CHEMISTRY

BOOKS - MTG IIT JEE FOUNDATION

STRUCTURE OF THE ATOM

Illustrations

1. Calculate the number of electrons, protons and neutrons in sodium atom. Given that

atomic number of sodium is 11 and mass number (atomic mass) is 23.

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2. The nucleus of the atom of an element contains 17 protons and 18 neutrons. Calculate the atomic number and mass number of the element and represent them along with the symbol of the element.

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3. Two atoms, X and Y are given below.

$^{19}_{9}X, {}^{20}_{10}Y$

Show that both atoms have the same number of neutrons.

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4. Two atoms, X and Y are given below.

$^{19}_{9}X, {}^{20}_{10}Y$

Are both atoms of the same element? Explain.

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5. Complete the following table.

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6. Fill in the blanks

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7. Write the electronic configuration of chlorine atom (atomic no. = 17, mass no. = 35).

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8. The atom of an element has 2 electrons in the M-shell. What will be the atomic number of the element? Name the element.

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9. Lithium atom has atomic mass 6 and has 3 protons in it nucleus. How many neutrons does it have? Write down its electronic configuration.

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10. Write the distribution of electrons in nitrogen atoms

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11. The valency of hydrogen is 1, magnesium, 2 aluminium 3 and carbon 4 . Can you see any connection between the valency of an element and the number of electrons it has in its outermost electron shell ? What would you predict the valencies of helium (He), phosphorus (P), sulphur (S) and neon (Ne) to be ?

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12. If the number of electrons in an ion is 10 and the number of protons is 9, then

What would be the atomic number of the ion?

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13. If the number of electrons in an ion is 10 and the number of protons is 9, then

What is the charge on the ion?

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14. An ion M^{2+} contains 10 electrons and 12 neutrons .What is the atomic number and mass number the element M? Name the element.

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15. Arrange the given elements in the increasing order of their reactivity.

$_{19}X^{39}, _{12}Y^{24}, _{14}W^{28}$

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16. Oxygen consists of isotopes O^{16},O^{17} and O^{18} and carbon consists of isotopes C^{12} and C^{13} .How many types of CO_2 molecules can be formed ? Also report their molecular weights.

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17. Which of the following pairs represent isotopes and which represent isobars?

$_{92}^{235}U$, $_{92}^{238}U$

Calculate the difference in the number of neutrons in the isotopic pairs.

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18. Which of the following pairs represent isotopes and which represent isobars?

$^{40}_{19}K, {}^{40}_{20}Ca$

Calculate the difference in the number of neutrons in the isotopic pairs.

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19. Which of the following pairs represent isotopes and which represent isobars?

$^{3}_{1}H, ^{3}_{2}He$

Calculate the difference in the number of neutrons in the isotopic pairs.

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20. Which of the following pairs represent isotopes and which represent isobars?

$^{16}_{8}O, ^{18}_{8}O$

Calculate the difference in the number of neutrons in the isotopic pairs.

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Solved Examples

1. What valency will be shown by an element having atomic number 12?

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2. What is the number of valence electrons in the atom of an element A having atomic number 20? Name the valence shell of this atom.

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3. There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number. How will you represent the element?

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4. The atom of an element has 9 protons, 9 electrons and 10 neutrons.

What is the atomic number of the element?

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5. The atom of an element has 9 protons, 9 electrons and 10 neutrons.

What is the mass number of the element?

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6. The atom of an element has 9 protons, 9 electrons and 10 neutrons.

Name the element and give its electronic configuration.

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7. The atom of an element has 9 protons, 9 electrons and 10 neutrons.

Predict the valency of the element

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8. The average atomic mass of copper is 63.5. It exists as two isotopes which are $._{29}^{63}Cu$ and $._{29}^{65}Cu$. Calculate the percentage of each isotope present in it.

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9. An electron is regarded as a universal particle. Explain.

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10. Most of the space in an atom is empty. Justify.

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11. Why do helium, neon and argon have a zero valency?

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12. Why are isotopes of an element chemically similar?

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13. The elements are identified by their atomic numbers and not by their mass numbers. Justify.

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14. The composition of two atomic particles is given :

What is the mass number of X?

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15. The composition of two atomic particles is given :

What is the mass number of Y?

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16. The composition of two atomic particles is given :

What is the relation between X and Y?

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17. The composition of two atomic particles is given :

Which element/elements do they represent?

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18. Give three points of distinaction between isotopes and isobars.

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19. Both helium (He) and magnesium (Mg) have two valence electrons. He represents a

noble gas element, but Mg does not. Assign reason.

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20. Which of the two elements would be more reactive, element A of atomic number 36 or element B of atomic number 19 ?

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21. The atomic number of an element is 15. How many protons and electrons are there in an atom of the element?

