times 10^{-28}\text{g}$

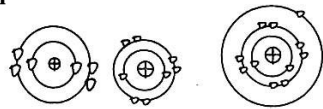
17. How many sub-shell in 'N' shell (Orbit)? [Chittagong Board 2015]

(a) 1 (b) 2 (c) 3 (d) 4

18. How many neutron in H^+ ion is? [Chittagong Board 2015]

- (a) 0 (b) 2 (c) 3 (d) 1

Answer the questions 19 and 20 from the following stem :



[Here A, B, C is used as symbol, not as the symbol of any regular element]

19. How many isotopes are there in the element 'A'?

- (a) 2 (b) 3 (c) 4 (d) 5

20. Element A –

- i. oxide is formed with 'B'
ii. covalent bond is formed with 'C'
iii. AB compound react with water and produce acid.

Which one of the following is correct?

- (a) i & ii (b) i & iii
(c) ii & iii (d) i, ii & iii

21. What is the atomic number of Potassium? [Sylhet Board 2015]

- (a) 15 (b) 17 (c) 19 (d) 21

22. What is the electron distribution of Sc? [Sylhet Board 2015]

- (a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
(b) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
(c) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
(d) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^1$

23. What is the real mass of a proton? [Sylhet Board 2015]

- (a) 1.567×10^{-24} (b) 1.67×10^{-24}
(c) 1.675×10^{-24} (d) 1.765×10^{-24}

24. D is an element which has 17 protons and 18 neutrons, how can the element be represented? [Sylhet Board 2015]

- (a) ${}^{34}_{17}D$ (b) ${}^{35}_{17}D$

31. Neutron number of the symbol ${}^{23}_{11}Na^+$ is —

- (a) 11 (b) 12
(c) 23 (d) 34

32. Which orbital of the following has the lowest energy?

- (a) 4s (b) 3d
(c) 4p (d) 4f

33. The maximum number of electrons in L shell is —

- (a) 2 (b) 8
(c) 16 (d) 32

34. How many electrons remain in the outermost shell of calcium? [Mirzapur Cadet-15]

- (a) 2 (b) 3
(c) 4 (d) 5

35. Which electronic configuration is correct for metal?

- (a) 2, 8, 2 (b) 2, 8, 4
(c) 2, 8, 6 (d) 2, 8, 8

36. What is the real mass of a proton? [Mirzapur Cadet-15]

- (a) 1.567×10^{-24} g (b) 1.67×10^{-24} g
(c) 1.675×10^{-24} g (d) 1.76×10^{-24} g

37. Which isotope of carbon is used to calculate the age of the universe? [Mirzapur Cadet-15]

- (a) C – 12 (b) C – 13
(c) C – 14 (d) C – 16

- (c) ${}^{35}_{18}D$ (d) ${}^{36}_{18}D$

25. What is the maximum electron bearing capacity of subshell d? [Jessore Board 2015]

- (a) 14 (b) 10
(c) 6 (d) 2

26. What is the relative molecular mass of Nitric acid?

[Jessore Board 2015]

- (a) 44 (b) 52 (c) 63 (d) 98

Answer the questions 27 and 28 from the following stem :

Isotope	%abundant
${}^{35}_{17}X$	75
${}^{37}_{17}X$	25

[Here X is used as symbol, not as the symbol of any regular element.]

27. What is the relative atomic mass of the element X?

[Jessore Board 2015]

- (a) 34.5 (b) 35.5
(c) 36.05 (d) 37.45

28. The element in the stem – [Jessore Board 2015]

- i. has 7 electrons in L shell
ii. has different number of electrons and proton
iii. mass of an atom is 5.89×10^{-23} gm

Which one of the following is correct?

- (a) i & ii (b) i & iii
(c) ii & iii (d) i, ii & iii

29. Which one is used to set pacemaker on heart? [Barisal Board 2015]

- (a) ${}^{32}P$ (b) ${}^{238}Pu$ (c) ${}^{195}Pt$ (d) ${}^{103}Pd$

30. How many neutrons are present in the isotope of carbon which is used to determine the age of earth?

[Barisal Board 2015]

- (a) 6 (b) 7 (c) 8 (d) 9

38. Which one is formed when ${}^{238}U$ dissociates spontaneously? [Rajshahi Cadet-15]

- (a) ${}^{206}Pb$ (b) ${}^{234}Th$
(c) ${}^{242}Pu$ (d) ${}^{210}Po$

39. Real mass of proton is — [Pabna Cadet-15]

- (a) 1.57×10^{-24} gm (b) 1.67×10^{-24} gm
(c) 1.77×10^{-24} gm (d) 1.87×10^{-24} gm

40. What is the neutron number of Mg? [Pabna Cadet-15]

- (a) 10 (b) 11
(c) 12 (d) 13

41. Latin name of Cu is — [Pabna Cadet-15]

- (a) Copper (b) Coprum
(c) Coper (d) Cuprum

42. Neutron number of deuterium is — [Pabna Cadet-15]

- (a) 1 (b) 2
(c) 3 (d) 4

43. Atoms of different mass of the same element is called

— [Joypurhat Girls' Cadet-15]

- (a) Isobar (b) Isotope
(c) Colloid (d) Gas

44. Which shell can accommodate maximum 32 electrons? [Joypurhat Girls' Cadet-15]

- (a) N-shell (b) M-shell
(c) L-shell (d) K-shell

45. Deuterium and Tritium are the isotopes of —

[Joypurhat Girls' Cadet-15]

- (a) Nitrogen (b) Hydrogen

- © Carbon d Oxygen
46. The maximum no. of electrons that can reside in a shell is — [Joypurhat Girls' Cadet-15]
 (a) $2n$ (b) $3n^2$
 (c) $3n$ (d) $2n^2$
47. Which of the following isotopes is used in the treatment of blood leukemia? [Rangpur Cadet-15]
 (a) Co – 60 (b) I – 131
 (c) P – 32 (d) Tc – 99
48. R is an element of proton number 68 and neutron number 72. Which of the following can be used to express the atom? [Rangpur Cadet-15]
 (a) ${}^{72}_{68}\text{R}$ (b) ${}^{140}_{68}\text{R}$
 (c) ${}^{140}_{72}\text{R}$ (d) ${}^{111}_{68}\text{R}$
49. Which element has half filled d-orbital electron? [Rangpur Cadet-15]
 (a) Cu (b) Fe
 (c) Cr (d) Sn
50. What is the relative mass of electron is equal of a proton or neutron? [Comilla Cadet-15]
 (a) $1/1840$ (b) $1/1871$
 (c) $1/1850$ (d) $1/2050$
51. What is used to detect the movement of phosphate thoroughly within the plant? [Feni Girls' Cadet-15]
 (a) Radioactively ray (b) Geiger Counter
 (c) C-14 isotope (d) MRI-Machine
52. Least electron of which metal enters to d-orbital? [Feni Girls' Cadet-15]
 (a) Alkali metals (b) Alkaline earth metals
 (c) Halogens (d) Coinage metals
53. Isotope of which element is used to set pacemaker in heart? [Feni Girls' Cadet-15]
 (a) Technetium (b) Proactinium
 (c) Gamarium (d) Plutonium
54. Electron bearing capacity of M shell is — [Faujdarhat Cadet-15]
 (a) 2 (b) 8
 (c) 18 (d) 32
55. How many electrons are there in the N-shell of Xenon? [Faujdarhat Cadet-15]
 (a) 2 (b) 8
 (c) 18 (d) 32
56. Which isotope is the used for determination age of fossil? [Sylhet Cadet-15]
 (a) P (b) I
 (c) C (d) O
57. Total number of proton in KCl — [Sylhet Cadet-15]
 (a) 35 (b) 36
 (c) 37 (d) 38
58. Percentage abundance of deuterium — [Sylhet Cadet-15]
 (a) 0.015 (b) 0.014
 (c) 0.013 (d) 0.012
59. On the formation which molecule in every atom attain the electronic configuration of Argon. [Sylhet Cadet-15]
 (a) MgO (b) CaO
 (c) KCl (d) KBr
60. Which one is the isotope of ${}^{16}_8\text{X}$? [Jhenidah Cadet-15]
 (a) ${}^{30}_{15}\text{X}$ (b) ${}^{17}_8\text{X}$
- (c) ${}^{16}_9\text{X}$ (d) ${}^{16}_{10}\text{X}$
61. Which one is used to set pacemaker in heart? [Mirzapur Cadet-14]
 (a) Plutonium-238 (b) uranium-235
 (c) Technetium-99 (d) ruthenium-106
62. How many electrons are there in ${}^{19}\text{K}^+$ ion? [Mirzapur Cadet-14]
 (a) 18 (b) 20
 (c) 17 (d) 39
63. How many electrons are in a circular orbit which is situated around the nucleus? [Mirzapur Cadet-14]
 (a) 8
 (b) equal to the number of protons which is attached to the neutrons in nucleus.
 (c) 12
 (d) equal to the number of neutrons which is attached to the protons in nucleus.
64. What is the latin name of sodium? [Mirzapur Cadet-14]
 (a) Natrium (b) Cuprum
 (c) Kalium (d) Plumbum
65. What is the atomic number of Sc? [Mirzapur Cadet-14]
 (a) 21 (b) 22
 (c) 23 (d) 24
66. What is the valence of nitrogen in Nitrogen di oxide molecule? [Mymensingh Girls' Cadet-14]
 (a) 2 (b) 3
 (c) 4 (d) 5
67. Which expresses the valence electron of beryllium? [Mymensingh Girls' Cadet-14]
 (a) 2 (b) 3
 (c) 4 (d) 5
68. What is the mass of $\frac{1}{12}$ th the part of carbon -12 isotope? [Mymensingh Girls' Cadet-14]
 (a) $1.66 \times 10^{-22}\text{g}$ (b) $1.66 \times 10^{-23}\text{g}$
 (c) $1.66 \times 10^{-24}\text{g}$ (d) $1.66 \times 10^{-27}\text{g}$
69. Which one is correct according to energy? [Rajshahi Cadet-14]
 (a) $4s > 3d > 3p$ (b) $4f > 5p > 4p$
 (c) $3d > 4p > 4d$ (d) $3s > 4d > 3d$
70. There is no neutron in the nucleus in which atom? [Pabna Cadet-14]
 (a) N (b) H
 (c) Na (d) Cu
71. Which is used for agriculture purpose? [Pabna Cadet-14]
 (a) 131-I (b) 32-P
 (c) 14-C (d) 153-Sm
72. Which of the following isotopes is used both in medicine and food preservation? [Joypurhat Girls' Cadet-14]
 (a) ${}^{60}\text{Co}$ (b) ${}^{131}\text{I}$
 (c) ${}^{32}\text{P}$ (d) ${}^{153}\text{Sm}$
73. How many number of orbitals are present in N shell of Francium? [Rangpur Cadet-14]
 (a) 8 (b) 16 (c) 32 (d) 50
74. ${}^{28}_{14}\text{X}$ is an isotope of..... [Rangpur Cadet-14]
 (a) Oxygen (b) Carbon
 (c) Nitrogen (d) Silicon
75. What is the actual chemical formula of sodium zincate? [Rangpur Cadet-14]
 (a) $\text{Na}_2\text{Zn}(\text{OH})_4$ (b) NaZnO_2
 (c) NaZnO (d) NaZnO_3
76. Rust form in the presence of — [Rangpur Cadet-14]
 (a) H_2O (b) $\text{H}_2\text{O}(\text{g})$ (c) O_2 (d) Fe

N.B.: H_2O and O_2 both are needed to form rust

77. Relative tendency of an atom in a molecule to attract the shared electron pair towards itself in a covalent bond is called— [Rangpur Cadet-14]

- (a) Electron affinity (b) Electro negativity
(c) Ionization potential (d) Polarization

78. Z is an element of proton number 211 and neutron number 241. Which of the following can be used to express the atom? [Comilla Cadet-14]

- (a) $\begin{smallmatrix} 341 \\ 211 \end{smallmatrix} \text{Z}$ (b) $\begin{smallmatrix} 452 \\ 211 \end{smallmatrix} \text{Z}$
(c) $\begin{smallmatrix} 211 \\ 452 \end{smallmatrix} \text{Z}$ (d) $\begin{smallmatrix} 341 \\ 241 \end{smallmatrix} \text{Z}$

79. Which isotope is used calculated the ages of various objects of the world along with fossil, mummy and even the age of the universe? [Comilla Cadet-14]

- (a) ^{60}Co (b) ^{32}P
(c) ^{131}I (d) ^{14}C

80. Maximum electron capacity of the 4th energy level— [Comilla Cadet-14]

- (a) 18 (b) 32
(c) 50 (d) 52

81. Which one of the following is used in treatment of thyroid glands? [Feni Girls' Cadet-14]

- (a) ^{131}I (b) ^{125}Pd
(c) ^{89}Sr (d) ^{32}P

82. $^{14}_6\text{A}$ is the isotope of— [Feni Girls' Cadet-14]

- (a) Oxygen (b) Carbon
(c) Nitrogen (d) Aluminium

83. Which one of the following is used to calculate the age of a tree? [Feni Girls' Cadet-14]

- (a) ^{14}C (b) ^{106}Ru
(c) ^{89}Sr (d) ^{32}P

84. What is the maximum electron capacity of f and d orbital respectively? [Faujdarhat Cadet-14]

- (a) 10 and 14 (b) 14 and 10
(c) 6 and 10 (d) 10 and 6

85. The amount of matter present in any substance— [Sylhet Cadet-14]

- (a) Weight (b) mass
(c) element (d) Compound

86. Which one has half filled d orbital in its electronic configuration— [Sylhet Cadet-14]

- (a) K (b) Sc
(c) Fe (d) Cr

87. How many maximum number of electrons are in 5th shell of an atom. [Sylhet Cadet-14]

- (a) 8 (b) 18
(c) 32 (d) 14

88. What is the percentage of abundance of hydrogen? [Jhenidah Cadet-14]

- (a) 0.015 (b) 98.99
(c) 99.98 (d) 89.98

89. In $^{17}_8\text{O}$ how electron are there? [Jhenidah Cadet-14]

- (a) 8 (b) 17 (c) 9 (d) 10

90. In N shell how many electrons can remain? [Jhenidah Cadet-14]

- (a) 8 (b) 18 (c) 24 (d) 32

91. Which one is used to prevent the growth of thyroid glands? [Jhenidah Cadet-14]

- (a) ^{127}I (b) ^{131}I

(c) ^{31}P

(d) ^{32}P

(b)

92. The general electronic configuration of inert element is— [Jhenidah Cadet-14]

- (a) ns^2np^6 (b) ns^1np^6
(c) ns^2np^5 (d) ns^1np^5

93. What is the Latin name of lead? [Jhenidah Cadet-14]

- (a) Natrium (b) plumbum
(c) kalium (d) ferrum

94. What is the percentage of abundance of protium in nature? [Barisal Cadet-14]

- (a) 0.015% (b) 0.15%
(c) 9.98% (d) 99.98%

95. Which isotope is not used in cancer treatment? [Barisal Cadet-14]

- (a) ^{131}Cs (b) ^{192}Ir
(c) ^{106}Ru (d) ^{138}La

96. How many electrons are present in M-shell of P? [Barisal Cadet-14]

- (a) 2 (b) 5 (c) 7 (d) 8

97. Which one is correct? [Barisal Cadet-14]

- (a) $3p < 4s < 3d$ (b) $4p < 3d < 5s$
(c) $3s < 2p < 3d$ (d) $3d < 4s < 4d$

98. What is the real mass of proton? [Barisal Cadet-14]

- (a) $1.67 \times 10^{-23}\text{g}$ (b) $1.67 \times 10^{-24}\text{g}$
(c) $1.675 \times 10^{-24}\text{g}$ (d) $9.11 \times 10^{-28}\text{g}$

99. Which ray emitted from ^{60}Co kills bacteria? [Barisal Cadet-14]

- (a) α -ray (b) β -ray
(c) γ -ray (d) None

100. Same number of valence electron containing elements are — [Rajshahi Cadet-15]

- i. Be
ii. O
iii. Sr

Which one of the following is correct?

- (a) ii & iii (b) i, ii & iii
(c) i & iii (d) i & ii

101. Fruit is preserved by — [Pabna Cadet-15]

- i. α ray
ii. β ray
iii. γ ray

Which one of the following is correct?

- (a) i (b) ii (c) iii (d) i, ii & iii

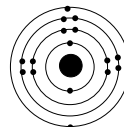
102. Which bears the unique identity of an atom? [Comilla Cadet-15]

- i. Mass Number
ii. Atomic Number
iii. Nucleon Number

Which one is correct?

- (a) i (b) ii (c) ii & iii (d) i, ii & iii

103. A model element is given in the following — [Sylhet Cadet-15]



- i. The element has IA group and 4th period
ii. It can react with sulphur
iii. It is alkaline earth metal

Which one is correct?

- (a) i, ii (b) ii, iii

- (c) iii, i (d) i, ii, iii
- 104.i. Rutherford model is compare to solar model
 ii. According to Bhers, Electrons are moving around the nucleus in definite circular path
 iii. Maxwell shows electrons goes towards centre

Which one is true? [Barisal Cadet-15]

- (a) i & ii (b) ii & iii
 (c) i & iii (d) i, ii & iii
105. In the $^{27}_{13}\text{Al}^{3+}$ ion— [Pabna Cadet-14]

- i. Number of proton is 14
 ii. Number of electron is 10
 iii. Number of neutron is 14

Which one of the following is correct?

- (a) i & ii (b) i & iii
 (c) ii & iii (d) i, ii & iii
106. Which is remain in the nucleus? [Pabna Cadet-14]

- i. Electron
 ii. Proton
 iii. Neutron

Which one of the following is correct?

- (a) i (b) i & ii
 (c) ii & iii (d) i & iii
107. Radioactive isotopes are used in— [Joypurhat Girls' Cadet-14]

- i. Producing electricity
 ii. Chemotherapy
 iii. Agriculture

Which one of the following is correct?

- (a) i, ii (b) i, iii
 (c) ii, iii (d) i, ii, iii
108. For isotope - [Sylhet Cadet-14]

- i. Atomic number same
 ii. Mass number different
 iii. Proton number same

Which one is correct?

- (a) i & ii (b) ii & iii
 (c) i & iii (d) i, ii & iii
109. Uses of radio active elements is given below: [Sylhet Cadet-14]

- i. ^{192}Ir is used as cancer treatment
 ii. Plutonium-238 is used as a pace maker
 iii. ^{89}Sr is used as bone pain

Whih one is correct?