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Ncert Section

1. What are canal rays?

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2. If an atom contains one electron and one proton, will it carry any charge or not?

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3. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.

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4. On the basis of Rutherford's model of an atom, which sub- atomic particle is present in the nucleus of an atom?

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5. Draw a sketch of Bohr's model of an atom with three shells.

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6. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold ?

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7. Name the three sub-atomic particles of an atom.

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8. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

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9. Write the distribution of electrons in carbon and sodium atoms.

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10. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

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11. How will you find the valency of chlorine, sulphur and magnesium ?

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12. If number of electrons in an atom is 8 and number of protons is also 8, then what is the atomic number of the atom

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13. If number of electrons in an atom is 8 and number of protons is also 8, then what is the charge on the atom?

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14. Atomic numbers of oxygen and sulphur are 8 and 16 respectively. Oxygen atom has 8 neutrons and sulphur atom has 16 neutrons. Find out the mass number of oxygen and sulphur atom.

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15. Write the electronic configuration of any one pair of isotopes and isobars.

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16. For the symbol H,D and T tabulate three sub-atomic particles found in each of them.

17. Compare the properties of electrons, protons and neutrons.

18. What are the limitations of J.J. Thomson's model of the atom?

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19. What are the limitations of Rutherford's model of the atom ?

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20. Describe Bohr's model of the atom.

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21. Compare all the proposed models of an atom given in this chapter.

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22. Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.

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23. Define valency by taking examples of silicon and oxygen.

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24. Explain with examples

Atomic number

Give any two uses of isotopes.

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25. Explain with examples

Mass number

Give any two uses of isotopes.

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26. Explain with examples

Isotopes

Give any two uses of isotopes.

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27. Explain with examples

Isobars

Give any two uses of isotopes.

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28. Na^+ has completely filled K and L shells.

Explain.

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29. If bromine atom is available in the form of, say two isotopes 3$Br (49.70%) and 3Br (50.30%), calculate the average atomic mass of bromine atom. Ans.: % of 3Br isotope = 49.7 % of 3Br isotope = 50.3 Average atomic mass of bromine atom

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30. The average atomic mass of a sample of an element X is 16.2 μ. What is the percentage of

each isotope $^{18}_{8}X$ and $^{18}_{8}X$ in the sample?

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31. If Z = 3, what would be the valency of the element? Also, name the element

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32. Composition of the nuclei of two atomic species X and Y are given as under:

Give the mass numbers of X and Y. What is the relation between the two species?

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33. J.J. Thomson proposed that the nucleus of an atom contains only nucleons.

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34. A neutron is formed by an electron and a proton combining together. Therefore, it is

neutral.

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35. The mass of an electron is about $\frac{1}{1000}$ times that of proton.

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36. An isotope of iodine is used for making tincture iodine, which is used as a medicine.

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37. Rutherford's alpha-particle scattering experiment was responsible for the discovery of

A. atomic nucleus

B. electron

C. proton

D. neutron

Answer: A

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38. Isotopes of an element have

A. the same physical properties

B. different chemical properties

C. different number of neutrons

D. different atomic numbers.

Answer: C

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39. Number of valence electrons in Cl^- ion are:

A. 16

B. 8

C. 17

D. 18

Answer: B

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40. Which one of the following is a correct electronic configuration of sodium?

A. 2,8

B. 8, 2, 1

C. 2, 1, 8

D. 2, 8, 1

Answer: A

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41. complete the following table

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Exercise Multiple Choice Questions Level 1

1. The mass number A, atomic number Z and number of neutrons n are related as

A. n= A-Z

B. $n = A + Z$

C. $n = A \times Z$

D. none of these.

Answer: A

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2. Rutherford's experiment on the scattering of α particle showed for the first time that the atom has

A. nucleus

B. electron

C. proton

D. neutron

Answer: A

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3. In the nucleus of $^{40}_{20}Ca$, there are

A. 40 protons and 20 electrons

B. 20 protons and 40 electrons

C. 20 protons and 20 neutrons

D. 20 protons and 40 neutrons.

Answer: C

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4. Maximum number of electrons that can be present in N shell is _____

A. 18

B. 32

C. 2

D. 8

Answer: B

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5. Cathode rays are made up of

A. positively charged particles

B. negatively charged particles

C. neutral particles

D. none of these.

Answer: B

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6. Rutherfords experiments , which established the nuclear model of atom , used a beam of:-

A. β--particles which impinged on the metal foil and got absorbed

B. Y-rays which impinged on a metal foil and ejected electrons

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

D. α-particles nuclei, which impinged on a metal foil and got scattered.

Answer: D

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7. Rutherford's alpha particle scattering experiment eventually led to the conclusion that

A. mass and energy are related

B. nucleus is present in the centre of the atom

C. neutrons are buried deep in the nucleus

D. the point of impact with matter can be precisely determined.

Answer: B

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8. A neutral atom (atomic number > 1) has

A. electron and proton

B. neutron and electron

C. neutron, electron and proton

D. neutron and proton.

Answer: C

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9. Isotopes have

A. same physical and chemical properties

B. same physical properties but different chemical properties

C. same chemical properties but different physical properties

D. different physical and chemical properties.

Answer: C

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10. Select the pair of isobars from the following species:

$^{37}_{17}A, ^{35}_{17}B, ^{37}_{18}C, ^{36}_{18}D, ^{38}_{19}E$

A. A and B

B. A and C

C. C and E

D. C and D

Answer: B

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11. Valency of oxygen is

A. 1

B. 2

C. 3

D. 4

Answer: B

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12. Which of the following shows the electronic configuration of Ca^{2+}?

A. He

B. Ne

C. Ar

D. F^-

Answer: C

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13. The number of neutrons in the element Be is

A. 4

B. 5

C. 9

D. 13

Answer: B

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14. Which of the following particles is not deflected by a magnetic field?

A. Proton

B. Neutron

C. Electron

D. All of these

Answer: B

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15. Which of the following elements contains only two electrons in the outermost shell?

A. Helium

B. Beryllium

C. Beryllium

D. All of these

Answer: D

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16. The charge on the atom having 17 protons, 18 electrons is

A. $+1$

B. -1

C. -2

D. zero

Answer: B

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17. Maximum number of electrons in any orbit is

A. n^2

B. $2n^2$

C. $1/2n^2$

D. None of these

Answer: B

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18. Which of the following statements are part of Bohr's model of hydrogen atom?

A. Energy of the electrons in the orbit is quantized.

B. The electron in the orbit nearest to the nucleus has the lowest energy.

C. Electrons revolve in different orbits around the nucleus.

D. All of these

Answer: D

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19. The number of electrons in the valence shell of calcium is

A. 6

B. 8

C. 2

D. 4

Answer: C

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20. Na^+ ion is isoelectronic with

A. Li^+

B. Mg^{2+}

C. Ca^{2+}

D. Ba^{2+}

Answer: B

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21. Which of the following is not true for isotopes?

A. They have the same atomic number.

B. They have the same mass number.

C. They have the same electronic configuration.

D. They have the same chemical properties

Answer: B

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22. The valency of an element is

A. the mass of the element displacing 1 part by the mass of hydrogen

B. the mass of the element combining with 8 parts by the mass of oxygen

C. the number of atoms of hydrogen combining with 1 atom of the given element

D. the number of atoms in 1 molecule of the given element.

Answer: C

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23. Which of the following electronic configurations is wrong?

A. $Li(3) = 2, 1$

B. $O(8) = 2, 6$

C. $S(16) = 2, 6, 8$

D. $P(15) = 2, 8, 5$

Answer: C

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24. $MgCl_2$ is the formula for an ionic compound of magnesium and chlorine. If the charge on Cl is -1, then the charge on Mg must b

A. $+2$

B. $+3$

C. -2

D. -3

Answer: A

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25. A cation has a positive charge because

A. there are more protons than neutrons

B. the neutrons in the nucleus are charged

C. there are fewer electrons than protons

D. there are more electrons than protons.

Answer: C

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26. What will be the valency of an atom if its outermost shell contains four electrons?

A. 8

B. 4

C. 2

D. 6

Answer: B

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27. In Rutherford's gold foil experiment most of the α-particles pass through the gold foil without any deviation from their paths . This indicates that

A. the atom is spherical

B. there is a positively charged nucleus at the centre of the atom

C. the entire mass of the atom is concentrated at the nucleus of the atom

D. most portion of the atom is empty space.

Answer: D

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28. Rutherford's model of an atom could not explain its stability. This was overcome by another atomic model. The postulates of the new model of atom are (i) an atom consists of a positively charged sphere and the electrons are embedded in it (ii) each shell or orbit corresponds to a definite energy, therefore, these circular shell are also known as energy shells (iii) as long as the electrons revolve in the stationary orbit it neither radiates nor absorbs energy.

A. (i) and (ii)

B. (ii) and (iii)

C. (i) and (iii)

D. (i), (ii) and (iii)

Answer: B

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29. Isotones have

A. same mass number but different atomic numbers

B. same atomic number but different mass numbers

C. same value of (mass number - atomic number)

D. same number of electrons

Answer: C

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30. The main drawback of Rutherford's model of the atom is that

A. it does not explain the stability of atom

B. it does not show the location of protons

C. it does not explain neutral nature of an atom

D. it does not explain existence of a nucleus in an atom.

Answer: A

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Exercise Multiple Choice Questions Level 2

1. How many electrons are present in the M shell of an atom of an element with atomic number 23?

A. 5

B. 6

C. 12

D. 11

Answer: D

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2. The ratio between the neutrons in C and Si with respect to atomic masses 12 and 28 is

A. $2:3$

B. $3:2$

C. $3:7$

D. $7:3$

Answer: C

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3. An element M has an atomic mass 19 and atomic number 9. Its ion is represented by

A. M^+

B. M^{2+}

C. M^-

D. M^{2-}

Answer: C

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4. Which of the following do not have the same number of valence electrons?