- (a) i & ii (b) ii & iii
 (c) i & iii (d) i, ii & iii

Answer next two question on the basis of following stem

Isotope	% of abundant
^{235}X	15
^{238}X	85

110. What amount of ^{235}X exist in 1000 of X atom? [Rajshahi Cadet-15]

- (a) 15 (b) 150
 (c) 50 (d) 85

111. What is the relative atomic mass of X? [Rajshahi Cadet-15]

- (a) 236.5 (b) 237.5
 (c) 237 (d) 237.3

[Answer question number 112-115 in light of the following stem]

Part of a group of periodic table is given below — [Rangpur Cadet-15]

N (7)
X
Y

(b)

Z

 112. What is the latin name of Z?

- (a) plumbum (b) stanum
 (c) stibium (d) selenium

113. In what period of the periodic table does element Y belong to?

- (a) 2nd (b) 3rd
 (c) 4th (d) 5th

114. Which of the following elements show variable valency?

- (a) N (b) X
 (c) Y (d) Z

115. Which of the following elements reacts with water to form poison?

- (a) N (b) X
 (c) Y (d) Z

Answer question 116 & 117 according to following stem

Carbon has three isotopes and in respect of present abundness the amount of ^{13}C , ^{14}C and ^{12}C is 20%, 10% and 70% respectively. [Comilla Cadet-15]

116. What is the relative atomic mass of carbon?

- (a) 12.4 (b) 12.5
 (c) 12.3 (d) 12.6

117. In stem ^{14}C isotope use —

- i. Calculated the age of universe
 ii. To determine the presence of tumor and its position
 iii. In treatment of blood leukemia

Which one is correct?

- (a) i & ii (b) i
 (c) ii & iii (d) i, ii & iii

Go thurgh the diagram and answer the question no : 118, 119

$\text{M} \rightarrow \text{Q}$, M has two electron in its 4th shell, Q has 7 electrons in its 3rd shell, R is nonmetal. [Sylhet Cadet-15]

118. How many lone pair electrons in QR stable compounds?

- (a) 1 (b) 2
 (c) 3 (d) 4

119. The properties of QR compound —

- i. covalent compounds
 ii. Ionic compound
 iii. oxide of R can react with base

Which one of the following is correct?

- (a) i, ii (b) ii, iii
 (c) i, iii (d) i, ii, iii

Answer next two question on the basis of following stem

Isotope	% of abundant
^{236}X	15
^{238}X	85

120. What is the relative atomic mass of X? [Rajshahi Cadet-14]

- (a) 237 (b) 237.5
 (c) 237.7 (d) 236.5

121. What amount of ^{236}X exist in 1000 of X atom? [Rajshahi Cadet-14]

- (a) 50 (b) 85
 (c) 150 (d) 15

Follow the stem and answer question 122 and 123.

Al^{3+}	Be^{2+}	N^{3-}	S^{2-}
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122. Maximum number of electron shell present in which ion?

- (a) Al^{3+} (b) Be^{2+} (c) N^{3-} (d) S^{2-}

123. Al^{3+} and N^{3-}

- i. Ions are isoelectronic
 ii. Both are oxidant

iii. 10 and 3 protons are present respectively

Which one of the following is correct?

(a) i, ii

(b) ii, iii

(c) i

(d) i, ii, iii

(c)

★★ 3.1 Elements | Text Page -25

- Symbol of the atom of Carbon is **C** and the atomic number is 6
- We can determine the configuration of electron of any element by its atomic number, e.g.- atomic number of Mg is 12; its electron configuration is – $1s^2 2s^2 2p^6 3s^2$

124. Where is the whole mass of an atom concentrated?

- (a) nucleus (b) proton
(c) electron (d) neutron

(a)

125. Which element is inert?

- (a) N (b) S
(c) Ar (d) Ca

(c)

126. Which one is an element?

- (a) Na (b) NaCl (c) CO_2 (d) H_2O

(a)

127. What is the atomic number of Ne?

- (a) 8 (b) 10 (c) 18 (d) 20

(b)

128. What is the symbol of Sulfur?

- (a) P (b) Se (c) S (d) S_8

(c)

129. Which of these two elements have the same characteristics? (higher skill)

- (a) N & Na (b) Ca & O
(c) Ar & He (d) C & Mg

(c)

★★ 3.2 Symbols of Elements | Text Page -25

- In chemistry, atoms of every elements are expressed by a unique symbol
- Symbol of elements are expressed by one or two letters of the English alphabet
- There are some atoms of elements which are symbolized by its Latin name instead of its English name.
- Symbol of **Na** has been taken from its Latin name Natrium.

► General Multiple Choice Questions and Answers

130. What is the symbol of Copper? (knowledge)

- (a) Cu (b) Co
(c) C (d) Cr

(a)

131. What is the symbol of Boron? (knowledge)

- (a) Bo (b) B
(c) Br (d) Bn

(b)

132. What is the symbol of Cobalt? (knowledge)

- (a) Cl (b) Cd
(c) Co (d) C

(c)

133. Na is the symbol of which element? (knowledge)

- (a) potassium (b) nitrogen
(c) silver (d) sodium

(d)

134. What is the symbol of Chromium? (knowledge)

- (a) Cu (b) Cr
(c) C (d) Co

(b)

135. What is the symbol of Ununbium? (knowledge)

- (a) Ulun (b) Unn
(c) Unb (d) Uub

(d)

136. Which one is the symbol of Manganese? (knowledge)

- (a) Mg (b) Mn
(c) Mo (d) Md

(b)

137. Kalium is the latin name of which element? (knowledge)

- (a) copper (b) sodium
(c) fobium (d) potassium

(d)

138. Which of these symbols is taken from Latin name?

- (a) Na (b) Cl
(c) Mg (d) Al

(a)

139. Which one is the symbol of Lead? (knowledge)

- (a) Ld (b) Le
(c) Pb (d) Pm

(c)

140. What is the Latin name of Sodium? (knowledge)

- (a) nobedaum (b) natrium
(c) kalium (d) plumbum

(b)

141. Which statement about atom is time?

- (a) all the elements house only one number (mass mamber)
(b) the mass mamber can be less than the atomic number
(c) the mass mamber con qual the proton number
(d) the number of neafrons never equals the number of electrons

(c)

142. Which one is the symbol of first and third group?

- (a) Pb (b) Mn
(c) Cl (d) Co

(d)

143. Which one is English symbol? (knowledge)

- (a) Na (b) Cl
(c) Pb (d) Co

(b)

144. What is molecular mass of Sodium Hydro-oxide?

- (a) 40 (b) 40g
(c) 23 (d) 23g

(a)

145. What is the molecular mass of Calcium Carbonate?

- (a) 100 (b) 106
(c) 110 (d) 120

(a)

146. What is the molecular mass of Sulfuric Acid?

- (a) 98 (b) 100
(c) 98g (d) 106g

(a)

147. What is the Latin name of Iron? (knowledge)

- (a) iron (b) ferus
(c) ferrum (d) steel

(c)

148. The name Boron originates from which of these languages? (knowledge)

- (a) english (b) latin
(c) spanish (d) arabic

(d)

► Multiple Completion Based questions-answers

149. Which of these symbols are named from Latin —

- (conceptual)
i. Na
ii. Ca
iii. Cu

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

(b)

150. Which molecules have same number of protons—

- (conceptual)
i. N_2
ii. CH_4
iii. NH_3

Which one of the following is correct?

- (a) i and ii
 (c) ii and iii
 (b) i and iii
 (d) i, ii and iii

151. The correct representation of elements is — (conceptual)

- i. $^{27}_{13}\text{Al}$
 ii. $^{28}_{14}\text{Si}$
 iii. $^{16}_{8}\text{O}_8$

Which one of the following is correct?

- (a) i and ii
 (c) ii and iii
 (b) i and iii
 (d) i, ii and iii

152. Symbol containing three letters — (application)

- i. Uus
 ii. Uln
 iii. Uup

Which one of the following is correct?

- (a) i and ii
 (c) ii and iii
 (b) i and iii
 (d) i, ii and iii

★★ 3.3 Particles of atom | Text Page -26

- Atom has three permanent particles - electron, proton and neutron. Among these, protons and neutrons stay in Nucleus
- Sum of the numbers of the two particles in Nucleus is known as Nucleon Number
- Atomic number is a unique characteristic of an atom
- In an atom, number of electrons and protons are equal
- Relative masses of proton and neutron are equal; which are 1 and the relative mass of an electron is equal to 1/1840 of that of a proton and a neutron
- Actual masses of proton and neutron are 1.675×10^{-24} g and actual mass of electron is 9.11×10^{-28} g
- Charge of proton is 1.60×10^{-19} Coulomb and charge of electron is -1.60×10^{-19} Coulomb. Neutron is a charge neutral particle

► General Multiple Choice Questions and Answers

153. Which one is not a fundamental particle? (application)

- (a) neutron
 (c) hydrogen
 (b) proton
 (d) electron

154. What is the number of protons in the nucleus of Neon? (conceptual)

- (a) 2
 (c) 18
 (b) 10
 (d) 36

155. Which metal atom has the highest number of electrons? (conceptual)

- (a) Mg
 (c) Ae
 (b) Zn
 (d) Na

156. What is the atomic mass of Hydrogen? (knowledge)

- (a) 3.95×10^{-12} g
 (c) 2.99×10^{-23} g
 (b) 1.673×10^{-24} g
 (d) 1.67×10^{-24} g

157. What is the actual mass of an electron? (knowledge)

- (a) 1.67×10^{-23} g
 (c) 1.675×10^{-24} g
 (b) 9.11×10^{-28} g
 (d) 9.11×10^{-24} g

158. What is the actual mass of neutron? (knowledge)

- (a) 9.1×10^{-28} g
 (c) 1.675×10^{-24} g
 (b) 1.67×10^{-24} g
 (d) 1.60×10^{-24} g

159. Which of these particles is electrically neutral?

- (a) proton
 (c) electron
 (b) neutron
 (d) nucleus

160. Which one is the negatively charged particle of an atom? (knowledge)

- (a) proton
 (c) electron
 (b) neutron
 (d) nucleus

161. Who discovered electron? (knowledge)

- (a) Chadwick
 (c) Rutherford
 (b) Thomson
 (d) Avogadro

162. What is the number of stable particles in an atom? (knowledge)

- (a) 2
 (c) 4
 (b) 3
 (d) 5

163. Which statement about the normal state of the permanent particles of an atom is correct? (conceptual)

- (a) number of protons and electrons are the same
 (c) number of neutrons and electrons are the same
 (b) number of protons and neutrons are the same
 (d) number of protons and electrons are different

164. If an atom of an element has x number of protons, y number of electrons and z number of neutrons, then what is the mass number of that element? (conceptual)

- (a) x + y
 (c) y + z
 (b) x + z
 (d) x + y + z

165. An electron is ---- times lighter than a proton. (knowledge)

- (a) 1839
 (c) 1840
 (b) 1819
 (d) 1901

166. What is the actual mass of a proton? (knowledge)

- (a) 1.60×10^{-19} g
 (c) 1.67×10^{-24} g
 (b) 1.675×10^{-24} g
 (d) 1.67×10^{-23} g

167. What is the actual charge of an electron? (knowledge)

- (a) 1.60×10^{-19} coulomb
 (b) 1.6×10^{-20} coulomb
 (c) -1.60×10^{-19} coulomb
 (d) 1.80×10^{-19} coulomb

168. Which one is the number of protons in an atom? (knowledge)

- (a) mass number
 (c) atomic mass
 (b) no. of nucleons
 (d) atomic number

169. What is the nucleon number of $^{235}_{92}\text{U}$? (conceptual)

- (a) 92
 (c) 235
 (b) 143
 (d) 327

170. Al has 13 protons and its mass number is 27. what is its neutron number?. (conceptual)

- (a) 40
 (c) 13
 (b) 14
 (d) 15

171. Which one is the positively charged particle of an atom? (knowledge)

- (a) proton
 (c) neutron
 (b) electron
 (d) nucleus

172. By which letter, the mass number is expressed? (knowledge)

- (a) Z
 (c) A
 (b) B
 (d) M

173. By which letter, the atomic number is expressed? (knowledge)

- (a) M
 (c) A
 (b) N
 (d) Z

174. Which element does not have any neutron? (knowledge)

- (a) lithium
 (c) hydrogen
 (b) helium
 (d) deuterium

► Multiple Completion Based questions-answers

175. Symbol of proton is ressedas — (conceptual)

- i. H^+
 ii. P
 iii. P^+

Which one of the following is correct?

- (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii
176. What is correct about an atom? (conceptual)
- the number of neutrons means the number of nucleons
 - proton Number is called atomic number
 - mass of the neutrons is called atomic mass
- Which one of the following is correct?
- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii
177. What is correct about principal particles of an atom — (application)
- the mass of proton 1.67×10^{-24} g
 - is the mass of electron 9.11×10^{-24} g
 - the mass of neutron 1.675×10^{-24} g
- Which one of the following is correct?
- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii
178. The symbol ${}^{28}_{14}\text{Si}$ — means — (application)
- 28 is the mass number
 - the number of protons is 14
 - the number of protons and electrons are 28
- Which one of the following is correct?
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
179. Proton has — (conceptual)
- the symbol H^+
 - positive charge
 - mass equal to hydrogen
- Which one of the following is correct?
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
180. Atomic number — (conceptual)
- is equal to the number of protons
 - is expressed by Z
 - is fundamental characteristic of elements
- Which one of the following is correct?
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
181. In the symbol ${}^{16}_8\text{O}^{2-}$ — (higher skill)
- 16 indicates the mass number
 - the number of electrons is 8
 - the number of protons is 8
- Which one of the following is correct?
- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii

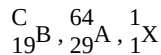
► Situation set Based Questions-Answers

Read the passage below and answer to the question 182 – 183:
The composition of two particles X and Y is as shown below:

Particle	Number of electrons	Number of neutrons	Number of protons
X	10	A	8
Y	18	18	17

182. X & Y — (application)
- are metal atoms
 - are negative ions
 - are non-metallic atoms
- Which one of the following is correct?
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
183. What is the value of A? (conceptual)
- (a) 8 (b) 9
(c) 10 (d) 11

Read the passage below and answer to the question no. 184 – 185:



184. What is the value of C? (conceptual)
- (a) 39 (b) 30
(c) 19 (d) 20
185. A of the stem — (higher skill)
- has 29 protons
 - has 29 X^+ nucleus
 - is Cu
- Which one of the following is correct?
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

★★ 3.4 Identity of an Atom | Text Page-27

- The number of protons in an element is the atomic number of it.
- Atomic number and mass number are expressed as Z and A respectively.
- If the mass number and atomic number of an atom are known, then the neutron number can be determined For example: the number of protons in Na is 11, and the number of nucleons i.e. the mass number is 23. So the number of neutrons is $23-11=12$.

► General Multiple Choice Questions and Answers

186. Which one is true for Fe^{2+} ion? (application)
- (a) 26 protons, 28 electrons
(b) 28 protons, 26 electrons
(c) 26 protons, 24 electrons
(d) 24 protons, 26 electrons
187. What is the number of electrons in ${}^{27}_{13}\text{Al}^{+3}$? (application)
- (a) 8 (b) 10
(c) 13 (d) 18
188. What is the number of electrons in ${}^{39}_{19}\text{K}^{+}$? (conceptual)
- (a) 18 (b) 19
(c) 20 (d) 39
189. In an atom, there are a number of protons, b number of electrons and c number of neutrons. What is its mass number? (conceptual)
- (a) a+b (b) a+c
(c) b+c (d) a+b+c
190. Which ion has the same number of electrons as argon atom? (conceptual)
- (a) Ca^{2+} (b) Al^{3+}
(c) F^- (d) Mg^{2+}
191. What is the number of negatively charged particles in ${}^{19}_9\text{F}^-$? (application)
- (a) 8 (b) 9 (c) 10 (d) 19
192. What is the number of electrons in ${}^{16}_8\text{O}^{2-}$? (application)
- (a) 6 (b) 8 (c) 10 (d) 16
193. What is the number of neutrons in ${}^{16}_8\text{O}^{2-}$? (application)
- (a) 5 (b) 6
(c) 7 (d) 8
194. What is the number of charge neutral particles in ${}^{39}_{19}\text{M}^{+}$ ion? (application)
- (a) 18 (b) 19
(c) 20 (d) 39
195. Which scientist introduced the concept of energy levels? (knowledge)
- (a) Rutherford (b) Neils Bohr
(c) Maxwell (d) Mendeleev
196. What are ${}^{64}_{29}\text{Zn}$ and ${}^{64}_{30}\text{Zn}$? (conceptual)

- (a) isotone (b) isotope
(c) isobar (d) isomer
197. Which one is correct for neutron? (conceptual)
(a) there is no charge
(b) the mass is double to that of proton
(c) has symbol P
(d) has symbol c
198. What is the number of electrons in $^{35}_{17}\text{Cl}$? (conceptual)
(a) 17 (b) 35
(c) 18 (d) 19
199. By which letter, mass number is expressed? (knowledge)
(a) A (b) B
(c) C (d) Z
200. How many protons are there in a chlorine atom? (knowledge)
(a) 8 (b) 12
(c) 14 (d) 17
201. What is the atomic number of gold? (knowledge)
(a) 89 (b) 69
(c) 59 (d) 79
202. Which one expresses the atomic number, mass number, charge and number of atoms? (conceptual)
(a) $^A_Z\text{X}^{m+}$ (b) $^A_Z\text{X}^{m+}$
(c) $^AZ^{m+}$ (d) $^AX_Z^{m+}$
203. What is the mass number of $^{35}_{17}\text{Q}$? (application)
(a) 35 (b) 18
(c) 17 (d) 16
204. What is atomic number of an element? (conceptual)
(a) the number of neutrons in its atom
(b) the number of protons and neutrons in its atom
(c) the number of protons in its nucleus
(d) the number of fundamental particles in its atom
205. The atomic number of sodium is 11. What does it mean? (conceptual)
(a) there is 1 electron in its atom
(b) there are 11 protons in its nucleus
(c) there are 11 neutrons in its atom
(d) the sum of number of protons and neutrons in its nucleus is 11
206. What is the number of neutrons in $^{23}_{11}\text{Na}^+$? (application)
(a) 11 (b) 12
(c) 23 (d) 34
207. What will be the number of nucleons if an atom contains 17 protons and 18 neutrons? (application)
(a) 35 (b) 18
(c) 17 (d) 1
208. What is the mass number of chlorine atom? (knowledge)
(a) 35 (b) 17
(c) 11 (d) 18
209. How many isotopes are discovered naturally and artificially? (knowledge)
(a) 1100 (b) 1200
(c) 1300 (d) 1400
210. Which isotope is used to treat the thyroid gland? (knowledge)
(a) ^{125}I (b) ^{130}I
(c) ^{127}I (d) ^{131}I
211. Which isotope plays role in the physiology of plants? (knowledge)
(a) ^{32}P (b) ^{30}P
(c) ^{125}P (d) ^{131}I
212. Which isotope is used to install pacemaker in heart? (knowledge)
- (a) ^{238}Pu (b) ^{235}Pu
(c) ^{238}U (d) ^{235}U
213. What is the mass number of an element if its atom contains m number of protons, n number of electrons and l number of neutrons? (application)
(a) $M+n$ (b) $N+1$
(c) $M+1$ (d) $M+n+1$
214. O^{2-} (oxide ion) has – electrons. (application)
(a) 7 (b) 10
(c) 8 (d) 9
215. How many protons are there in Al^{3+} ? (application)
(a) 13 (b) 11
(c) 12 (d) 10
216. How many electrons are there in Ca^{2+} ? (application)
(a) 18 (b) 11
(c) 12 (d) 20
217. What is the number of neutrons in $^{35}_{17}\text{Cl}$? (application)
(a) 35 (b) 17
(c) 18 (d) 52
218. What is the number of neutrons in $^{92}_{23}\text{U}$? (application)
(a) 235 (b) 92
(c) 142 (d) 143
219. What is the number of electrons in $^{23}_{11}\text{Na}^+$? (application)
(a) 10 (b) 11
(c) 12 (d) 23
220. What is the number of donated electrons in $^{27}_{13}\text{Al}^{3+}$? (application)
(a) 13 (b) 3
(c) 27 (d) 14
221. What is the number of electrons in $^1_1\text{H}^+$ ion? (application)
(a) 0 (b) 1
(c) 2 (d) 3
222. If the atomic number of carbon is 12, how many electrons are there in a carbon atom? (application)
(a) 6 (b) 12
(c) 24 (d) 25
223. What is the element with seven electrons in the M shell? (conceptual)
(a) Cl (b) Ar
(c) S (d) Si
224. What is the correct order of energy of the orbitals? (application)
(a) $3s < 4s < 3d < 4p$ (b) $5s < 4d < 5p < 6s$
(c) $4f < 6d < 5d < 6p$ (d) $4s < 4p < 3d < 5s$
225. The atom of which element is 32 times heavier than the $1/12^{\text{th}}$ of a carbon-12 isotope? (higher skill)
(a) P (b) O
(c) Fe (d) S
226. By which letter, atomic number is expressed? (knowledge)
(a) Z (b) A
(c) M (d) N
227. What is the number of electrons in $^{24}_{12}\text{Mg}^{2+}$? (application)
(a) 8 (b) 10
(c) 12 (d) 14
- Multiple Completion Based questions-answers
228. Daltons atomic theory—(conceptual)
i. is the base of modern chemistry
ii. says that atoms are not dividable
iii. says that the particles by which atom is formed are called fundamental particles

Which one of the following is correct?

- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii **a**

229. In ${}^1\text{H}^+$ ion — (conceptual)

- i. the number of protons and neutrons are equal
ii. there is one proton, but no neutron
iii. has no neutron or electron

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **c**

230. If the atomic mass number of an element is 12 — (conceptual)

- i. the number of protons is 6, the number of neutrons is 6
ii. the atomic number is 6, the number of neutrons is 6
iii. the number of protons is 9, the number of neutrons is 3

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **a**

231. If the atomic number mass of an element is 23 — (conceptual)

- i. the number of protons is 11, the number of neutrons is 12
ii. the number of protons is 12, the number of neutrons is 13
iii. the number of nucleons is 23

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **b**

232. ${}^{16}_8\text{O}^{2-}$ means — (conceptual)

- i. it has 10 electrons
ii. it has 8 protons
iii. it has 6 neutrons

Which one of the following is correct?

- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii **a**

233. ${}^{14}_7\text{X}$, ${}^{24}_{12}\text{Y}$, ${}^{15}_7\text{Z}$ — these formulae mean — (higher skill)

- i. X & Y are isotones
ii. Y has ionic form similar to Ne
iii. the compound formed by Y and Z is Mg_3N_2

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **c**

234. ${}^{14}_7\text{N}^{3-}$ means — (higher skill)

- i. number of proton is 7
ii. number of electrons is 5
iii. number of neutrons is 7

Which one of the following is correct?

- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii **b**

► Situation set Based Questions-Answers

Read the passage below and answer to the question no. 235 – 236:

${}^{16}_8\text{X}$ expresses the element X. X has another form – ${}^{18}_8\text{X}$. In a sample of X, there is 90% of ${}^{16}_8\text{X}$ and 10% of ${}^{18}_8\text{X}$.

235. What is the number of electrons in X? (conceptual)

- (a) 8 (b) 18 (c) 16 (d) 10 **a**

236. What is the mass of X? (application)

- (a) 16 (b) 18
(c) 16.2 (d) 18.2 **a**

Read the passage below and answer to the question nos. 237 – 239:

35₁₇A, 27₁₃B and 37₁₇C – three sample elements are presented

237. Which two elements are isotopes? (conceptual)

- (a) A & B (b) A & C
(c) B & C (d) A & A **b**

238. Which compound can be formed by the elements mentioned above? (application)

- (a) MgBr_2 (b) MgCl_2
(c) NaF (d) AlCl_3 **d**

239. The compound formed by A and B — (higher skill)

- i. forms white precipitate in basic solution
ii. can be produced by neutralization reaction
iii. shows bi-directional reaction in hydrolysis

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **d**

Observe the table below and answer to the question no. 240 – 242:

Element or particle	Proton	Neutron	Electron
A	3	4	2
B	17	20	18
C	12	12	12
D	17	18	17
E	17	20	17
F	18	22	18

240. Isotopes are — (higher skill)

- i. D
ii. B
iii. E

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii **d**

241. Which one is metal atom? (conceptual)

- (a) A (b) B
(c) C (d) D **c**

242. Which one is an anion? (conceptual)

- (a) A (b) B (c) C (d) D **b**

Read the passage below and answer to the question no. 243 and 244:

Element	Mass number, A	Atomic number, Z
Y	9	4
Z	11	5

243. What is the number of protons in Y? (application)

- (a) 9 (b) 4 (c) 5 (d) 13 **b**

244. What is the number of electrons in Z? (application)

- (a) 1 (b) 3
(c) 4 (d) 5 **d**

Answer Questions 245 and 246 on the basis of the formula:



245. How many protons are there in the given formula?

- (a) 13 (b) 12
(c) 14 (d) 27 **a**

246. How many electrons are there in the outermost energy shell of the given ion? (higher skill)

- (a) 8 (b) 3
(c) 5 (d) 2 **a**

★★ 3.5 Isotope | Text Page-28

- The numbers of neutrons in isotopes are different. Hydrogen has 7 isotopes.
- The three isotopes of hydrogen are – hydrogen or protium, deuterium, tritium; which are found in nature.

- Among the three isotopes, tritium ${}^3_1\text{H}$ is formed by radioactivity and is found in very low amount in nature.
- The amounts of ${}^1_1\text{H}$ and ${}^2_1\text{H}$ or ${}^2_1\text{D}$ are 99.98% and 0.015% respectively.

► General Multiple Choice Questions and Answers

247. The atoms of the same element with different mass numbers are called — (knowledge)

- (a) isobar (b) isotope
(c) isotherm (d) isotone

(b)

248. How many isotopes does hydrogen have? (knowledge)

- (a) 5 (b) 6
(c) 7 (d) 8

(c)

249. How many isotopes of hydrogen are found in nature? (knowledge)

- (a) 2 (b) 3
(c) 4 (d) 5

(b)

250. An atom of an element has a number of protons, b number of neutrons, c number or electrons. What is the number of nucleons? (conceptual)

- (a) a+b+c (b) a+b
(c) b+c (d) a+c

(c)

251. If the neutron numbers of two atoms are the same, they are called — (knowledge)

- (a) isotope (b) isomer
(c) isobar (d) isotone

(d)

252. Which one is equal in isotopes? (conceptual)

- (a) mass number
(b) neutron number
(c) number of protons
(d) number of protons and neutrons

(c)

253. How many deuteriums are there in 100000 hydrogen atoms? (knowledge)

- (a) 99985 (b) 15
(c) 20 (d) 16

(b)

254. ${}^{13}_6\text{A}$ is the isotope of which element? (conceptual)

- (a) oxygen (b) carbon
(c) nitrogen (d) aluminum

(b)

255. An isotope of hydrogen has 2 neutrons, what is its mass number? (knowledge)

- (a) 1 (b) 2 (c) 3 (d) 4

(c)

256. Which one is equal in isotopes? (knowledge)

- (a) number of protons (b) mass number
(c) number of neutrons (d) quantity of charge

(a)

257. Which one is equal in ${}^{16}_8\text{X}$ and ${}^{17}_8\text{Y}^-$? (knowledge)

- (a) Mass number (b) No. of neutrons
(c) No. of protons (d) No. of electrons

(c)

258. Deuterium and Tritium are Isotopes of Which Element? (knowledge)

- (a) nitrogen (b) hydrogen
(c) carbon (d) oxygen

(b)

259. Which one has 2 neutrons? (conceptual)

- (a) hydrogen (b) deuterium
(c) tritium (d) lithium

(c)

260. Which energy levels of calcium have 2 electrons? (conceptual)

- (a) K & L (b) L & M
(c) M & N (d) K & N

(d)

261. Which energy levels of scandium have 8 electrons? (conceptual)

- (a) K & L
(c) M & N

- (b) L & M
(d) K & N

(b)

262. How many sub-shells are there in the 5th shell? (knowledge)

- (a) 3 (b) 4
(c) 5 (d) 6

(d)

263. Which of the following pairs are isobars? (conceptual)

- (a) ${}^3_1\text{H}$, ${}^7_3\text{Li}$ (b) ${}^{12}_6\text{C}$, ${}^5_1\text{H}$
(c) ${}^4_1\text{H}$, ${}^4_2\text{He}$ (d) ${}^{12}_6\text{C}$, ${}^7_3\text{Li}$

(c)

264. Which ones are isotones? (application)

- (a) ${}^{12}_6\text{C}$, ${}^7_1\text{H}$ (b) ${}^5_1\text{H}$, ${}^4_2\text{He}$
(c) ${}^3_1\text{H}$, ${}^7_3\text{Li}$ (d) ${}^{12}_6\text{C}$, ${}^7_3\text{Li}$

(a)

265. Which one has no neutron? (conceptual)

- (a) lithium (b) oxygen
(c) helium (d) hydrogen

(d)

266. What is the mass number of deuterium? (application)

- (a) 1 (b) 2 (c) 3 (d) 4

(b)

267. What is the mass number of tritium? (application)

- (a) 1 (b) 3
(c) 4 (d) 1

(b)

268. Which is formed due to difference in the number of neutrons? (knowledge)

- (a) isotope
(b) no. of protons
(c) elements
(d) difference in number of electrons

(a)

269. Due to difference in which one, isotopes are formed? (knowledge)

- (a) proton (b) photon
(c) electron (d) neutron

(d)

270. Which one is not equal in isotopes? (knowledge)

- (a) atomic number (b) mass number
(c) no. of electrons (d) chemical nature

(b)

271. What is the diameter of nucleus? (knowledge)

- (a) 10^8cm (b) 10^{10}cm
(c) 10^{-10}cm (d) 10^{-15}m

(d)

272. ${}^{16}_8\text{X}$ is isotope of which one? (conceptual)

- (a) O (b) S (c) Na (d) Si

(a)

273. What is the atomic number? (knowledge)

- (a) no. of neutrons (b) mass number
(c) no. of protons (d) no. of charges

(c)

274. What is the mass number of tritium? (knowledge)

- (a) 1 (b) 2 (c) 3 (d) 4

(c)

275. Which one is formed due to difference in mass number? (knowledge)

- (a) isomer (b) isobar
(c) isotope (d) isotone

(c)

276. ${}^{17}_8\text{X}$ is isotope of which one? (conceptual)

- (a) ${}^{30}_{15}\text{X}$ (b) ${}^{17}_9\text{X}$
(c) ${}^{17}_8\text{X}$ (d) ${}^{16}_{10}\text{X}$

(c)

277. Which pair is example of isotope? (conceptual)

- (a) ${}^{12}_6\text{C}$, ${}^{12}_7\text{C}$ (b) H_2 , He (c) H^+ , H (d) ${}^{12}_6\text{C}$, ${}^{14}_6\text{C}$

(d)

278. An atom and an ion of ${}^{23}_{11}\text{Na}$ have — (conceptual)

- (a) 11 electrons (b) 12 neutrons

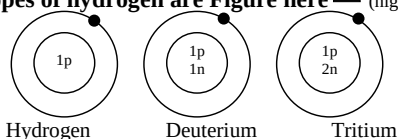
- (c) 23 protons (d) 23 neutrons
- 279. Which one is equal in case of an atom?** (conceptual)
- (a) there is only one mass number for an element
(b) number of nucleons is less than number of protons
(c) number of electrons and number of protons are equal
(d) number of neutrons is equal to number of electrons
- 280. Which one is Isotopes have the same for isotopes?** (conceptual)
- (a) atomic number (b) mass number
(c) no. of electrons (d) chemical nature
- 281. Which one is same for isotones?** (conceptual)
- (a) no. of protons (b) no. of neutrons
(c) no. of electrons (d) no. of photons
- 282. Z is an element which has 111 protons and 141 neutrons. By which symbol, it can be expressed?** (application)
- (a) ${}_{111}^{141}\text{Z}$ (b) ${}_{111}^{141}\text{Z}$
(c) ${}_{111}^{1252}\text{Z}$ (d) ${}_{301}^{141}\text{Z}$

► Multiple conclusive questions & answers

- 283. An isotope found in nature** — (conceptual)
- i. ${}^{14}\text{C}$
ii. ${}^{130}\text{Te}$
iii. ${}^{120}\text{N}$
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
- 284. In 100000 hydrogen atoms, there are** — (conceptual)
- i. 99985 hydrogen
ii. 15 deuterium
iii. negligible number of tritium
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
- 285. In case of atoms** — (higher skill)
- i. ${}^1_1\text{H}$ is protium
ii. ${}^3_1\text{H}$ is formed only by radioactivity
iii. ${}^2_1\text{H}$ has availability of 0.015%
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii
- 286. The isotopes of hydrogen are** — (conceptual)
- i. hydrogen
ii. deuterium
iii. tritium
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

- 287. In case of isotopes** — (conceptual)
- i. atomic number is the same but mass number is different
ii. chemical nature is the same
iii. they are atoms of the same element
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

- 288. Isotopes of hydrogen are Figure here** — (higher skill)



- i. mass number of the first one is 2
ii. number of electrons of the 3^{rd} one is 1
iii. mass number of the 2^{nd} one is 2
- Which one of the following is correct?**
- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii

- 289. Isotope of hydrogen** — (conceptual)
- i. has different mass number than hydrogen
ii. has same atomic number
iii. tritium

Which one of the following is correct?

- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii

- 290. Hydrogen's isotope** — (conceptual)
- i. in H, there are 1 proton, 1 neutron
ii. in D, there are 1 neutron, 1 electron, 1 proton
iii. in T, there are 1 electron and 2 neutrons, 1 proton

Which one of the following is correct?

- (a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii

- 291. In case of different mass numbers** — (conceptual)
- i. the atoms of the same elements are isotopes
ii. isotopes are formed due to difference in number of neutrons
iii. the number of protons and electrons are not changed in the atom of the same element

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

★★ 3.6 Relative atomic mass | Text Page-29

- The average of the availabilities of the isotopes is relative atomic mass
- The scientists have decided the $1/12^{\text{th}}$ of carbon-12 isotopes as standard of relative atomic mass

► General Multiple Choice Questions and Answers

- 292. The natural availability of two isotopes of chlorine are** — ${}^{35}_{17}\text{Cl}$ (75%) and ${}^{37}_{17}\text{Cl}$ (25%). **What is the relative atomic mass of chlorine?** (application)
- (a) 18 (b) 20
(c) 35.75 (d) 35.5
- 293. Which one is 16 times heavier than $1/12^{\text{th}}$ of a carbon-12 isotope?** (conceptual)
- (a) P (b) N
(c) O (d) Si
- 294. The number of protons in Al is 13. The mass of an atom of it is $4.482 \times 10^{-23}\text{g}$. What is its relative atomic mass?** (application)
- (a) 26 (b) 27
(c) 25 (d) 13

► Multiple Completion Based questions-answers

- 295. According to modern definition, the relative atomic mass of an element is** — (higher skill)
- i. atomic mass of the element/ $1/12^{\text{th}}$ of a C-12 isotope
ii. atomic mass of the element/ $1.66 \times 10^{-24}\text{g}$
iii. the mass of an atom of the element/ $1/12^{\text{th}}$ of a C-12 isotope
- Which one of the following is correct?**
- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

► Situation set Based Questions-Answers

Read the Statement below and answer to the question no. 296 – 297:

In 100 atoms of potassium, there are 94 of ${}^{39}\text{K}$ and 6 of ${}^{41}\text{K}$.

296. What will be the average mass (grams) of the atom mentioned in the stimulus? (application)

- (a) 29 (b) 40
(c) 39.12 (d) 39.22

297. In the isotope of the atom mentioned in the stimulus

— (higher skill)

- i. number of protons is equal, but mass numbers are different
ii. number of electrons in both elements are equal
iii. number of neutrons in both elements are equal

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

★★ 3.7 Relative molecular mass from relative atomic mass | Text Page -30

- Relative molecular mass can be determined from relative atomic mass. For example: the relative molecular mass of $N_2 = 2 \times 14 = 28$ (as N is di-atomic and its relative atomic mass is 14)

► General Multiple Choice Questions and Answers

298. What is relative atomic mass of oxygen? (knowledge)

- (a) 8 (b) 16
(c) 18 (d) 32

299. What is the molecular mass of O_2 ? (knowledge)

- (a) 8 (b) 16
(c) 20 (d) 32

300. How many atoms are there in the molecule of N_2 ? (knowledge)

- (a) 1 (b) 2
(c) 3 (d) 4

301. How many atoms are there in ozone? (knowledge)

- (a) 1 (b) 2
(c) 3 (d) 4

302. What is the relative atomic mass of Na? (knowledge)

- (a) 11 (b) 18 (c) 20 (d) 23

303. What is the molecular mass of H_2SO_4 ? (application)

- (a) 32 (b) 64
(c) 90 (d) 98

304. What is the relative molecular mass of HNO_3 ? (application)

- (a) 16 (b) 32
(c) 63 (d) 67

★★ 3.8 Radioactive isotope and their uses | Text Page-30

- The number of isotopes either natural or synthesized has exceeded 1300. Among these some are stable and maximum are unstable. The unstable isotopes convert are to the isotopes of another elements by emitting different types of rays such as (α -ray, β -ray, γ -ray). This property of the atom of elements is called radioactivity.
- The γ -ray causes damage to the living cells.
- These radioactive isotopes can be produced by nuclear reaction.
- In order to diagnose the expansion of bone and the reason of pain and to locate the spot of pain, Tc-99m or ^{99m}Tc (Isotope of Technetium) are used. γ -ray emitted from the ^{99m}Tc .
- ^{153}Sm or ^{89}Sr is used to the treatment of bone pain
- To determine the presence of tumor and kalasment radioactive isotopes are used. In treatment cancer tissues are damaged by emitting γ -ray from ^{60}Co .
- ^{131}I prevents the growth of thyroid glands.