A. H, Li, Na, K

B. He, Mg, Be, Ca

C. B, Al, N, P

D. O, S, Se

Answer: C

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5. The triad of nuclei that is isotonic is

A. ${}_6C^{14}, {}_7N^{15}, {}_9F^{17}$

B. ${}_6C^{12}, {}_7N^{14}, {}_9F^{19}$

C. ${}_6C^{14}, {}_7N^{14}, {}_9F^{17}$

D. ${}_6C^{14}, {}_7N^{14}, {}_9F^{19}$

Answer: A

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6. The electronic configuration of elements A, B, C and D are (2, 8, 1), (2, 8, 2), (2, 8, 6) and (2, 8, 7) respectively. Which of them can make an ion with two negative charges?

A. A

B. B

C. C

D. D

Answer: C

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7. According to Bohr's atomic model, as we move away from the nucleus

A. radius of the orbit go on increasing

B. energy of the orbits go on decreasing

C. both (a) and (b)

D. neither (a) or (b)

Answer: A

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8. A has 9 protons, 9 electrons and 10 neutrons, B has 12 protons, 12 electrons and 12 neutrons. Formula of the compound between A and B is

A. BA_2

B. AB_2

C. B_2A_3

D. AB_4

Answer: A

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9. The number of electrons in carbon and fluorine are respectively

A. 6,9

B. 9,6

C. 4,7

D. 8,8

Answer: A

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10. The increasing order for the values of e/m (charge/mass) is

A. e, p, n, α

B. n, p, e, α

C. n, p, α, e

D. n, α, P, e

Answer: D

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11. How many total protons are found in one molecule of retinol $\left(C_{20_{H}}{}_{-}(30)O\right.$?

A. 51

B. 151

C. 600

D. 158

Answer: D

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12. An element A has atomic mass 39 and atomic number 19. Which one of the following ions it will form on ionising one electron?

A. A^+ ion

B. A^- ion

C. A^{++} ion

D. A^{--} ion

Answer: A

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13. Which of the following has more electrons than neutrons?

A. F^{-}

B. Al^{3+}

C. O^{2-}

D. Na^{+}

Answer: C

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14. Which of the following is an accurate illustration of a nitrogen atom?

A. 

B. 

C. 

D. 

Answer: A

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15. Which of the following is a correct representation of Cl^- ?

A. 

B. 

C. 

D. 

Answer: A

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16. Two particles X and Y have the composition as shown in the table.

The particles X and Y are

A. metal atoms

B. non-metal atoms

C. negative ions

D. positive ions.

Answer: C

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17. The relative atomic mass of naturally occurring chlorine is not a whole number. What is the reason for this?

A. Chlorine atoms can have different numbers of neutrons

B. Naturally occurring chlorine cannot be obtained pure.

C. Chlorine is unstable.

D. The mass of the electrons has been included.

Answer: A

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18. An element L has 9 protons and its valency is 1. Another element M has valency 3 and 5. What is the difference in the number of electrons in L and M?

A. 6

B. 5

C. 4

D. 3

Answer: A

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19. Schematic atomic structures of three elements are given below:

Which of the following is the correct formula of the compound formed by the given three elements?

A. Na_3PO_4

B. $Na_{32}CO_3$

C. Na_2SO_4

D. Na_2SO_3

Answer: B

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20. Vivek was given few models of atoms representing their structures. He was asked to choose one pair of isotopes and one pair of isobars.

Which of the following options contains the correct pairs?

	Isotopes	Isobars
A.	(i) and (ii)	(iii) and (iv)
B.	(i) and (iv)	(ii) and (iii)
C.	(i) and (iii)	(ii) and (iv)
D.	(ii) and (iv)	(i) and (iii)

Answer: C

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Exercise Match The Following

1. 

A. P-4, Q-3, R-2, S-1

B. P-1, Q-2, R-3, S-4

C. P-2, Q-1, R-4, S-3

D. P-2, Q-1, R-3, S-4

Answer: C

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2. 

A. P-4, Q-3, R-1, S-2

B. P-1, Q-2, R-3, S-4

C. P-3, Q-2, R-1, S-4

D. P-4, Q-2, R-1, S-3

Answer: A

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3. 