- Phosphate ^{32}p is used in treatment of blood leukemia.
- Plutonium-238 is used to set pacemaker in heart.
- In different types of cancer treatment ^{131}Cs , ^{192}Ir , ^{125}Pd , ^{106}Ru are used.
- Solution of radioactive ^{32}p Containing phosphate is injected to the root of plants. The scientists can detect the movement of phosphate thoroughly within the plants using Geiger counter, and from this they can determine the mechanism of using phosphorous for enhancing growth of plants.
- Radioactive isotopes have wide applications in agriculture, food preservation, medical field, power plants etc.
- One of the reasons That cause cancer is radioactivity.
- Nuclear energy is used in destructive purposes besides power generation.

► General Multiple Choice Questions and Answers

305. Which one is radioactive isotope? (knowledge)

- (a) ^1_3H (b) $^6_{12}\text{C}$
(c) ^{99m}Tc (d) alpha ray

306. What is the characteristic of radioactive isotopes? (knowledge)

- (a) emission of x ray
(b) emission of gamma ray
(c) emission of Rontgen ray
(d) emission of ultraviolet ray

307. Which one is used in chemotherapy? (knowledge)

- (a) X-rays (b) B-rays
(c) radioactive element (d) nuclear reaction

308. Which one is used to treat leukemia? (knowledge)

- (a) ^{238}Pu (b) ^{32}p
(c) ^{99}Tc (d) ^{50}Co

309. Which one is used to kill cancer-infected tissues? (knowledge)

- (a) $^{60}_{24}\text{Co}$ (b) $^{60}_{24}\text{Cr}$ (c) ^{131}I (d) ^{153}Sm

310. Which one is used to treat pain in the bones? (knowledge)

- (a) ^{60}Co (b) ^{99}Tc (c) ^{125}I (d) ^{87}Sr

311. Which one prevents the growth of thyroid tissues? (knowledge)

- (a) ^{137}Cs (b) ^{131}I (c) ^{192}Ir (d) ^{125}I

312. Which one is used in Geiger counter? (knowledge)

- (a) ^{30}P (b) ^{31}P
(c) ^{32}P (d) ^{33}P

313. Which isotope is used in medical field and agriculture? (knowledge)

- (a) ^{131}I (b) ^{125}I
(c) ^{32}P (d) ^{153}Sm

314. Which one is used to determine the age of the earth? (knowledge)

- (a) ^{12}C (b) ^{13}C
(c) ^{14}C (d) ^{16}C

315. In food preservation, bacteria are killed by (knowledge)

- (a) ^{60}Cr (b) ^{60}Co
(c) ^{32}P (d) ^{235}U

316. Which is the source of energy of atomic bomb?
(knowledge)

- (a) ^{238}U (b) ^{14}C
(c) ^{92}U (d) ^{298}U

(a)

► Multiple Completion Based questions-answers

317. In case of isotopes — (higher skill)

- i. the atomic number is the same, but mass numbers are different
ii. chemical characteristics are the same
iii. there are differences in physical properties

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

318. In case of unstable isotopes — (higher skill)

- i. alpha rays are emitted
ii. beta rays are emitted
iii. ultraviolet rays are emitted

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

319. Radioactive rays are used in — (higher skill)

- i. medical field
ii. agriculture
iii. food preservation

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

320. ^{60}Co is used in — (higher skill)

- i. killing cancer-infected cells
ii. food preservation
iii. setting pacemaker in heart

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

321. ^{32}P is used in — (higher skill)

- i. medical field
ii. agriculture
iii. food preservation

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

322. In case of radioactive isotopes — (application)

- i. they are formed by nuclear reactions
ii. they emit gamma rays which are harmful for living cells
iii. they emit different types of rays and are converted to isotopes of other elements

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

323. In order to detect growth of bones and determining the location of pain, which one is used? — (conceptual)

- i. $^{99\text{m}}\text{Tc}$
ii. ^{153}Sm
iii. ^{89}Sr

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

324. Geiger counter is used in — (conceptual)

- i. counting the number of radioactive isotopes
ii. in determining the quantity of radioactive isotopes
iii. in determining the using method of ^{32}P in plants

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

(c)

325. In food preservation, which one is used? — (conceptual)

- i. gamma ray
ii. ^{60}Co
iii. C-14

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

(a)

► Situation set Based Questions-Answers

Read the statement below and answer to the question no. 326 and 327:

(b) In nature, there is 75.53% of $^{35}_{17}\text{Cl}$ and 24.47% $^{37}_{17}\text{Cl}$.

326. What is the mass number of the elements mentioned? (conceptual)

- (a) 35.5 (b) 35
(c) 36.5 (d) 37

(a)

210. The elements are — (conceptual)

- (a) isotopes (b) isotones
(c) isobars (d) isomers

(a)

Read the statement below and answer to the question no. 327 and 328:

U-235 and U-238 are two isotopes of uranium.

327. For what purpose, the 1st isotope of the stem is used?

- (application)
(a) as fuel in nuclear reactors
(b) in reply to: treating cancer
(c) in food preservation
(d) in setting pacemaker in heart

(a)

328. What is the composition of the 2nd isotope (e, p, n)?

- (application)
(a) 92, 91, 146
(b) 92, 92, 146
(c) 146, n+p=146
(d) e+p = 238, p = 92, n+p = 146

(b)

★★ 3.9 Atomic model | Text Page-32

a) Rutherford's atomic model:

- In the year 1911, the atomic model of Rutherford was established on the basis of the results of alpha particle emission experiment.
- According to this model –
- In the center of the atom there is a positively charged massive substance. This massive substance is called the centre of nucleus of the atom. Compared to the whole volume of the atom the volume of nucleus is negligible. It possesses almost the whole mass and all positive charges.
- Atoms are electrically neutral. So nucleus is surrounded by a number of negative charge electrons, equal to the number of positive charge proton of the nucleus.
- Electrons always move round the nucleus as the planets revolve round the sun in the solar system. The centripetal force due to the electrostatic force between the positive nucleus and the negative electrons is equal to the centrifugal force of the moving electrons.

► General Multiple Choice Questions and Answers

329. The revolving paths of the electrons are called?
(knowledge)

- (a) path of electron (b) energy levels

- (c) spiral path (d) path **(b)**
330. By experimenting on which particle, Rutherford obtained the concept of atomic model? (knowledge)
 (a) gamma (b) beta
 (c) alpha (d) X **(c)**
331. In which year, Rutherford discovered nucleus? (knowledge)
 (a) 1912 (b) 1913
 (c) 1911 (d) 1910 **(c)**
332. What is the ratio of the radius of nucleus and radius of atom? (knowledge)
 (a) 1/100000 (b) 1/10000000
 (c) 1/1000 (d) 1/1000000 **(a)**
333. What is the ratio of the atomic number of hydrogen isotope present in heavy water and water? (higher skill)
 (a) 1 : 2 (b) 2 : 1
 (c) 1 : 1 (d) 2 : 3 **(c)**
334. Like charges repel each other, but protons stay in the center? How? (conceptual)
 (a) they stay in specific orbits
 (b) nuclear force < repulsion force
 (c) electrons attract the protons
 (d) the strong nuclear force holds the protons together **(b)**
335. Which one is suggested by Rutherford's atomic model? (knowledge)
 (a) the center of atom is electrically neutral
 (b) atom is positively charged like the solar system
 (c) the mass of nucleus is negligible in comparison to the mass of atom
 (d) the equal numbers of negative charge are present outside the nucleus as the positive charge inside the nucleus **(d)**
336. Who introduced the concept of nucleus at the center of atom? (knowledge)
 (a) Dalton (b) Bohr
 (c) Rutherford (d) Thomson **(c)**
337. Which one is the basis of Rutherford's atomic model? (knowledge)
 (a) emission of beta particle
 (b) emission of alpha particle
 (c) emission of gamma ray
 (d) emission of ultraviolet ray **(b)**
338. Rutherford named the center of atom as — (knowledge)
 (a) neutron (b) fundamental center
 (c) nucleus (d) mass center **(c)**
339. Which one is at the center of atom? (knowledge)
 (a) fundamental particles with positive charge
 (b) energy levels
 (c) centripetal force
 (d) centrifugal force **(a)**

► Multiple Completion Based questions-answers

- 340. Dalton's atomic theory —** (conceptual)
 i. is the base of modern chemistry
 ii. says that atoms are indivisible
 iii. says that atoms are formed by small particles
Which one of the following is correct?
 (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii **(a)**
341. According to Rutherford's atomic model — (higher skill)
 i. nucleus has almost all of the mass of the atom

- ii. atom is electrically neutral because it has equal number of electrons and neutrons
 iii. electrons are continuously revolving around the nucleus

Which one of the following is correct?

- (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii **(b)**

342. According to Rutherford's atomic model — (conceptual)

- i. the electrons are always revolving around the nucleus just like the planets are revolving around the sun in the solar system
 ii. atom is electrically neutral
 iii. there are protons in the center of atom

Which one of the following is correct?

- (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii **(d)**

343. In Rutherford's atomic model — (conceptual)

- i. the reason behind the stability of atom is the electrostatic attraction force between the nucleus and the electrons
 ii. the volume of nucleus is negligible in comparison to the volume of the entire atom
 iii. atom is electrically neutral

Which one of the following is correct?

- (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii **(c)**

344. The limitation of Rutherford's atomic model is — (conceptual)

- i. it can explain the spectrum
 ii. it cannot explain the mechanism with atoms with more than 1 electron
 iii. it cannot say anything about the shapes of the orbits of the electrons

Which one of the following is correct?

- (a) i and ii (b) i and iii
 (c) ii and iii (d) i, ii and iii **(c)**

b) Bohr's atomic model:

- Neils Bohr published this renowned model in the year 1913.
- When any electron gets transferred from a lower orbit or energy level such as $n = 1$ to a higher orbit or energy level such as $n = 2$, it absorbs a certain amount of energy. Again, when any electron is transferred from a higher orbit or energy level such as $n = 2$ to a lower orbit or energy level such as $n = 1$, it emits a fixed amount of energy.
- By this model, the atomic structure and atomic spectrum can be explained.
- Electrons move round the nucleus of atom in some circular paths. These paths are called orbits or energy levels.
- 1st, 2nd, 3rd, 4th, 5th energy levels are designated by K, L, M, N, O respectively.
- The limitation of this model is that it cannot explain the spectrum of the atoms with more than one electron.

► General Multiple Choice Questions and Answers

345. In which year, Bohr's atomic model was published?

(knowledge)

- (a) 1911 (b) 1912
(c) 1913 (d) 1813

346. Which one is suggested by Bohr's model?

(knowledge)

- (a) electrons move round the nucleus of atom in some circular paths.
(b) the protons are situated around the nucleus
(c) the number of protons and neutrons are equal
(d) atom is electrically neutral

347. Which one is suggested by Bohr's model?

(knowledge)

- (a) electrons move round the nucleus of atom in some permanent circular paths
(b) when any electron gets transferred from a lower orbit or energy level to a higher orbit or energy level, it absorbs a certain amount of energy
(c) when any electron is transferred from a higher orbit or energy level such as $n = 2$ to a lower orbit or energy level, it emits a fixed amount of energy.
(d) electrons emit a fixed amount of energy to be transferred to higher energy level

348. Which scientist introduced the concept of atomic energy levels? (knowledge)

- (a) Rutherford (b) Neils Bohr
(c) Maxwell (d) Mendeleev

349. Which one is a limitation of Bohr's atomic model?

(knowledge)

- (a) it can explain atomic spectrum
(b) it can explain hydrogen and its spectrum
(c) it can explain the positions of electrons
(d) it can explain the mass numbers of atoms

350. The paths in which the electrons revolve around the nucleus are called — (knowledge)

- (a) energy levels (b) sub-levels
(c) electron paths (d) oval paths

► Multiple Completion Based questions-answers

351. Bohr suggested in his atomic model that — (conceptual)

- i. electrons move round the nucleus of atom in some circular paths
ii. electrons neither emits nor absorbs energy during revolving in a specific orbit
iii. electrons transfer to higher or lower energy levels by absorbing or emitting specific amount of energy

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

352. The main suggestion of electron configuration based on Bohr's model is — (conceptual)

- i. the energy levels are designated by n
ii. the closer energy levels are with higher energy and the energy decreases with the distance from the nucleus
iii. electrons emit energy and transfer to lower energy level from higher energy level

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

★★ 3.10 Arrangement of electron in Energy

level | Text Page-34

- The maximum electron bearing capacity of each principle energy level is $2n^2$
- The space in which the possibility of finding electron is called orbital
- Electrons enter into the next upper energy level being filled with the lower energy level with electrons first
- The number of sub energy shells in K,L,M,N shells are 1(1s), 2(2s,2p), 3(3s,3p,3d), 4(4s,4p,4d,4f) respectively
- Generally it is seen that, when the orbital of equal energy remains fully filled or half filled, the electronic configuration attains more stability. That means, np^3 , np^6 , nd^5 , nd^{10} and nf^{14} have the most stability. For this reason the elements of electronic configuration $d^{10}s^1$ and d^5s^1 become more stable. Following this rule electronic configuration of Chromium (Cr) is:
 $Cr(24) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
- In the elements with atomic number 19 or more than that, the electrons enter to the 4th energy level instead of filling the 3rd energy shell. For example—
 $K(19) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^0 4s^1$
 $Sc(21) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$

► General Multiple Choice Questions and Answers

353. Z is a basic element, the atomic number of which is 57. How many electrons are there in its M shell? (conceptual)

- (a) 2 (b) 8
(c) 18 (d) 32

354. What is the electronic configuration of nitrogen? (conceptual)

- (a) 2, 3 (b) 2, 5
(c) 2, 7 (d) 2, 8

355. How many electrons are there in the N shell of potassium? (conceptual)

- (a) 1 (b) 2
(c) 6 (d) 8

356. What is the capacity of electrons in any principal energy levels of atoms? (knowledge)

- (a) n^2 (b) $2n^2$
(c) $4n^2$ (d) $3n^2$

357. Which element has 2, 8, 2 electronic configuration? (knowledge)

- (a) Na (b) K
(c) Mn (d) Mg

358. What is the highest number of electrons in N shell? (application)

- (a) 32 (b) 18
(c) 8 (d) 2

359. Which one is the electronic configuration of Mg? (conceptual)

- (a) 2, 8, 2 (b) 2, 4, 2
(c) 2, 8, 1 (d) 2, 2, 4

360. Which one is the electronic configuration of Na^+ ? (higher skill)

- (a) 2, 8, 1 (b) 2, 8, 2
(c) 2, 8 (d) 2, 8, 7

361. The 2nd principal energy level is designated by— (knowledge)

- (a) M (b) N
(c) K (d) L

362. In which shell, there can be 32 electrons? (higher skill)

- (a) N (b) M
(c) L (d) K

363. In which shell, the highest electron capacity is 18 electrons? (conceptual)

- (a) 1st (b) 2nd
(c) 3rd (d) 4th

364. What is the highest electron capacity off the 2nd shell? (conceptual)

- (a) 8 (b) 16
(c) 12 (d) 18

365.



What is the position of the element in the periodic table? (application)

- (a) group V, period 2 (b) group III, period 5
(c) group VI, period 1 (d) group II, period 4

366. The electronic configuration of an element is 2, 8, 18, 8, 1. What is its period in the periodic table? (application)

- (a) 1 (b) 5
(c) 7 (d) 3

367. The electronic configuration of an element is 2, 8, 18, 8, 2. Which one is its position in the periodic table? (application)

- (a) period 4, group IIA (b) period 5, group IIA
(c) period 2, group IIA (d) period 6, group IIA

368. Which one is the electronic configuration of iron? (higher skill)

- (a) 2, 8, 16 (b) 2, 8, 14, 2
(c) 2, 8, 8, 6, 2 (d) 2, 8, 10, 6

369. Which one is the electronic configuration of $_{21}\text{Sc}$? (higher skill)

- (a) 2, 8, 9, 2 (b) 2, 8, 92
(c) 2, 8, 10, 1 (d) 2, 8, 11

370. How many electrons are there in the N shell of Zn? (higher skill)

- (a) 2 (b) 8
(c) 18 (d) 32

371. Which one is the electronic configuration of the nearest inert gas of sodium? (conceptual)

- (a) 2, 8, 2 (b) 2, 8
(c) 2, 8, 8 (d) 2, 8, 3

372. If a proton is inserted in the atom of oxygen, it will convert to the atom of — (higher skill)

- (a) carbon (b) nitrogen
(c) oxygen (d) fluorine

373. What is the number of electrons in the outermost energy level of Sc? (higher skill)

- (a) 3 (b) 2
(c) 8 (d) 14

374. Which one is the electronic configuration of Rb? (conceptual)

- (a) 2, 8, 18, 8, 1 (b) 2, 8, 18, 18, 8, 1
(c) 2, 8, 18, 32, 8, 1 (d) 2, 8, 18, 18, 32, 8

375. What is the number of electrons in the N shell of Fr atom? (higher skill)

- (a) 8 (b) 18
(c) 32 (d) 50

376. The N shell of which element contains 8 electrons? (higher skill)

- (a) Cd (b) Ar
(c) Cl (d) Kr

377. For which value of n, the shell will be the closest to nucleus? (higher skill)

- (a) 1/2 (b) 1
(c) 2 (d) 3

378. What is the electronic configuration of S^{2-} ion? (higher skill)

- (a) 2, 8, 6 (b) 2, 8, 8
(c) 2, 8, 4 (d) 2, 8, 5

379. Which one is the electronic configuration of Fe^{2+} ? (higher skill)

- (a) 2, 8, 2 (b) 2, 8, 14
(c) 2, 8, 14, 2 (d) 2, 8, 8

380. Which is the position of the element with the electronic configuration of 2, 8, 18, 8 in the periodic table? (application)

- (a) period 3, group IIA (b) period 3, group 0
(c) period 4, group IIA (d) period 4, group 0

381. Which one has the electronic configuration – 2, 8, 18, 8? (conceptual)

- (a) Ar (b) Kr
(c) Rn (d) Ne

382. The atomic number of an element is 38. Which one is the position of it in the periodic table? (application)

- (a) period 5, group IA (b) period 5, group IIA
(c) period 5, group IA (d) period 5, group IA

383. Which one means 1 mole of sodium carbonate? (application)

- (a) 106g (b) 53g
(c) 140g (d) 6.023×10^{23} g

384. What does happen when a drop of water fall upon a heated frying pan? (application)

- (a) it dries out and converts to white powder
(b) it boils
(c) the bonds in the water breaks due to heat and it converts to atoms
(d) the molecules of water disperse and divide into small pieces

385. Which one is the electronic configuration of K(19)? (higher skill)

- (a) 2, 8, 8, 1 (b) 2, 8, 7, 2
(c) 2, 7, 7, 3 (d) 2, 8, 8, 0, 1

386. Which one has the electronic configuration of 2, 8, 7? (higher skill)

- (a) F (b) Ar
(c) Cl (d) O

387. What is the highest electron capacity of f – sub shell? (conceptual)

- (a) 6 (b) 14
(c) 10 (d) 2

388. Which one is the organization of M shell/ 3rd principal energy shell? (conceptual)

- (a) 2s, 2p, 3d (b) 3s, 3p, 3f
(c) 3s, 3p, 3d (d) Ms, Mp, Md

► Multiple Completion Based questions-answers

389. In case of the first shell — (conceptual)

- i. the highest electron capacity is 2
ii. it is designated by K
iii. the highest electron capacity is 8

Which one of the following is correct?