A. P-1, Q-2, R-3, S-4

B. P-1, Q-4, R-2, S-3

C. P-2, Q-1, R-3, S-4

D. P-4, Q-1, R-2, S-3

Answer: B

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4. 

A. P-4, Q-3, R-2, S-1

B. P-1, Q-2, R-3, S-4

C. P-3, Q-1, R-2, S-4

D. P-4, Q-3, R-1, S-2

Answer: D

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5. 

A. P-1, Q-2, R-3, S-4

B. P-4, Q-3, R-2, S-1

C. P-2, Q-4, R-3, S-1

D. P-2, Q-3, R-4, S-1

Answer: D

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Exercise Assertion Reason Type

1. Assertion : Bohr's orbits are called stationary orbits. Reason : Electrons remain stationary in these orbits for sometime.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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2. Assertion : In Rutherford's gold foil experiment,very few d-particles are deflected back. Reason : Nucleus present inside the atom is heavy.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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3. Assertion : Anions are larger in size than the parent atom. Reason : In an anion, the number of protons in the nucleus is less than the number of electrons moving around it.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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4. Assertion : For noble gases, valency is zero.

Reason : Noble gases have 8 valence electrons.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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5. Assertion : The atoms of different elements having same mass number but different atomic numbers are known as isobars. Reason : The sum of protons and neutrons, in the isobars is always different.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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6. Assertion : Cathode rays travel in straight lines. Reason : Cathode rays do not penetrate through thin sheets.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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7. Assertion : Thomson's atomic model is known as 'raisin pudding' model. Reason : The atom is visualized as a pudding of positive charge with electrons (raisins) embedded in it.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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8. Assertion : Atom is electrically neutral. Reason : A neutral particle, neutron is present in the nucleus of atom.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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9. Assertion : Cathode rays get deflected towards the positive plate of electric field. Reason : Cathode rays consist of negatively charged particles known as electrons.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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10. Assertion : Isotopes are electrically neutral.

Reason : Isotopes are species with same mass number but different atomic numbers.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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Exercise Comprehension Type

1. At the suggestion of Ernest Rutherford, Hans Geiger and Ernest Marsden bombarded a thin gold foil by d-particles from a polonium

source. It was expected that O-particles would go right through the foil with hardly any deflection. Although most of the alpha particles indeed were not deviated by much, a few were scattered through very large angles. Some were even scattered in the backward direction. The only way to explain the results Rutherford found, was to picture an atom as being composed of a tiny nucleus in which it is positive charge and nearly all its mass is concentrated.

Rutherford's c-particle scattering experiment led to the conclusion that

A. mass and energy are related

B. mass and positive charge of an atom are concentrated in the nucleus

C. neutrons are present in the nucleus

D. atoms are electrically neutral.

Answer: B

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2. At the suggestion of Ernest Rutherford, Hans Geiger and Ernest Marsden bombarded a thin gold foil by d-particles from a polonium source. It was expected that O-particles would go right through the foil with hardly any deflection. Although most of the alpha particles indeed were not deviated by much, a few were scattered through very large angles. Some were even scattered in the backward direction. The only way to explain the results Rutherford found, was to picture an atom as being composed of a tiny nucleus in which it is

positive charge and nearly all its mass is concentrated.

The C-particle scattering experiment led to the conclusion that

A. α-particles can approach within a distance of the order of 10^{-14} m of the nucleus

B. the radius of the nucleus is less than 10^{14}m

C. scattering follows Coulomb's law

D. the positively charged parts of the atom move with extremely high velocities.

Answer: B

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3. At the suggestion of Ernest Rutherford, Hans Geiger and Ernest Marsden bombarded a thin gold foil by d-particles from a polonium source. It was expected that O-particles would go right through the foil with hardly any

deflection. Although most of the alpha particles indeed were not deviated by much, a few were scattered through very large angles. Some were even scattered in the backward direction. The only way to explain the results Rutherford found, was to picture an atom as being composed of a tiny nucleus in which it is positive charge and nearly all its mass is concentrated.

Which of the following is not correct observation/ conclusion from Rutherford's scattering experiment?

A. Nucleus is small but heavy.

B. Nucleus always carries positive charge.

C. Atom is nearly 10 times greater than the size of the nucleus.

D. The number of a-particles hitting the nucleus is very large.

Answer: D

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4. At the suggestion of Ernest Rutherford, Hans Geiger and Ernest Marsden bombarded a thin gold foil by d-particles from a polonium source. It was expected that O-particles would go right through the foil with hardly any deflection. Although most of the alpha particles indeed were not deviated by much, a few were scattered through very large angles. Some were even scattered in the backward direction. The only way to explain the results Rutherford found, was to picture an atom as being composed of a tiny nucleus in which it is

positive charge and nearly all its mass is concentrated.