- (a) i and ii (b) i and iii
(c) ii and iii (d) i, ii and iii

390. The electronic configuration of magnesium is as shown below — (higher skill)

1. In the center of the atom there is a positively charged massive substance. This massive substance is called the centre of nucleus of the atom. Compared to the whole volume of the atom the volume of nucleus is negligible. It possesses almost the whole mass and all positive charges.
2. Atoms are electrically neutral. So nucleus is surrounded by a number of negative charge electrons, equal to the number of positive charge proton of the nucleus.
3. Electrons always move round the nucleus as the planets revolve round the sun in the solar system. The centripetal force due to the electrostatic force between the positive nucleus and the negative electrons is equal to the centrifugal force of the moving electrons.

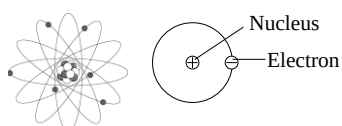


Fig : Rutherford's Atom

d Analyzing the model drawn in the stem, it can be seen that the electron revolves in a spiral path and reach the center. So it is a temporary or unstable model of atom.

According to Maxwell's electromagnetic theory of radiation any charged particle, if moves in a circular way, always emits radiation and its radius of movement will become smaller gradually and ultimately reach the centre.

So according to Rutherford's atomic model, atom will be unstable.

These are the logical opinions about the stability of the model drawn.

Ques. ► 2

4W	12X	20Y	29Z
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[Here W, X, B and Z is used as symbols, not as the symbols of any regular element]

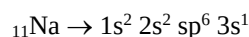
- What is mass number? 1
- The valences of ${}_3\text{Li}$ and ${}_{11}\text{Na}$ are the same, explain why? 2
- Which elements of the above stem have the equal number of electron at their outermost energy level? 3

- The electrons of one of the above elements cannot configured in general rule- explain with logic. 4

Answer to the question no. 2

a The sum of the number of protons and neutrons is called the mass number.

b ${}_3\text{Li}$ and ${}_{11}\text{Na}$ have the electronic configurations as shown – ${}_3\text{Li} \rightarrow 1s^2 2s^1$



So the common electronic configurations of the valency shells of lithium and sodium atom are ns^1 and the common electronic configurations of the elements are $(n-1)s^2 (n-1)p^6 ns^1$.

The number of electrons in the outermost energy shell of an element is its valency. There is one electron for the outermost energy shells of Li and Na. so their valency is identical, which is 1.

c The electronic configurations of the elements given in the stimulus are –

Symbol of element	Electronic configuration	Number of electrons in the outermost energy shell
4W	$1s^2 2s^2$	2
12X	$1s^2 2s^2 2p^6 3s^2$	2
20Y	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$	2
29Z	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^1$	1

So observing the electronic configurations of their outermost energy shells, it is seen that they all have the same number of electron in the outermost energy shell.

d The electronic configuration of ${}_{29}\text{Z}$ is not normal, because generally it is seen that, when the orbital of equal energy remains fully filled or half filled, the electronic configuration attains more stability. That means, np^3 , np^6 , nd^5 , nd^{10} and nf^{14} have the most stability. For this reason the elements of electronic configuration $d^{10}s^1$ and d^5s^1 become more stable. So the electronic configuration of ${}_{29}\text{Z}$ will be $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$ instead of $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$, i.e. it will obtain the more stable electronic configuration.



Board Exam Creative Questions with Answers



Board Exam questions are very important for the exam preparation. So practice these questions again and again properly.

Ques. ► 3 The formula of two elements are given below with their atomic numbers. ${}_{26}\text{A}$, ${}_{29}\text{B}$ [DB.-15]

- What is isomer? 1
- Define isotope with example. 2
- The electron distribution of the second element is an exception. Explain. 3
- Write the electron distribution of the first element and explain its valency. 4

Answer to the question no. 3

a If the structures of two compounds having the same molecular formula are different, they are called isomer of each other.

b The atoms of the same element but having different mass numbers are called isotopes. For example the three

isotopes of hydrogen are protium (${}^1_1\text{H}$), Deuterium (${}^2_1\text{H}$) and tritium (${}^3_1\text{H}$).

c The atomic number of the element mentioned in the stem is 27, so the element is copper. Electrons are placed in different energy levels, sub-levels and orbitals following some rules. The arrangement of electrons in different orbitals is called electron distribution.

The electron distribution of Cu(29) :

Which is an exception $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ of the general rule. According to the general convention, the orbital 4s was supposed to be filled and then electrons will enter in to the 3d orbital. But, if all the orbitals with same energy are filled, it becomes more stable. So, the electron distribution $d^{10}s^1$ becomes more stable. Therefore, the mentioned element that is copper's electron distribution is an exception to the general convention.

d The atomic number of the first element mentioned in the stem is 26. So, the element is Iron. Valency is mainly the capacity of an element to combine with other elements.

The electron distribution of iron Fe (26) is –

F(26) : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$ from this electron distribution, we can see that there are 2 electrons in the 4s orbital. Iron can easily donate these two electrons and becomes Fe^{2+} ion. As an example, an Iron atom forms ferrous chloride by combining with two monovalent chlorine atoms. In this case, the two chlorine atoms accept two electrons from iron, so, the compound formed is FeCl_2 and the valency of the Iron atom in it is 2.

Again, if two electrons from the 4s orbital and one electron from the 3d orbital are released, Fe^{3+} ion is formed. In this case, the 3d orbital gains a steady state.

Fe^{3+} (23) : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^0$

As an example, an Iron atom forms ferric chloride with three monovalent chlorine atoms. In this case, three chlorine atoms accept three electrons from the Iron atom. Therefore, the produced compound is FeCl_3 and the valency of Iron in it is 3. So, it can be said that we explain Iron's valency from its electron distribution.

Ques. ►4 'A' is a halogen element of 3rd period, it has two isotopes and in respect of percent abundance of the halogen amount is 75% and 25% respectively. Here 'A' is used as symbol, not as the symbol of any regular element. [BB.-15]

- What is melting point? 1
- Explain, in between diffusion and effusion, which will be occurred first in case of body spray? 2

- Determine the relative atomic mass of the element from the stem. 3
- What type of bond is formed between 'A' and another element of group 2 in the same period? Give argument in favour of your answer. 4

Answer to the question no. 4

a The temperature at which any solid substance starts melting it is called the melting point of the material of the substance.

b Between diffusion and effusion, effusion occurs first while using body spray. Because, effusion is the passage of stored gaseous substance through a small orifice due to high pressure. In this case, the gaseous substance is effused and then it is diffused in air and we can smell it.

c The halogen present in the third period of the periodic table is chlorine (Cl).

On the basis of abundance 75% of ${}^{35}\text{Cl}$ is present in nature and 25% of ${}^{37}\text{Cl}$ is present.

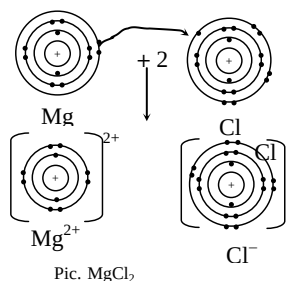
Their relative atomic mass is determined in the table.

Isotope	${}^{35}\text{Cl}$	${}^{37}\text{Cl}$
Mass number	35	37
Percentage	75	25
Relative atomic mass	$\frac{35 \times 75}{100} + \frac{37 \times 25}{100}$ $= 35.5$	

∴ the relative atomic mass of the element is 35.5.

d The element in Group-2 of the same period is Mg. It creates ionic bond with the halogen of Group-2, chlorine. The process of formation of ionic bond between Magnesium and Chlorine is given below —

The atomic number of Magnesium is 12 and its electronic configuration is 2, 8, 2 and the atomic number of Chlorine is 17 and its electron configuration is 2, 8, 7. Magnesium atom releases two electrons and forms Mg^{++} of fulfill its octet. On the other hand, two chlorine atoms accept these two electrons to fulfill its octet and form Cl^- ions.



In this way, the positive and negative ions formed due to releasing and accepting electrons remain together and form MgCl_2 .



**Cadet Colleges Creative
Questions with Answers**



Cadet Colleges questions are also important for your excellent preparation. They will help you to give a clear idea about the question as well as chapterwise exclusive questions and answers. So, practice them with proper attention.

Ques. ►5 In 1911 Ernest Rutherford proposed an atom model. But scientists pointed out that his atom model has

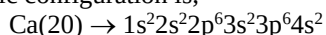
some defects. So, Neil Bohr in 1913 proposed a new atom model. [Joyprhat Cadet-15]

- Define diffusion. 1
- Write down the electronic configuration of Ca. 2
- Explain Bohr's atom model. 3
- Why Bohr's gave a new atom model? 4

Answer to Ques. No. 5

a The tendency of solid, liquid or gas to spread spontaneously and uniformly in any medium is called the diffusion.

b The atomic number of calcium (Ca) is 20 and its electronic configuration is,



c In 1913 Neil's Bohr gave his momentous atom model the structure of atom. It also gave about the origin of atomic spectra. Bohr's I can be divided into three important parts :

i. The concept of stationary orbit or energy level : According to Bohr electrons move in denote circular lipito around the nucleus. During the revolution the orbit will follow all rules of physics. But so long electron/electrons remain in a definite orbit, it will not absorb or radiate any energy. These circular paths are known as stationary orbits or energy levels,

ii. Concept of angular momentum of electrons : The stationary orbits are determined by the rule that the angular momentum of electrons rotating in these orbits must be integral multiple of $h/2\pi$.

$$\text{i.e. } mvr = n \frac{h}{2\pi}$$

Here m = mass of electron; v = velocity of electron in a orbit; r = radius of that orbit; h = Plank's constant; n = integer i.e. 1, 2, 3, 4, etc.

Based on the value of n the orbits are called K, L, M, etc. orbit.

ii. Concept of origin of spectral lines : An electron can jump from one orbit or energy level to another. When it jumps from higher energy level to lower energy level then it radiates energy which is equal to difference of energy in two levels. If E_2 is the energy of electron at higher level and E_1 is the energy of electron at lower level, then the frequency of emitted radiation u is related to the energies accordig to following equation.

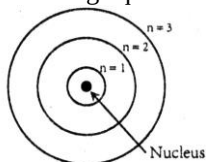


Fig- Bohr's atom model

$$E_2 - E_1 = \Delta E = h\nu$$

When an electron jumps from lower level to higher level then it absorbs equal amount of energy from light or other source.

d For the limitation of Rutherford atomic model, Bohr's gave a new atom model, which can be explained by :

- At first Rutherford's atom model gave an idea about atomic structure but there were some limitations. On the other hand, Bohr's atom model was based on

Rutherford's atom model and it removes the limitations of Rutherford's atom model.

- Rutherford's model failed to explain about the size and shape of the path of motion of electrons around the nucleus and it was one of the most important limitations of atomic structure. Bohr's atom model superseded that very limitation of Rutherford's model. Bohr's model explained that electrons move around nucleus in some circular stable axes known as orbits or energy levels. Bohr's model also explained that an electron neither emit nor absorb energy while it remains in a certain energy level.
- Rutherford's model did not give any idea about transfer of electrons from one energy level (orbit) to another one. But Bohr's model explained that an electron can get transferred from one energy to another one emitting or absorbing energy.
- Rutherford's model did not give idea about line spectrum but Bohr's model explained the origin of line spectrum.

From the above comparative state, we can say that Bohr's atom model is highly effective idea about atomic structure.

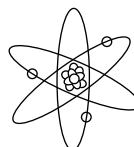
Ques. ► 6

fig-A

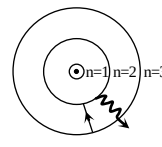


fig-B

[Pabna Cadet-15]

- What is real charge of proton? 1
- Discuss two uses of radio active isotope. 2
- Explain the postulates of fig (A). 3
- Write down the limitation of fig (B) 4

Answer to Ques. No. 6

a The real charge of proton is $1.6 \times 10^{19}\text{C}$.

b Two uses of radioactive isotopes are —

- Phosphate ^{32}P is used in treatment of blood leukemia.
- Plutonium – 238 is used to set pacemaker in heart.

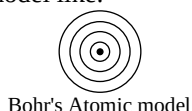
c In figure (A), the atomic model is Rutherford of Rutherford atomic model are given below :

- In the center of the atom there is a positively charged massive substance. This massive substance is called the centre of nucleus of the atom. Compared to the whole volume of the atom the volume of nucleus is negligible. It possesses almost the whole mass and all positive charges.
- Electrons always move round the nucleus as the planets revolve round the sun in the solar system. The centripetal force due to the electrostatic force between the positive nucleus and the negative electrons is equal to the centrifugal force of the moving electrons.

d In figure (b), the atomic model is Bohr's atom model. As the Bohr's atom model has many advantages it also has some limitations. Such as–

1. Although Bohr's atom model can explain the spectrum of hydrogen, but it can not explain the spectrum on ions or atoms containing more than one electrons.
2. When electrons are transferred from one energy level to another energy level according to Bohr's atom model there would be a single line in spectrum. But observing the spectrum of hydrogen or other ions with a sensitive apparatus it is seen that every line splits into several fine lines.

Ques. ►7 Teacher said a student to draw an atomic model. Student drew few circles in a big circle from the same centre. When teacher said to come and show. Student show his model like.



Bohr's Atomic model

[Barisal Cadet-15]

- a. What is relative atomic mass? 1
- b. What do you mean by kinetic properties of particles? 2
- c. Discuss the atomic model that is indicated by stem. 3
- d. According to the model drawn, give logical explanation of arrangement of electrons and stability of atom. 4

Answer to Ques. No. 7

a The relative mass of an element is the ratio of the mass of an atom of the element to the $\frac{1}{12}$ part of mass of carbon- 12 isotope.

b The properties for which the particles are always try to move from one place to another is known as kinetic properties of particles. The kinetic properties of particles is more in gaseous state than in liquid state and is more in liquid state than in solid state.

c The atomic model is Bohr's atomic model that is indicated by stem.

In 1913 Neils Bohr gave his momentous atom model describing the structure of atom. It also gave an explanation about the origin of atomic spectra. Bohr's postulates can be divided into three important parts :

- i. The concept of stationary orbit or energy level:**
According to Bohr electrons move in definite circular paths around the nucleus. During the revolution the electrons will follow all rules of physics. But so long electron/electrons remain in a definite orbit, it will not absorb or radiate any energy'. These circular paths are known as stationary orbits or energy levels.
- ii. Concept of angular momentum of electrons :** The stationary orbits are determined by the rule that the angular momentum of electrons rotating in these orbits must be integral multiple of $\frac{h}{2\pi}$,

$$\text{i.e. } mvr = n \frac{h}{2\pi}$$

Here m = mass of electron; v = velocity of electron in a orbit; r = radius of that orbit; h = Plank's constant; n = integer i.e. 1, 2, 3, 4, etc.

Based on the value of n the orbits are called K, L, M, etc. orbit.

iii. Concept of origin of spectral lines : An electron can jump from one orbit or energy level to another. When It jumps from higher energy level to lower energy level then it radiates energy which is equal to difference of energy in two levels. If E_a is the energy of electron at higher level and E_i is the energy of electron at lower level, then the frequency of emitted radiation u is related to the energies according to following equation.

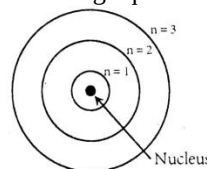


Fig- Bohr's atom model

$$E_2 - E_1 = \Delta E = h\nu$$

When an electron jumps from lower level to higher level then it absorbs equal amount of energy from light or other source.

d To reduce the limitation of Rutherford atomic model. Bohss give an atomic model. By this model we can easily explain about the arrangement of electrons and stability of atom.

Explanation: The electrons first enter at the orbit which have lower energy. After complete the lower energy shell the electron enter the higher energy orbital. By this rule the electron fulfill the energy shell. According to increasing energy, the orbits are arranged by K.L.M. N ... shell. When the value of principle quantum number $n = 1$, then K energy, when $n = 2$, then L energy shell, when $n = 3$, then M energy shell etc.

When any electron gets transferred from a lower orbit or energy level such as $n = 1$ to a higher orbit or energy level such as $n = 2$ It absorbs a certain amount of energy. Again when any electron is transferred from a higher orbit or energy level such as $n = 2$ to a lower orbit or energy level such as $n = 1$, it emits a frxed amount of energy. So electron never falls into nucleus. That process makes the atom stable. So Bohr's gives a logical explanation of arrangement of electrons and stability of atom.

Ques. ►8 ${}_{12}\text{X}$, ${}_{15}\text{Y}$, ${}_{24}\text{Z}$ are very important elements in chemistry. Atomic number and electronic configuration are always a unique characteristics for a element. Isotopic property is needed for the continuous Develoment of mankind which is easily visible among the above compounds. The above two of three compounds can easily show that property but the third

one does not even show the normal general electronic configuration. [Mirzapur Cadet-14]

- What is Atomic number? 1
- What do you mean by relative atomic number? 2
- Describe the isotopic property by taking one of the elements from the stem. 3
- Which one will show the exceptional electronic configuration in the stem? 4

Answer to the question no. 8

a The number of protons in the nucleus of an atom, which is characteristic of a chemical element and determine the place in the periodic table is called atomic number.

b Relative atomic mass is a dimensionless physical quantity, the ratio of the average mass of atoms of an element (from a single given sample or source) to $\frac{1}{12}$ of the mass of an atom of carbon – 12 (known as the unified atomic mass unit). The word 'relative' is in reference to making the figure relative to carbon-12. So, it is dimensionless.