Alpha particles that come closer to the nuclei

A. are deflected more

B. are deflected less

C. make more collision

D. are slowed down more

Answer: A

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5. The maximum number of the electrons which are permitted to be assigned to an energy shell of an atom is called the electron capacity of that shell. The distribution of electrons in different orbits or shells is governed by a scheme known as Bohr-Bury scheme. Electrons are filled in the shells in a stepwise manner in increasing order of energy of the energy shell.

What is the maximum electrons capacity of M shell?

A. 24

B. 8

C. 18

D. 32

Answer: C

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electrons in different orbits or shells is governed by a scheme known as Bohr-Bury scheme. Electrons are filled in the shells in a stepwise manner in increasing order of energy of the energy shell.

Identify the element with the configuration K-2, L-8, M-3.

A. Aluminium

B. Magnesium

C. Sodium

D. Beryllium

Answer: A

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7. The maximum number of the electrons which are permitted to be assigned to an energy shell of an atom is called the electron capacity of that shell. The distribution of electrons in different orbits or shells is governed by a scheme known as Bohr-Bury scheme. Electrons are filled in the shells in a stepwise manner in increasing order of energy

of the energy shell.

Which of the following have same valency A(2,8, 2), B(2, 8, 4), C(2, 2), D(2,8)?

A. A and B

B. B and C

C. A and C

D. C and D

Answer: C

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8. The maximum number of the electrons which are permitted to be assigned to an energy shell of an atom is called the electron capacity of that shell. The distribution of electrons in different orbits or shells is governed by a scheme known as Bohr-Bury scheme. Electrons are filled in the shells in a stepwise manner in increasing order of energy of the energy shell.

Which of the following configurations represent sodium?

A. 2,8,4

B. 2, 8,5

C. 2,3

D. 2,8,1

Answer: D

9. The mass of an atom is due to the masses of protons and neutrons in the nucleus. The relative masses of protons and neutrons are almost equal to one. Therefore, the atomic

mass of an element should be nearly a whole number. But in many cases the atomic masses are fractional. The main reason for these fractional atomic masses is that these elements occur in nature as a mixture of several isotopes. The atomic mass of an element is the average of the atomic masses of these isotopes in the ratio of their proportion of occurrence.

Chlorine occurs in nature in the form of two isotopes with atomic masses 35 u and 37 u in the ratio of 3 : 1 respectively. Atomic mass of chlorine is

A. 35.5 u

B. 34.5 u

C. 35 u

D. 36 u

Answer: A

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10. The mass of an atom is due to the masses of protons and neutrons in the nucleus. The relative masses of protons and neutrons are

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An element occurs in two isotopic forms with atomic masses 10 and 11. What is the

percentage abundance of two isotopes in the sample having atomic mass 10.80?

A. 20,80

B. 50,50

C. 25,70

D. 60, 40

Answer: A

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11. The mass of an atom is due to the masses of protons and neutrons in the nucleus. The relative masses of protons and neutrons are almost equal to one. Therefore, the atomic mass of an element should be nearly a whole number. But in many cases the atomic masses are fractional. The main reason for these fractional atomic masses is that these elements occur in nature as a mixture of several isotopes. The atomic mass of an element is the average of the atomic masses of these isotopes in the ratio of their

proportion of occurrence.

The fractional atomic masses of elements are due to the existence of

A. isotopes having different masses

B. diagonal relationship

C. equal number of electrons and protons

D. none of these.

Answer: A

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12. A major drawback of Rutherford's model of an atom is that it does not explain the stability of the atom. He suggested that electrons are revolving around the nucleus in circular revolutions. However the circular motion is said to be accelerated. If we apply this electromagnetic theory to Rutherford's model it means that the electrons revolving around the nucleus will radiate energy continuously at every turn and move closer and closer to the nucleus. To overcome this drawback of Rutherford's model, Neils Bohr

proposed a new model which suggest that electron could revolve around the nucleus in certain fixed circular paths called energy level which have fixed or quantized energy. As long as an electron remains in a particular orbit, it does lose or gain energy.

According to Bohr's postulates the orbits are also known as energy levels because

A. each orbit has fixed energy

B. all orbits have fixed energy

C. electrons do not radiate energy

D. orbits move in a circular path.

Answer: A

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The change in energy of an electron takes place only when

A. it remains in a particular orbit

B. the orbit is circular

C. the electron jumps from one energy level to another energy level

D. electron goes closer to the nucleus.

Answer: C

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14. A major drawback of Rutherford's model of an atom is that it does not explain the stability of the atom. He suggested that electrons are revolving around the nucleus in circular revolutions. However the circular motion is said to be accelerated. If we apply this electromagnetic theory to Rutherford's model it means that the electrons revolving around the nucleus will radiate energy continuously at every turn and move closer and closer to the nucleus. To overcome this drawback of Rutherford's model, Neils Bohr

proposed a new model which suggest that electron could revolve around the nucleus in certain fixed circular paths called energy level which have fixed or quantized energy. As long as an electron remains in a particular orbit, it does lose or gain energy.