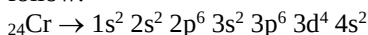
c ^{12}X , ^{15}Y , ^{24}Z elements of the stem are Magnesium, Phosphorus and Chromium. Isotope is any of two or more forms of a chemical element, having the same number of protons in the nucleus, or the same atomic number, but having different numbers of neutrons in the nucleus, or different atomic mass.

Each three elements of stem has isotopes. Among them phosphorus (P) has 23 isotopes from ^{24}P to ^{46}P . All of them has same atomic number (15). Even with same atomic number every isotope of phosphorus has different characteristics. Only one isotope of phosphorus ^{31}P is stable. The longest lived radioactive isotopes are ^{33}P with a half life 25.34 days and ^{32}P with a half life of 14.263 days and ^{32}P with a half life of 14.263 days. All other have half lives under 2.5 minutes, most under a second. The least stable is ^{25}P with a half life shorter than 30 nanoseconds.

All of them had different mass and density. Due to different characteristics they are used in different manners.

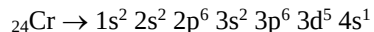
Note : Mg Has three naturally occurring and stable isotope as ^{24}Mg , ^{25}Mg and ^{26}Mg . And naturally occurring chromium (Cr) is composed of four stable isotopes; ^{50}Cr , ^{52}Cr , ^{53}Cr and ^{54}Cr .

d ^{12}X , ^{15}Y , ^{24}Z elements of the stem are Magnesium, Phosphorus and Chromium respectively. Among them Chromium has exceptional electronic configuration. Electronic configuration of Chromium should be as follow:



Because according to Aufbau principle, electrons must fill lowest energy shells first (4s has lower energy than 3d).

But in the case of chromium exception occurs. It shows electronic configuration as follow



It is because element with half filled or fully filled orbital are more stable than other outer usual electronic configuration.

Ques. 9 $\text{Ca}(\text{OH})_2(\text{s}) + \text{Cl}_2(\text{g}) \xrightarrow{40^\circ\text{C}} \text{A}(\text{s}) + \text{H}_2\text{O}(\text{l})$
[Rajshahi Cadet-14]

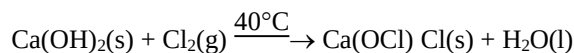
- Name the compound of A. 1
- How does sodium hydrogen carbonate blow up cake? 2
- Calculate molecular mass of A. 3
- Explain the importance of A with reactions. 4

Answer to the question no. 9

a Name of the compound A is bleaching powder (commercial name) or calcium chloro hypochlorite (chemical name).

b Sodium hydrogen carbonate is mixed with the flour of cake and heated. On heating sodium hydrogen carbonate dissociates to sodium carbonate, carbon di-oxide and water. Carbon di-oxide escaped through blowing up the cake.

c By completing the reaction of stem we get,



So, the formula of 'A' compound is $\text{Ca}(\text{OCl})\text{Cl}$ or CaOCl_2 .

We know that,

Atomic mass of Ca = 40

Atomic mass of O = 16

Atomic mass of Cl = 35.5

So, molecular mass of $\text{Ca}(\text{OCl})\text{Cl}$ = atomic mass of Ca + atomic mass of O + 2 × atomic mass of chlorine

$$= 40 + 16 + 2 \times 35.5 = 127.$$

∴ Molecular mass of A compound ($\text{Ca}(\text{OCl})\text{Cl}$) is 127.

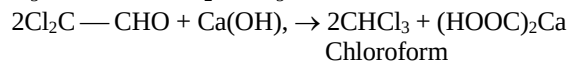
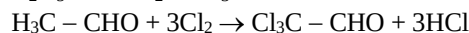
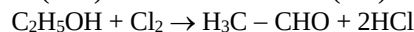
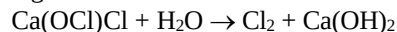
d 'A' compound of the stem is calcium chloro hypochlorite $\{\text{Ca}(\text{OCl})\text{Cl}\}$. It has great importance in our daily life.

$\text{Ca}(\text{OCl})\text{Cl}$ is used for the disinfection of drinking water or swimming pool water. It is also used in bathroom cleaners, household disinfectant sprays, moss and algae removers and weed killers.

$\text{Ca}(\text{OCl})\text{Cl}$ produce nascent oxygen which on oxidation process kill the germ.

$[\text{O}] + \text{germ} \rightarrow \text{oxidized dead germ}$

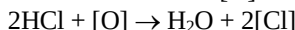
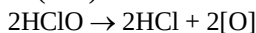
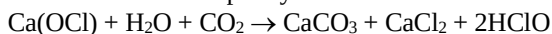
Again it can be used to manufacture chloroform.



Chloroform

It is also used as a bleaching agent. $\text{Ca}(\text{OCl})\text{Cl}$ react with water and atmospheric CO_2 to produce hypochlorous acid (HOCl). HOCl dissociate instantly and produce nascent oxygen. This nascent oxygen removes the spots by oxidation reaction. Nascent oxygen and HCl react and produce water and nascent chlorine.

Which also remove spot by oxidation.



Ques. ►10

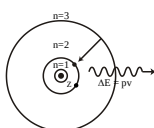


Fig-1

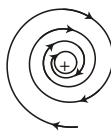


Fig-2

[Joypurbat Cadet-14]

- What is pH? 1
- Write down two importance of neutralization reaction. 2
- Write the concept of atomic model according to fig-1. 3
- Explain the comparative success of the given models. 4

Answer to the question no. 10

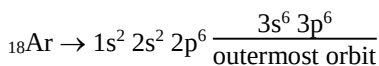
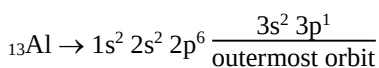
a Negative logarithm value of proton concentration of a solution is called pH.

b Importance of neutralization reaction is daily life :

In degestion : Acid is produced in stomach in need of digestion. Excess acid in stomach creates irritation. To lessen that weak base like magnesium hydroxide can be taken as medicine. Other edible bases are magnesium carbonate or sodium-bi-carbonate etc. These bases neutralize the acid in stomach and produce salt, water and carbon-dioxide.

In dental care: There are innumerable bacteria in human mouth. These bacteria eat the adhering part of the food in the mouth and produce acid. This acid attacks the tooth's enamels (calcium compound) and result the dental cariage. When you brush your teeth basic toothpaste neutralizes the acid inside the mouth which prevents the dental carriage.

c Atomic model described fig-1 is Bohr's atom model. The concept of atomic model of the stem (in fig-1) is described below :



According to Bohr electrons move in definite circular paths around the nucleus. During the revolution the electrons will follow all rules of physics. But so long electron/electrons remain in a definite orbit, it will not absorb or radiate any energy. These circular paths are known as stationary orbits.

d Second figure of the stem represent Rutherford's atomic model has their own success.

Success of Rutherford atom model:

- ⇒ Rutherford atom model was the first experiment based model.
- ⇒ It gives the idea about nucleus, its size, mass and charge.
- ⇒ It is the basis of Bohr's atomic model.

Success of Bohr's atom model:

- ⇒ Bohr's model combined successfully Rutherford's 'Solar system' model, with the Planck hypothesis on the quantified energy states at atomic level + Einstein's photons.
- ⇒ It gives explanation about atomic emission and absorption spectra.
- ⇒ It was the first 'working' model of atoms.

Ques. ►11 Now a day's different types of isotopes are use in different purpose for the betterment. But all time they don't do well. Sometimes they created hazardous.

[Jhenidah Cadet-14]

- What is base? 1
- What do mean by inert gas? 2
- Mention three uses of isotopes. 3
- Explain the hazardous activity of isotope. 4

Answer to the question no. 11

a Water insoluble metal oxide or hydroxide which form salt and water by reacting with acid is called base.

b Any of the chemically inert gaseous elements of group-18 or 0 of the periodic table are called inert gas. Helium, neon, argon, krypton, xenon and radon are the six member of inert gas family. Their outermost shell is fully occupied by electron. All of them except helium (which has duet structure) has octate structure in their outermost shell.

c Three uses of isotope is described below :

In medical science, In order to diagnosis the expansion of bone and the reason of pain and to locate the spot of pain., Tc-99m or ${}^{99\text{m}}\text{Tc}$ (Isotope of Technetium) are injected and faster sometime the location and type of the bone pain will be visible on screen. y-ray emits from the ${}^{99\text{m}}\text{Tc}$. The symbol 'm' after the mass number expresses the Meta stable condition of isotope. ${}^{99\text{m}}\text{Tc}$ converts to isotope of mass ${}^{99}\text{Tc}$ emitting y-ray. (${}^{99\text{m}}\text{Tc} \rightarrow {}^{99}\text{Tc} + \text{y-ray}$)

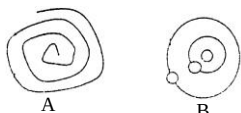
In food preservation. Now high yielding varieties are being developed in food preservation using radioactive rays and by uses of these both qualities and quantify of product are increased. Solution of radioactive ${}^{32}\text{P}$ phosphate is injected to the roof of plants. The scientists can detect the movement of phosphate throughly within the plants using Geiger counter, and from this they can determine the mechanism of using phosphorous for enhancing growth of plants.

d Isotope can be used for good. But it has some adverse effect. Hazardous activity of isotope is explained below :

Explanation: Various types of rays emit from radioactive isotopes. The life times of some of these elements are short and some are long. Radiation emitted from these isotopes, even in small doses, can cause cancer in humans and other living things. Fast moving photons (gamma rays), electrons (beta rays) and helium nuclei (alpha particles) can crush into our molecules and change their structure. If this happens to a DNA molecule, it can damage the genetic information. and

sometimes turn a cell cancerous. Radiation also causes burns, much like sunburn, in large doses, it causes harm instead of doing better. Radioactive substance is used in chemotherapy. The side effects of chemotherapy cause hair fall out and nausea. Sometimes it kills the useful bacteria in our body. As the nuclear energy obtained from the nuclear reaction used in electricity production, it might also be used for destructive purposes. The source of energy of all nuclear bombs along with the bomb thrown in Hiroshima and Nagasaki is nuclear reaction.

Ques. ►12 Observe the two models A and B and give the following answer.



[Sylhet Cadet-14]

- What is effusion? 1
- Why acidic solution can conduct electricity? 2
- Which figure A or B related with explanation of Rutherford atomic model? 3
- Which one A or B is better for explanation of atomic structure? Explain with logic. 4

Answer to the question no. 12

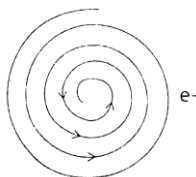
a The passage of gases from a region of high pressure top a region of low pressure through fire pores is called effusion.

b A solution can conduct electricity when it contains ions. In acidic solution, the acid gives cation/proton and anion into the solution. These ions are responsible to conduct electricity. That is why acidic solution can conduct electricity.

c Figure A is related with explanation of Rutherford atomic model.

Rutherford atomic model : In the centre of the atom there is positively charged massive substance which possesses almost the whole mass and all positive charge. Nucleus is sorrounded by a number of negative charge electrons, equal to the number of positive charge proton of the nucleus. Electrons always move round the nucleus.

But the main limitation of Rutherford's atom model is that according to Maxwell's electromagnetic theory of radiation any charged particle, if moves in a circular way, always emits radiation and it radius of movement will become smaller gradually and ultimately reach the nucleus. Thus according to Rutherford's atom model, atoms will get an unstable state. But atoms do not emit energy or electrons never enter into the nucleus.



d Between the Rutherford atomic model and Bohr's atom model. Bohr's atom model is better for explanation of atomic structure.

- (1) There is no explanation in Rutherford atomic model regarding how the electrons will move round the nucleus in case of atoms having more than one electrons. But it is explained in Bohr's atom model.
- (2) Rutherford's atom model did not give any idea about the shape and size of the orbit where the electron moves. But it explained in Bohr's atom model.
- (3) Rutherford's model cannot give satisfactory explanation of the formation of the spectrum of atom where Bohr's atom model can give clear concept of the formation of the spectrum of atom.
- (4) According to Rutherford's atom model, atoms will get an unstable state. But atom do not emit energy or will not get an unstable state.

For the above reason, Bohr's atom model is much better for explnation of atomic structure than Rutherford's atom model.

Ques. ►13 A, B, C, D, E elements having atomic no 6, 8, 11, 14, 17 respectively. Due to attain inert gas electronic configuration these elements can lose, gain or share electron with one another and form compounds. [Barisal Cadet-14]

- What is radical? 1
- State octet and duet rule? 2
- How compound CE gets dissolve in water? 3
- Though compound AB_2 is gas, compound DO_2 is solid. Explain with your logic. 4

Answer to the question no. 13

a Radical is a bundle of more than one atoms of more than one elements which acts as a single ion.

b **Octate rule:** Obtaining 8 electron arrangements at valency shell is called the octate rule. Example to gain the stability, the electronic configuration of Ca^{2+} .

Duet rule : Obtaining the arrangement of He at valence shell is called Duet rule. Example, to gain stability the electronic configuration of Li^+ .

c Hence the atomic number of C and E are 11 and 17. So, they are sodium (Na) and chlorine (Cl).

Dissolve in water : NaCl is an ionic compound which is attracted by the attraction force of cation Na^+ and anion (Cl^-). When NaCl add in water, it decomposes again into cation (Na^+) and anion (Cl^-). On the other hand, water is a polar solvent. That is why there is slightly partial positive charge in hydrogen atom and slightly partial negative charge in oxygen atom. So, cation (Na^+) is attracted by partial negative charge and anion (Cl^-) is attracted by partial positive charge on H^+ . By this way, NaCl is dissolved in water.



Creative Essay type Questions with Answers Based on Classwork



Classworks promote higher thinking and to-the-point answering.
Practise the questions attentively.

Ques. ►15 Observe the following figures and answer the questions.

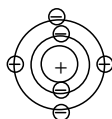


Fig: 1

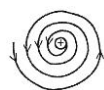


Fig:

- What is Rutherford's atomic model? 1
- What is the reason behind the positioning of protons and neutrons inside the nucleus? 2
- Mention every postulate of figure 2. 3
- Analyze the limitations of figure 1 by figure 2. 4

Answer to the question no. 15

a Based on the alpha particle emission experiment Rutherford proposed a model on the structure of atom in 1911. This is as follows-

b According to the structure of nucleus, it contains some positively charged protons. But the positively charged protons stay together instead of repulsing each other. In order to explain this paradox, it is suggested that there is a particle named neutron inside the nucleus, due to which protons and neutrons are transformed to each other continuously. During this transformation, a special attraction force is created among the protons and neutrons. This attraction force is called nuclear force. Due to this force, the protons stay together instead of repulsing each other.

c The figure shown in the stem indicates the atomic model of Rutherford. Its postulates are as shown below:

- In the center of the atom there is a positively charged heavy substance. The heavy substance is called centre of atom or nucleus positively charged is present at the centre of an atom and it is known as the nucleus which consists of the major mass of the atom. Heavy substance is called the centre of nucleus or the atom. Compared to the whole volume of the

atom the volume of nucleus is negligible. It possesses almost the whole mass and all positive charges.

- Atoms are electrically neutral. So nucleus is surrounded by a number of negative charge electrons, equal to the number of positive charge proton of the nucleus.
- Electrons always move round the nucleus as the planets revolve round the sun in the solar system. The centripetal force due to the electrostatic force between the positive nucleus and the negative electrons is equal to the centrifugal force of the moving electrons.

d In figure 2, some limitations of Rutherford's atomic model are indicated:

- Planets in the solar system are electrically neutral, but the electrons are negatively charged. (figure-1)
- According to Maxwell's electromagnetic theory of radiation any charged particle, if moves in a circular way, always emits radiation and its radius of movement will become smaller gradually and ultimately reach the center. Therefore, electrons gradually emit energy and ultimately reach the nucleus. Thus, according to Rutherford's atom model, atoms will get an unstable state. But atoms do not emit energy, or electrons never enter into the nucleus. (figure-1)
- This model cannot give satisfactory explanation of the formation of the spectrum of atom. (figure-1)

So it can be said that some limitations of figure 1 are revealed by figure 2.



Additional Creative Questions with Answers



Practice this part very well. Try to answer the questions all by yourself first. Read the answer and make sure your answer has been resembling with it.

Ques. ►16 In the figure below, three structures of hydrogen are shown. Analyze them and answer the following questions:



Hydrogen, H



Deuterium, D



Tritium, T

- What is fundamental particle? 1
- Differentiate between $^{13}_6\text{C}$ and $^{12}_6\text{C}$ 2

- Determine the mass numbers of the elements shown in the stimulus. 3

- Analyze the figures and data of the stimulus and write down your decisions based upon them. 4

Answer to the question no. 16

a The extremely small particles by which atoms are made are called fundamental particles.

b Differences between $^{13}_6\text{C}$ and $^{12}_6\text{C}$ -

- i. $^{13}_6\text{C}$ has 7 neutrons but $^{12}_6\text{C}$ has 6 neutrons.
- ii. $^{13}_6\text{C}$ has mass number of 13 but $^{12}_6\text{C}$ has mass number of 12.

c The atoms of the same element with the same number of protons but different mass numbers are called isotopes.

In the stimulus, ^1_1H , ^2_1H (D) and ^3_1H (T) are hydrogen, deuterium and tritium respectively. They are three isotopes of hydrogen.

We know that mass number = number of neutrons + number of protons

So in ^1_1H , ^2_1H , mass number = $0+1=1$

in ^1_1H , mass number = $1+1=2$

in ^1_1H , mass number = $2+1=3$

d Analyzing the structures of hydrogen given in the stimulus, we can take several decisions.

In case of ^1_1H , it has 1 proton and 1 electron. It has no neutron. It is mostly available in nature (99.985%). Its mass number is 1. It is called as protium.

In case of ^2_1H , it has 1 proton and 1 electron. It has 1 neutron. Its availability in nature is 0.015%. Its mass number is 2. It is called as deuterium.

In case of ^3_1H , it has 1 proton and 1 electron. It has 2 neutrons. It is not available in nature. It can be produced from radioactivity. Its mass number is 3. It is called as tritium.

The physical characteristics of the elements are different (such as density), but their chemical characteristics are not different. Because chemical nature is determined by number of electrons. For example, by reaction with oxygen, the products are:

According to the availability in nature, the relative atomic mass of hydrogen is:

$$(1 \times 99.985 + 2 \times 0.015) / 100 = 1.00015$$

It is to be mentioned that, the reason behind the formation of isotopes is the difference in the number of neutrons.

Ques. ►17 Observe the following table.

	Number of protons	Number of neutrons	Number of electrons
^7_3Li			3
$^{19}_9\text{F}^-$		10	
$^{27}_{13}\text{Al}^{3+}$	13		

- a. What is the relation between mass number and atomic number? 1
- b. What do you mean by ion? 2

- c. Complete the table given above. 3
- d. Show the atomic structures mentioned in the table. 4

Answer to the question no. 17

a Mass number is the sum of the number of protons and neutrons. Atomic number is the number of protons. Atomic number and mass number are designated by Z and A respectively. So, $A = Z + N$

b An entity with charge is called ion. When electron is removed from or added to the atom of an element, it becomes ion. Ion is of two kinds – cation and anion.

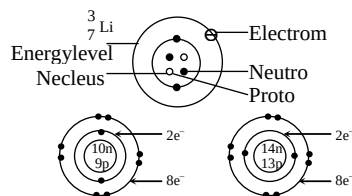
When electron is removed from an atom, it becomes cation. For example, $\text{Na} - e \rightarrow \text{Na}^+$ (cation)

When electron is added to an atom, it becomes anion. For example, $\text{F} + e \rightarrow \text{F}^-$ (anion)

c

	Number of protons	Number of neutrons	Number of electrons
^7_3Li	3	4	3
$^{19}_9\text{F}^-$	9	10	10
$^{27}_{13}\text{Al}^{3+}$	13	14	10

d The atomic structures of the atoms and ions given in the table are drawn below:



Ques. ►18

Atom	Number of electrons	Number of protons	Number of neutrons
A	1	1	0
B	6	6	7
C	6	6	6
D	8	8	8

- a. What is the actual mass of atom? 1
- b. What do you mean by relative atomic mass? 2
- c. Determine the mass of an atom of D. also calculate the relative atomic mass of it. [the mass of $1/12^{\text{th}}$ of a C-12 isotope = $1.66 \times 10^{-24}\text{g}$] 3
- d. The atomic mass of C with respect to A is not the actual atomic mass – analyze. 4

Answer to the question no. 18

a The actual mass of an atom is the sum of the masses of protons, electrons and neutrons in that atom.

b The relative atomic mass of element = mass of one atom of element / $1/12^{\text{th}}$ of mass of a carbon-12 isotope.

For example: the relative atomic mass of Na is 23. So an atom of Na is 23 times heavier than $1/12^{\text{th}}$ of mass of a carbon 12 isotope.

c In D, there are 4 protons, 4 neutrons and 4 electrons. The masses of proton and neutron are almost equal, but electron's mass is negligible in comparison to the mass of proton. So the actual mass of an atom is the sum of the masses of the protons and the neutrons.

So, the actual mass of 1 atom of D =

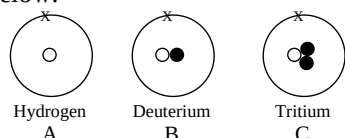
$$(8 \times 1.672 \times 10^{-24}) + (8 \times 1.67 \times 10^{-24}) + (8 \times 9.11 \times 10^{-28}) = 2.6560 \times 10^{-23} \text{ g}$$

$$\text{The relative atomic mass of D atom} = \frac{2.6560 \times 10^{-23}}{1.66 \times 10^{-24}} = 16$$

d The mass of one atom of an element is taken as standard, and then it is determined how many times heavier is one atom than the standard atom. It is the relative atomic mass of that atom. The atomic masses provided in the periodic table are the relative atomic masses. If an atom has no isotope, its relative atomic mass and mass number are equal. The proton number of the element given in the stimulus is 1, so it is hydrogen. The mass of one hydrogen atom = $0.1673 \times 10^{-23} \text{ g}$.

The actual mass of a C atom is $1.992 \times 10^{-23} \text{ g}$. The values of the actual masses of the atoms are so small that using them is not convenient. So the mass of one atom of an element is taken as standard, and then it is determined how many times heavier is one atom than the standard atom. It is the relative atomic mass of that atom. For this reason, the relative atomic mass is not the actual mass of an atom.

Ques. ►19 Hydrogen (H), deuterium (D) and Tritium (T) are isotopes of each other. Their atomic structures are shown below:



- What is isobar? 1
- What is the relation between $^{14}_{30}\text{Si}$ and $^{15}_{30}\text{P}$? 2
- What will be the physical state of the compound formed by the reaction between C and oxygen? Explain. 3
- Analyze the physical and chemical characteristics of the isotopes mentioned in the stimulus. 4

Answer to the question no. 19

a The atoms which have the same mass number, but different atomic numbers are called isobars.

b The atoms which have the same mass number, but different atomic numbers are called isobars. In Si and P atoms, the atomic numbers are different, but mass number is equal. So they are isobars of each other.

c C is T (tritium). The relative molecular mass of tritium is 6. It has 1 proton and 2 neutrons in its atom. Its mass number is 3. So the relative molecular mass is $2 \times 3 = 6$. There is no unit for relative molecular mass. By the reaction between T and oxygen, T_2O is formed. Because, T is an isotope of hydrogen and its chemical reactions are just like

hydrogen. T_2O is a liquid, because there is a very weak intermolecular attraction force among the molecules.

d There are some differences in the physical characteristics of the isotopes mentioned in the stimulus. H, D and T have different numbers of neutrons in their nuclei. So their masses, nuclear densities and kinetic characteristics are different. But their chemical characteristics are the same. Their electronic configuration is the same, because of the same number of protons and electrons. Due to the same electronic configuration, their chemical characteristics are similar.

Ques. ►20 There are two isotopes of boron: $^{10}_5\text{B}$ and

- there is 20% $^{10}_5\text{B}$ in a sample of boron.
 - How many electrons are there in the N shell? 1
 - What changes will happen if 1 electron and 2 neutrons are added to $^{35}_{17}\text{Cl}$ atom? 2
 - Calculate the number of protons, neutrons and electrons of the isotopes given in the stimulus. 3
 - Determine the relative atomic mass of boron from the information given in the stimulus. 4

Answer to the question no. 20

a 32.

b The number of protons in Cl atom is 17, so is the number of electrons. In this situation, Cl atom is electrically neutral. When an electron is added to it, the number of electrons will be $17+1=18$, so it will be negatively charged, forming Cl^- (chloride) ion, which is an anion. But when 2 neutrons are added, its number of protons, i.e. the atomic number will be the same. But the mass number will increase by 2. So the mass number will be $35+2=37$. So an isotope of chlorine, $^{37}_{17}\text{Cl}$ will be formed.

c From the formula $^{10}_5\text{B}$, it is known that the atomic number is 5 and the mass number is 10. Atomic number = number of protons = number of electrons. So in $^{10}_5\text{B}$, there are 5 protons and 5 electrons. Again, number of neutrons = mass number – number of protons = $10 - 5 = 5$.

But in case of $^{11}_5\text{B}$, the number of protons = number of electrons = 5, the electronic configuration is 2, 3. But the mass number is different, as the number of neutrons = mass number – number of protons = $11 - 5 = 6$.

d From the given information in the stem, the elements are isotopes of each other. The amount of ^{10}B is 20%.

So there is $100-20 = 80\%$ of ^{11}B in the sample.

The average relative atomic mass = $(m_1x + m_2y)/100$

Here, m_1 , m_2 are the mass numbers of the isotopes, and x , y are the percentage of availability of them in nature.

So the average relative atomic mass of boron = $(10 \times 20 + 11 \times 80)/100 = 10.8$

Ques. ▶ 21 Many isotopes are found in nature. Some of them are ^{14}C , $^{99\text{m}}\text{Tc}$, ^{131}I , ^{153}Sm , ^{89}Sr , ^{60}Co , ^{238}Pu , ^{32}P , ^{137}Cs .

- What is radioactivity? 1
- What do you mean by radioactive isotope? 2
- Which isotopes among the ones mentioned in the stimulus are used to treat diseases? Explain. 3
- In agriculture, the usage of isotopes has brought upon a revolution – analyze the statement. 4

Answer to the question no. 21

a The characteristic due to which the nucleus of the atoms of the heavy elements spontaneously divides into nuclei of atoms of new elements, and besides emit various types of invisible rays is called radioactivity.

b The number of isotopes either natural or synthesised has exceeded 1300. Among these some are stable and maximum are unstable. The unstable isotopes convert to the isotopes of another elements by emitting different types of rays such as (X-ray, X-ray, X-ray). This property of the atom of elements is called radioactivity. Isotopes of such types are called radioactive isotopes. In fact, changes occur in the nucleus of these atoms. The rays emitted from the atoms have high speed. The X-ray causes damage to the living cells. These radioactive isotopes can be produced by nuclear reaction.

c Among the isotopes mentioned, $^{99\text{m}}\text{Tc}$, ^{153}Sm , ^{89}Sr , ^{60}Co , ^{238}Pu , ^{32}P , ^{137}Cs , ^{131}I etc. are used to treat various diseases. In order to detect the growth of bones and location of pain, $^{99\text{m}}\text{Tc}$ (isotope of technetium) is used. After applying the injection, it is determined in which area the problems of bones are occurring. From $^{99\text{m}}\text{Tc}$, gamma ray is emitted. The letter “m” after the mass number indicates the metastable condition.

$^{99\text{m}}\text{Tc}$ converts to isotope of mass ^{99}Tc emitting X-ray.

$^{99\text{m}}\text{Tc} \rightarrow ^{99}\text{Tc} + \text{X-ray}$

^{153}Sm or ^{89}Sr is used to the treatment of bone pain.

To determine the presence of tumor and the locate its position radioactive isotopes are used. In treatment cancer tissues are damaged by emitting X-ray from ^{60}Co .

^{131}I prevents the growth of thyroid glands.

Phosphate ^{32}P is used in treatment of blood leukemia.

Plutonium-238 is used to set pacemaker in heart.

In different types of cancer treatment ^{131}Cs , ^{192}Ir , ^{125}Pd , ^{106}Ru are used.

d New high yielding varieties are being developed in agriculture using radioactive rays and by uses of these both qualities and quantity of product are increased. Solution of radioactive ^{32}P phosphate is injected to the root of plants. The scientists can detect the movement of phosphate thoroughly within the plants using Geiger counter, and from this they can determine the

mechanism of using phosphorous for enhancing growth of plants. Phosphorus plays important roles in cellular activities, transportation of energy, transformation of carbohydrates and transportation of genetic characteristics.

$^{32}_{15}\text{P}$ $\xrightarrow[\text{Solution}]{\text{Phosphate}}$ In plants ^{32}P ← Geiger counter

Ques. ▶ 22

Element	Electronic configuration
X	(Ar) $3d^{10} 5s^1$
Y	(Ar) $4s^1$

- How many parts are there in every atomic model? 1
- Why the atoms become charged? 2
- Determine the valency of X by showing its electronic configuration in diagram. 3
- Analyze the logic behind the entrance of electron in the 4th energy shell instead of filling the third energy shell for Y. 4

Answer to the question no. 22

a 2.

b The number of protons in the nucleus of an atom and the number of electrons revolving around the nucleus are the same. An atom is normally electrically neutral. But when a chemical bonding takes place, one or more electrons transfer from one atom to another atom completely. Due to this transformation, the number of protons and electrons in the atoms become different and atoms become charged.

c The electrons in the outermost energy levels of an atom are called the valence electrons, and the outermost energy level of the electronic configuration is called valence shell. From the number of valence electrons, the valency of any element can be determined easily. Generally the valency is equal to the number of valence electron or the number obtained by subtracting the number of valence electrons from 8.

The atomic number of Cu is 29. Its electronic configuration is 2, 8, 18, 1.

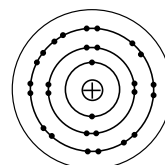


Fig : Electronic configuration of Cu

From the electronic configuration it is seen that there is only 1 electron in the outermost energy level. So its valency is 1.

d In the case of arrangement of electrons of elements with atomic number 19 or more, electrons enter at the 4th energy level without fulfilling the 3rd energy level. This can not be explained by the concept of distribution of maximum number of electrons in energy levels. From the electronic configuration, it is seen that Y is K. its

atomic number is 19. The electronic configurations of elements with atomic numbers from 1 to 18 follows the $2n^2$ rule. After the energy levels with low energy are filled, electrons enter the energy levels with higher energy.

Actually, there are some sub-levels in every energy levels. It can be explained by showing the electronic configuration in the sub-levels. But, the highest electron capacity in the energy levels remain the same.



Creative Questions with hints



Answer these questions yourself. See the super tips which will help you to answer the questions easily.

Ques. ►23

Symbol of element	Atomic number (Z)	Mass number
W	15	31
X	18	40
Y	19	39
Z	20	40

[W, X, Y and Z are symbolic, not symbols per se]

- Which isotope is used to kill cancer-infected tissues? 1
- Calculate the molecular masses of HNO_3 and SO_2 . 2
- Determine the number of protons, electrons and neutrons in the elements mentioned in the stimulus and briefly express them. 3
- Why electron enters the fourth energy shell rather than fulfilling the third energy shell in the electron configurations of Y and Z? Explain. 4

Answer to the question no. 23

a ^{60}Co .

b The molecular mass of HNO_3 = the molecular mass of H + molecular mass of N + (molecular mass of O) $\times$ 3 = 1 + 14 + 16 $\times$ 3 = 63

The molecular mass of SO_2 = the molecular mass of S + (molecular mass of O) $\times$ 2 = 32 + 16 $\times$ 2 = 64



Super tips: For answering Application and Higher Skill —

c What is the designation of the number of protons, number of electrons and number of neutrons in an atom? Explain with examples.

d The elements with atomic number greater than 19 have electrons entered into the fourth energy shell rather than fulfilling the third energy shell – explain.

Ques. ►24 $^{14}_{28}\text{Si}$, $^{15}_{31}\text{P}$, $^{8}_{17}\text{O} \rightarrow ^{8}_{16}\text{O}$

- How are the radioactive isotopes made? 1
- Write down two uses of radioactive isotopes in medical field 2
- Mention the number of neutrons, protons and electrons in the first three the atoms of the stimulus and draw the structural figures. 3
- Which two atoms are isotopes of each other in the stimulus? Explain. 4

Answer to the question no. 24

a By nuclear reaction.

b Two uses of radioactive isotopes in medical field are –

^{89}Sr – in treating pain in bones

^{238}Pu – in order to install pacemaker in heart.



Super tips: For answering Application and Higher Skill —

c Draw the structural figure of lithium (Li) atom.

d Explain isotopes.

Ques. ►25 Anila Hasan called her private tutor Farsid as the concept of atomic structure was not clear to her. In order to make his student understand the atomic structure, Farsid compared the atom with the solar system and said that the electrons revolve around the nucleus just as the planets revolve around the sun. Anila had a clear concept about atomic structure, but she found out some dissimilarities with the solar system.

- What is the highest capacity of electrons in the M shell? 1
- Mention two harmful sides of radioactive isotopes. 2
- According to which model of atoms, Farsid explained atomic structure to his student? Discuss the postulates of the model. 3
- What are the dissimilarities in the atomic structure found by Anila? Explain. 4

Answer to the question no. 25

a 18.

b The two harmful sides of radioactive isotopes are –

- It is one of the reasons of cancer.
- It is used to make atomic bombs, which were exploded in Hiroshima and Nagasaki.



Super tips: For answering Application and Higher Skill —

c Explain Rutherford's atomic model.

d Discuss the limitations of Rutherford's atomic model.

Ques. ►26 Once a teacher asked his students to write down the following isotopes –

^{103}Pb , ^{131}I , ^{147}Sm , ^{90}Sr , ^{60}Co , ^{131}Cs

Now he explained the uses of isotopes to his students.

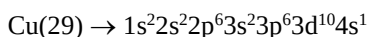
- What principle is followed by the electrons when they enter the energy shells? 1

- b. Why is the electron configuration of $_{29}\text{Cu}$ different than general cases? 2
- c. Which isotope is used to preserve food among the isotopes mentioned in the stimulus? Describe their importance. 3
- d. Some isotopes among the ones mentioned in the stimulus are used in medical field – explain. 4

Answer to the question no. 26

a They enter from shells with lower energy to the shells with higher energy.

b The electron configuration of Cu (29) is as shown below –



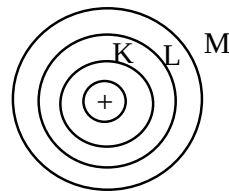
Here, the electron configuration of the outermost energy shell was supposed to be $4s^2 3d^9$ as general rule. Because the 3d shell comes before the 4s shell. But $3d^{10}$ orbital is much more stable than the $3d^9$ shell. So the electron configuration was $4s^1 3d^{10}$ rather than $4s^2 3d^9$.

 **Super tips:** For answering Application and Higher Skill —

c Discuss the importance of isotopes to preserve foods.

d Discuss the uses of radioactive isotopes in medical fields.

Ques. ▶ 27 X(9), Y(15), Z(18) and W(20) are four elements. The energy shells can be shown as below –



- a. To which system, Rutherford compared his atomic model? 1
- b. Mention the uses of ^{32}P , ^{131}I . 2
- c. According to the figure given in the stimulus, how many electrons will be in K, L, M shells of X, Y and Z atoms? Show by figures. 3
- d. Will there be any change of energy due to changing the energy shell from L to M for W atom? Explain. 4

Answer to the question no. 27

a Solar system.

b ^{131}I is used to prevent the growth of the tissues of the thyroid gland.

^{32}P is used in treating leukemia.

 **Super tips:** For answering Application and Higher Skill —

c How many electrons will be in the energy shells of phosphorus (P)? Explain.

d Discuss the Bohr atomic model.



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Knowledge and Comprehensive type Questions and Answers



You can get common the knowledge and comprehensive type questions in exam. So read these questions again and again.



Knowledge based Question-Answers

Ques-1. How many permanent particles are there in an atom?

Ans: 3.

Ques-2. Which permanent particles of atom have equal relative masses?

Ans: Proton & neutron.

Ques-3. What is the ratio of the mass of electron and mass of proton?

Ans: $1/1840$.

Ques-4. What is nucleon number?

Ans: The sum of the number of protons and number of neutrons is called nucleon number. It is also called mass number.

Ques-5. What is the number of neutrons in $_{14}^{28}\text{Si}$ atom?

Ans: 14.

Ques-6. How many of isotopes of hydrogen are there?

Ans: 3.

Ques-7. What is relative atomic mass?

Ans: It is the ratio of the mass of an atom and the mass of $1/12^{\text{th}}$ of a carbon-12 isotope.

Ques-8. What is relative molecular mass?

Ans: The ratio of the sum of the masses of all atoms in a molecule and $1/12^{\text{th}}$ of the mass of a carbon-12 atom is called the relative molecular mass of that molecule.

Ques-9. Which isotope is used in problems of bones?