The names and order of energy levels K, L, M, N or 1, 2, 3, 4 were given by

A. Rutherford

B. Dalton

C. Neils Bohr

D. Chadwick

Answer: C

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15. A major drawback of Rutherford's model of an atom is that it does not explain the stability of the atom. He suggested that electrons are revolving around the nucleus in circular revolutions. However the circular motion is said to be accelerated. If we apply

this electromagnetic theory to Rutherford's model it means that the electrons revolving around the nucleus will radiate energy continuously at every turn and move closer and closer to the nucleus. To overcome this drawback of Rutherford's model, Neils Bohr proposed a new model which suggest that electron could revolve around the nucleus in certain fixed circular paths called energy level which have fixed or quantized energy. As long as an electron remains in a particular orbit, it does lose or gain energy.

The atom remains stable and the electrons do not fall in the nucleus because

A. electrons do not lose or radiate energy in a particular orbit

B. circular motion is not accelerated

C. there is no attraction between electrons and protons

D. there is no space in the nucleus.

Answer: A

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Exercise Subjective Problems Very Short Answer Type

1. What is the absolute mass of the proton?

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2. What will be the charge on an atom with mass number one and atomic number one?

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3. Neutrons can be found in all atomic nuclei except in one case. Which is this atomic nucleus and what does it consist of?

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4. Which fact is proved by the following observation in Rutherford's scattering experiment' very few alpha particles are deflected back'?

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5. Give one important application of Iodine-131 isotope.

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6. What is a valence shell? How many electrons can be present in valence shell?

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7. Why are Bohr orbits called stationary states ?

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8. Why are anode rays also called canal rays?

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9. What does ${}_{18}^{40}Ar$ represent?

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10. What would you conclude from the observation that cathode rays rotate a light paddle wheel placed in their path?

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11. What characteristic feature is seen in the configurations of chemically inactive elements?

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12. Explain why ${}_{1}^{3}H$ and ${}_{2}^{3}He$ are not considered isotopes

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13. Give one similarity and one difference between the isotopes ${}_{6}^{14}C$ and ${}_{6}^{12}C$.

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14. Atomic number is defined in terms of protons and not in terms of electrons. Why?

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15. Name the ratioactive isotopes which is used in the treatment of cancer.

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Exercise Subjective Problems Short Answer Type

1. Justify the statement 'atomic number of an element is equal to the number of electrons in a neutral atom only and not in anion'.

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2. What is the difference between electrovalency and covalency?

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3. What do you understand by ground state and excited state of an atom?

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4. What will be the composition of the nucleus of the atom of an element with atomic number 19 and mass number 39?

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5. A nucleus is represented by ${}_{y}^{2y}X$. Identify the possible elements with such a nucleus.

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6. An element has two electrons in N-shell. Identify the element.

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7. Electronic configuration of a neutral atom 'X' is 2, 8, 6. What is the electronic configuration of X^{-2}?

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8. The atomic species A and B have different number of protons but the same number of nucleons. One the other hand, and atomic species X and Y have the same number of

protons but different number of nucleons. Which pair is an example of isobars ? Why ?

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9. What is electronic configuration of Al^{3+} ?

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10. Given that the percentage abundance of the isotope ${}^{20}_{10}N$ is 90 % and that of the

isotope $._{10}^{22}Ne$ is 10 %, calculate the average atomic mass of neon.

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11. Will ^{35}Cl and ^{37}Cl have different valencies? Justify your answer.

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12. Calculate the mass and charge of l mol of electrons

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13. An isotope of $^{112}_{50}Sn$ contains 68 neutrons. What will be its mass number?

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14. Draw Bohr's model of an atom with three shells. How many electrons L-shell can accommodate?

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15. How will you find the valency of nitrogen, oxygen and fluorine?

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Exercise Subjective Problems Long Answer Type

1. Answer the following:

Are there elements with the same number of electrons, protons and neutrons? Give few examples

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2. An ion M^{3+} contains 10 electrons and 14 neutrons. What are the atomic number and mass number of the element M? Name the element.

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3. Answer the following:

Three invisible radiations X, Y and Z are passed

through on electric field. X was found to be undeviated. Y deviated towards positive end of the electric field and Z towards negative. Identify the particles present in X, Y and Z. What is e/m ratio for X?

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4. Answer the following:

Define valency. How is it calculated for various elements?

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5. State two key points of Bohr's atomic model.

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6. How did Neils Bohr explain the stability of atom?

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7. What are octet and duplet rules? How do elements attain octet?

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8. Explain the formation of a cation. Give its main characteristics.

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9. What are isotones? Give examples.

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10. List some important uses of isotopes.

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Exercise Integer Numerical Value Type

1. An element A has atomic mass 27 and atomic number 13. Its ion is represented by A^{x+}. The value of x is

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2. An ion X^{2-} contains 10 electrons and 8 neutrons. The atomic number of the element X is

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3. In the Gold foil experiment of Geiger and Marsden, that paved the way for Rutherford's model of an atom, - 1.00% of the Cl-particles were found to deflect at angles $> 50^{\circ}$. If one

mole of a particles were bombarded on the gold foil, the number of α-particles that would deflect at angles less than 50° is

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4. The ratio of the radii of hydrogen atom and its nucleus is $\sim 10^{5}$. Assuming the atom and the nucleus to be spherical, the ratio of their sizes is

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5. An element A of valency 2 combines with element B to form a compound with formula A_5B_2. The valency of element B is

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Olympiad Hots Corner

1. Study the table carefully and select the correct statement

A. W is a noble gas.

B. X and Y are cations.

C. U and V are anions.

D. Z is the lightest element while V is the heaviest.

Answer: D

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2. The nucleon number of atom X is 37. It exists as a diatomic molecule, X_2. One molecule of X_2 contains 34 protons. How many neutrons are present in the nucleus of atom X?

A. 17

B. 20

C. 21

D. 25

Answer: B

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3. Consider the following graph of % abundance as mass of lead

The relative atomic mass of lead is

A. 208

B. 207.567

C. 207.302

D. 209

Answer: C

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4. If there are 12 neutrons in an atom and its atomic number is 11. How many protons are present in it?

A. 11

B. 12

C. 23

D. 1

Answer: A

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5. The schematic atomic structures of three elements X, Y and Z are given as:

Which of the following statements is/are incorrect? I. Z can form ZCl_3 and ZCl_5. II. Y exists in monoatomic form. III. X and Z combine to form X_3Z type compound. IV. X and Y combine to form XY_2 type compound.

V. X will gain two electrons to form a stable compound.

A. I and II only

B. I, II and IV only

C. II, IV and V only

D. III, IV and V only

Answer: D

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6. The given table shows the number of protons, neutrons and electrons in atoms or ions. Which atom/ion in the table is an isotope of the atom with the composition of 11 p, 11 e and 14 n?

A. P

B. Q

C. R

D. S

Answer: A

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7. X and Y are the two atomic species :

Select the correct statement about X and Y.

A. X and Y are isobars.

B. X and Y have different chemical properties.

C. X and Y have different physical properties.

D. X and Y are the atoms of different elements.

Answer: C

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8. The atomic masses of two isotopes of chlorine are 35 and 37. The number of neutrons respectively will be

A. 18, 20

B. 20,18

C. 17, 18

D. 18,17

Answer: A

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9. The number of protons, neutrons and electrons in four elements 1, 2, 3 and 4 are as follows:

(1) p = 6, n = 6, e = 6

(2) p = 6, n = 7, e = 6

(3) p = 18, n = 22, e = 18

(4) p = 19, n = 21, e = 19

In these

A. elements I and II are isotopes and elements III and IV are isobars

B. elements I and II are isotopes but elements III and IV are not isobars

C. elements I and II are isobars and element III and IV are isotopes

D. elements I and II are isobars but elements III and IV are not isotopes.

Answer: A

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10. An ion having a mass number 52 has 3 units of positive charge. The number of neutrons in the ion exceeds the number of electrons in it by 7. The atomic number of the element is

A. 28

B. 22

C. 26

D. 24

Answer: D

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11. The number of neutrons in an atom of Na is

A. 23

B. 11

C. 34

D. 12

Answer: D

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12. Element P has 5 electrons in its L shell while Q element has 5 electrons in its M shell. Which of the following statements is correct regarding elements P and Q?

A. Both elements have valency equal to 5 only.

B. Both elements have the same mass number.

C. Atomic number of element P is 7 and that of element Q is 15.

D. Both elements show valency equal to 3 only

Answer: C

Watch Video Solution

13. If there are 12 neutrons in an atom and its atomic number is 11, then how many electrons are present in it?

A. 23

B. 12

C. 10

D. 11

Answer: D

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14. Which one of the following is not isoelectronic with neon atom?

A. ${}_8O^{2-}$

B. ${}_{11}Na(+)$

C. ${}_9F^-$

D. ${}_{12}Mg^+$

Answer: D

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15. Chlorine atom does not differ from the chloride ion in which of the following context?

A. Electron

B. Volume

C. Proton

D. Chemical reactivity

Answer: C

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