Ans: Tc – 99m.

Ques-10. Which isotope is used to determine the age of fossils?

Ans: C-14.

Ques-11. Inside nucleus, which forces between nucleus and electron are equal and opposite?

Ans: Electrostatic attraction and centrifugal force of electrons.

Ques-12. What is the principle of Bohr atomic model?

Ans: The electrons revolve around the nucleus in energy shells of fixed energy.

Ques-13. What are the names of the sub-shells of the principal shells?

Ans: s,p,d,f.

Ques-14. What is the highest electron capacity of the f sub-shell?

Ans: 14.

Ques-15. What are the subshells of N-shell?

Ans: 4s,4p,4d,4f.

Ques-16. Write down the electronic configuration of scandium.

Ans: $\text{Sc}(21) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$.

Ques-17. Write down the electronic configuration of chromium.

Ans: $\text{Cr}(24) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$.



Comprehension based Questions-Answers

Ques-1. What is meant by ${}^A_Z\text{X}^{+m}$?

Ans: Here, X is the symbol of the element. A is the mass number of the element. Z is the atomic number of the element, i.e. number of protons. +m indicates the number of electrons donated or received by the element. If it receives electron, then it is –m. If it donates electron, then it is +m. If it neither receives nor donates electron, then m=0. Here, we can determine the number of neutrons from (A-Z).

Ques-2. In the following table, determine the atomic numbers, mass numbers, number of electrons and number of neutrons.

${}_{14}^{28}\text{Si}$, ${}_{15}^{31}\text{P}$, ${}_{8}^{17}\text{O}$, ${}_{19}^{39}\text{K}$.

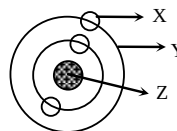
	Atomic number, Z	Mass number, A	Number of electrons	Number of neutrons
${}_{14}^{28}\text{Si}$	14	28	14	14
${}_{15}^{31}\text{P}$	15	31	15	16
${}_{8}^{17}\text{O}$	8	17	8	9
${}_{19}^{39}\text{K}$	19	39	19	20

Ques-3. Write down the names of the permanent particles of atom and the values of their relative and actual charges.

Ans: There are three permanent particles of atom. They are – i. proton, ii. Electron, iii. Neutron.

Particle	Relative charge	Actual charge
Proton	+1	1.60×10^{-19} coulombs
Electron	-1	-1.60×10^{-19} coulombs
neutron	0	0

Ques-4.



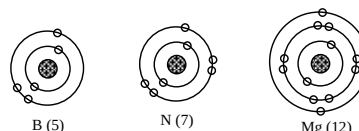
If X, Y and Z explain the atomic structure, then by which names are they called? Write down the names of two particles of Z.

Ans: X is the electron of an atom, Y is the energy shells to hold the electrons and Z is the nucleus of the atom.

The two permanent particles of nucleus of atom are – i. neutron, ii. proton.

Ques-5. Write down the electronic configurations of B, N and Mg and mention their number of neutrons.

Ans:



The number of neutrons of B, N and Mg are 6, 7 and 12 respectively.

Ques-6. What is isotope? Write down the names and symbols of the three isotopes of hydrogen.

Ans: The atoms of the same element with equal mass numbers are called isotopes.

The three isotopes of hydrogen are – i. protium, ${}^1_1\text{H}$, ii. Deuterium, ${}^2_1\text{H}$, iii. Tritium, ${}^3_1\text{H}$.

Ques-7. If the isotopes of X are ${}^a\text{X}$ and ${}^b\text{X}$ respectively, and the availability of them in nature are c% and d% respectively, then determine its relative molecular mass.

Ans: By averaging the percentage of availability of isotopes of an atom, the relative molecular mass of the atom is obtained. Here, the total mass of ${}^a\text{X}$ is $ac/100$, and the total mass of ${}^b\text{X}$ is $bd/100$. So the relative molecular mass of X = $ac/100 + bd/100 = (ac+bd)/100$.

Ques-8. Why there is no unit of relative atomic mass?

Ans: If two quantities of the same type is in ratio form, there is no unit. The relative atomic mass is expressed as below –

Relative atomic mass

= (the mass of an atom of element/the mass of $1/12^{\text{th}}$ of a carbon-12 atom)

So relative atomic mass is the ratio of two quantities of the same type. So there is no unit of relative atomic mass.

Ques-9. If the mass of an Al atom is $4.842 \times 10^{-23}\text{g}$, what is its relative atomic mass?

Ans: We know, the relative atomic mass of Al

= (the mass of an atom of Al/the mass of $1/12^{\text{th}}$ of a carbon—12 atom)

= $4.842 \times 10^{-23}\text{g} / 1.66 \times 10^{-24}\text{g} = 27.0$

Ques-10. What is radioactivity? Due to emission of which rays, an element is called radioactive?

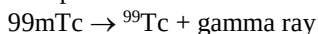
Ans: The conversion of an element to another element due to spontaneous emission of various rays from its atom is called radioactivity.

From a radioactive element, three types of rays are emitted. They are –

- i. alpha ray
- ii. beta ray
- iii. gamma ray

Ques-11. What will be formed from Tc – 99m, if gamma ray is emitted? Write down an use of Tc-99m.

Ans: Due to emission of gamma ray from Tc-99m, an isotope of ^{99}Tc is formed.



In order to determine the growth of bone, Tc-99m is used.

Ques-12. What are the uses of ^{89}Sr , ^{60}Co ?

Ans: ^{89}Sr is used in treating pains in the bones. ^{60}Co is used in treating cancer.

Ques-13. Discuss the uses of radioactive isotopes in agricultural field.

Ans: New high yielding varieties are being developed in agriculture using radioactive rays and by uses of these both qualities and quantity of product are increased. Solution of radioactive ^{32}P phosphate is injected to the root of plants. The scientists can detect the movement of phosphate thoroughly within the plants using Geiger counter, and from this they can determine the mechanism of using phosphorous for enhancing growth of plants.

Ques-14. Mention two uses of radioactive rays in preservation of food.

Ans: Two uses of radioactive rays in preservation of food are –

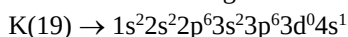
- i. In preservation of all kinds of fruits and vegetables.
- ii. In killing bacteria grown on food.

Ques-15. Why atoms are electrically neutral? By which atomic model, it can be explained?

Ans: We know that the proton of the nucleus is positively charged and electron is negatively charged. There are same number of protons and electrons in an atom. So the charges of protons and electrons are neutralized by each other. So atom is electrically neutral, which can be explained by Rutherford's atomic model.

Ques-16. In case of K, why the last electron enters 4s instead of 3d?

Ans: In the electronic configuration of atom, the electrons enter the energy shell with lower energy first. This happens in order to achieve stable electronic configuration. The lower energy shells are fulfilled first, then the higher energy shells are fulfilled one by one. The electronic configuration of K is as shown below –



As the energy of the 4s shell is lower than that of 3d shell, the electron enters 4s orbital.



Super Tips at a glance



Have you thought of the questions while reading the chapter?
If not, look at the questions below and find out the answers.

Ques-1. Describe the characteristics of the fundamental particles.

Ques-2. Describe the method of determining mass number, atomic number and the number of fundamental particles from $_{13}^{27}\text{Al}$ symbol.

Ques-3. Describe the determination of relative atomic mass from isotopes found in nature.

Ques-4. The atomic masses provided in the periodic table are the relative atomic masses – explain.

Ques-5. Describe the determination of relative molecular mass from relative atomic mass with examples.

Ques-6. Describe the uses of radioactive isotopes in medical field.

Ques-7. Describe the determination of relative atomic mass of an element by carbon-12 scale.

Ques-8. Describe the roles played by radioactive isotopes in agriculture.

Ques-9. Describe the Rutherford's atomic model.

Ques-10. Describe the limitations of Rutherford's atomic model.

Ques-11. Describe the postulates of Bohr's atomic model.

Ques-12. Describe the limitations of Bohr's atomic model.

Ques-13. Describe the electronic configuration in the energy shells of atoms with examples.

Ques-14. Why does the 29th electron go to 3d shell from 4s? Explain.

Ques-15. The electronic configuration of Cu and Na atoms are different – explain.

Ques-16. In the electronic configuration of Cr and Cu, the same method is applied – explain.

In this part important information of the chapter, at which it is needed to cast a look before exam or you must remember, such subject matters have been mentioned here at a glance. So that you can keep the important information in mind easily; specially you can make you self-confident revising these in a quick view.

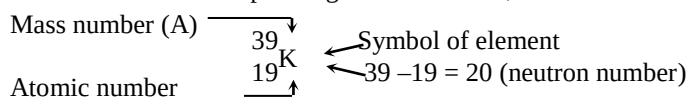


- ▶ **Element:** The substance which cannot be divided or chemically analyzed further is called element. For example: carbon (C), nitrogen (N), oxygen (O), sulfur (S) etc.
- ▶ **The particles of atom:** In atom, there are three permanent particles – proton, electron and neutron. Besides, there are some temporary particles. Protons and neutrons are positioned inside the nucleus of atom and the electrons revolve around the nucleus in different energy shells.

Particle	Symbol	Relative mass	Relative charge	Real mass	Real charge
Proton	p	1	+1	$1.67 \times 10^{-24} \text{g}$	$1.60 \times 10^{-19} \text{ coulomb}$
Neutron	n	1	0	$1.675 \times 10^{-24} \text{g}$	0
Electron	e	$\frac{1}{1840}$	-1	$9.11 \times 10^{-28} \text{g}$	$-1.60 \times 10^{-19} \text{ coulomb}$

- ▶ **Identity of atom:** The number of protons in atom is called atomic number, and the sum of the number of protons and neutrons is called mass number. When protons are removed from mass number, it is called neutron number. Number of protons is written at the lower left side of the symbol, and the mass number is written at the higher left side of the symbol.

The brief method of expressing atomic number, mass number and neutron number is as shown below–



- ▶ **Isotope:** The atoms with same atomic number but different mass number are called isotopes of each other. There are 7 isotopes of hydrogen. Three of them are found in nature.

Name	Figure	Symbol	Neutron	Percentage of availability
Hydrogen or protium		^1_1H	0	99.98
Deuterium		^2_1H or ^2_1D	1	0.015
Tritium		^3_1H or ^3_1T	2	Formed by radioactivity and found in a very low amount in nature

- ▶ **Relative atomic mass:** According to modern definition, the ratio of the mass of an atom and $1/12^{\text{th}}$ of the mass of a carbon-12 atom is called the relative atomic mass of that element. Relative atomic mass can also be determined from isotopes. For example: there are two isotopes of chlorine, ^{35}Cl and ^{37}Cl .

- ▶ **Determination of relative atomic mass:**

	^{35}Cl	^{37}Cl
Mass number	35	37
Percentage	75	25
Relative atomic mass	$35 \times 75 + 37 \times 25 / 100 = 35.5$	

- ▶ **Relative molecular mass:** Relative molecular mass is determined from relative atomic mass. Here, the number of atoms in the molecule is considered. For example: the relative atomic mass is 16. Again, there are 2 atoms in an oxygen molecule. So, the relative molecular mass of oxygen = $16 \times 2 = 32$.

- ▶ **Radioactive isotopes:** The isotopes which emit different types of radioactive rays and convert to isotopes of other elements are called radioactive isotopes. Among the emitted rays, gamma rays harm the living cells. The process of forming radioactive isotopes happens by nuclear reaction.

- ▶ **Uses of radioactive isotopes:**

1. **In medical science:** There are mainly two types of uses in this field.

(a) Diagnosis of any disease and locate the affected area

(b) Cure of disease.

(i) In order to diagnosis the expansion of bone and the reason of pain and to locate the spot of pain, Tc-99m or $^{99\text{m}}\text{Tc}$ (Isotope of Technetium) are injected and after some time the location and type of the bone pain will be visible on screen. γ -ray emits from the $^{99\text{m}}\text{Tc}$. The symbol 'm' after the mass

number expresses the Meta stable condition of isotope. ^{99m}Tc converts to isotope of mass 99Tc emitting γ -ray.

Reaction

^{153}Sm or ^{89}Sr is used to the treatment of bone pain.

- (ii) To determine the presence of tumor and the locate its position radioactive isotopes are used. In treatment cancer tissues are damaged by emitting γ - ray from ^{60}Co .
 - (iii) ^{131}I prevents the growth of thyroid glands.
 - (iv) Phosphate ^{32}P is used in treatment of blood leukemia
 - (v) Plutonium-238 is used to set pacemaker in heart. In different types of cancer treatment ^{131}Cs , ^{192}Ir , ^{125}Pd , ^{106}Ru are used
2. **In agriculture:** New high yielding varieties are being developed in agriculture using radioactive rays and by uses of these both qualities and quantity of product are increased Solution of radioactive ^{32}P phosphate is injected to the root of plants. The scientists can detect the movement of phosphate thoroughly within the plants using Geiger counter, and from this they can determine the mechanism of using phosphorous for enhancing growth of plants.
 3. **In food preservation:** Various harmful bacteria grow due to lack of proper preservation of all kinds of vegetables and fruit or if the cooking process is not appropriate and these bacteria are harmful for our health. In some cases it may cause death. Generally the γ -ray that emits from the ^{60}Co kills these harmful bacteria. This ray is also used in poultry farms when any bacterial disease is spread Foods are preserved using radioactive rays of a certain dose. Use of excess radioactive rays is very harmful for health. Radioactive rays must be applied to food at a limited dose and in a restricted place. This radioactive ray (γ -ray) of limited dose is safe as sunlight.
 4. **Production of electricity:** At the time of decay or nuclear reaction a large amount of heat is evolved. This heat energy can be converted to electric energy using various devices. In many countries of the world huge amount of electricity is produced from nuclear reaction in nuclear reactors. Besides this, radioactive rays can be used in pest control, in industrial plants, in measuring the thickness of metal sheets, measuring the height of liquid in a closed vassal, locating the hole in pipe lines. The ages of various objects of the world along with fossil, mummy, and even the age of the universe can be calculated by C-14.
- **The hazardous effects of using radioactive isotopes:** Various types of rays emit from the radioactive isotopes. The life times of some of these elements are short and some are long. Radio activity is a major cause of cancer. When not used in recommended doses, it causes harm instead of doing better. Radioactive substance is used in chemo therapy. The side effects of chemo therapy cause hair fall out and nausea. Sometimes it kills the useful bacteria in our body.
 - **Rutherford's atomic model:** In 1911, scientist Rutherford compared atomic structure with a miniature solar system. So his model is also called the solar model of atomic structure.
- Principles:
1. In the center of the atom there is a positively charged havey substance. This havey substance is called the centre of the atom. or nucleus Compared to the whole volume of the atom the volume of nucleus is negligible. It possesses almost the whole mass and all positive charges.
 2. Atoms are electrically neutral. So nucleus is surrounded by a number of negative charge electrons, equal to the number of positive charge proton of the nucleus.
 3. Electrons always move round the nucleus as the planets revolve round the sun in the solar system. The centripetal force due to the electrostatic force between the positive nucleus and the negative electrons is equal to the centrifugal force of the moving electrons.
- **The limitations of Rutherford's atomic model:**
 1. Planets in the solar system are electrically neutral, but the electrons are negatively charged
 2. According to Maxwell's electromagnetic theory of radiation any charged particle, if moves in a circular way, always emits radiation and it radius of movement will become smaller gradually and ultimately reach the centre. Therefore, electrons gradually emit energy and ultimately reach the nucleus. Thus, according to Rutherford's atom model, atoms will get an unstable state. But atoms do not emit energy, or electrons never enter into the nucleus.
 3. This model cannot give satisfactory explanation of the formation of the spectrum of atom.
 4. Rutherford's atom model did not give any idea about the shape and size of the orbit where the electron moves.

- There is no explanation regarding how the electron will move round the nucleus in case of atoms having more than one electron.

- **Bohr's atomic model:** According to the limitations of Rutherford's atomic model, scientist Neils Bohr presented his own model of atomic structure. The model is called Bohr's atomic model:

The main postulates of this model are as follows:

- Electrons move round the nucleus of atom in some circular paths.
- Around the nucleus there are some circular stable axes on which electron moves around. These are called energy level or orbit. The energy levels are designated as capital letters K, L, M, N in terms of the value of the hypothetical number 'n'. The first energy level is denoted as $n = 1$ (K energy level), the second energy level as $n = 2$ (L energy level) and, in this way, the value of n keeps increasing in full numbers such as 3, 4, 5 while the energy levels are marked by capital letters M, N, O respectively. While remaining in a certain orbit electrons neither emit nor absorb energy.
- When any electron gets transferred from a lower orbit or energy level such as $n = 1$ to a higher orbit or energy level such as $n = 2$, it absorbs a certain amount of energy. Again when any electron is transferred from a higher orbit or energy level such as $n = 2$ to a lower orbit or energy level such as $n = 1$, it emits a fixed amount of energy.

- **Limitations of Bohr's atom model:** As the Bohr's atom model has many advantages it also has some limitations. Such as –

- Although Bohr's atom model can explain the spectrum of hydrogen and atoms or ions like hydrogen containing one electron, but it can not explain the spectrum on ions or atoms containing more than one electrons.
- When electrons are transferred from one energy level to another energy level according to Bohr's atom model there would be a single line in spectrum. But observing the spectrum of hydrogen or other ions with a sensitive apparatus it is seen that every line splits into several fine lines.

- **Electronic configuration:** There are some orbits or energy shells around nucleus. The closest energy shell is $n=1$ or K shell. The second energy shell is $n=2$ or L shell, the 3rd and 4th energy shells are M and N shells respectively. They are called principal energy shells. According to $2n^2$ law, 2 electrons can stay in K shell, 8 electrons can stay in L shell, 18 electrons can stay in M shell and 32 electrons can stay in N shell.

Atomic number	Element	K	L	M
1	H	1		
8	O	2	6	
18	Ar	2	8	8

Every principal energy shell contains one or more sub-shells. These sub-shells are called as s, p, d, f etc. they are expressed by l , where the values of l are 0,1,2,3 etc. 2 electrons can stay in the s sub-shell, 6 electrons can stay in the p sub-shell, 10 electrons can stay in the d sub-shell and 14 electrons can stay in the f sub-shell. There is one sub-shell (s) in the 1st energy shell; s and p sub-shells in the 2nd energy shell; s,p,d sub-shells in the 3rd energy shell and s,p,d,f sub-shells in the 4th energy shells. In order to indicate the sub-shell, a number is used before the energy shell. For example: the sub-shells of the 3rd energy shell or M shell are 3s, 3p, 3d

It is the general property of electrons that they fill the sub level (orbital) of lower energy first and gradually enter into the sub levels of higher energy. The energy order of the sub-levels is: