Atomic Chemistry Questions with Solutions

Q1. Consider the species ^{72}Zn, ^{75}As and ^{74}Ge. These species have:

(a) the same number of electrons.
(b) the same number of protons.
(c) the same number of neutrons.
(d) the same number of protons and neutrons.

Correct Answer. (c) the same number of neutrons.

Q2. Which model does not able to explain the stability of an atom?

(a) Bohr's Model
(b) Rutherford's Model
(c) Thomson's Model
(d) None of the above

Correct Answer. (b) Rutherford's Model

Q3. Experimentation with cathode-ray led to the discovery of-

(a) electrons
(b) protons
(c) neutrons
(d) nucleus

Correct Answer - (a) electrons

Q4. The principal quantum number describes-

(a) size of the orbital
(b) shape of the orbital
(c) spin of the orbital
(d) orientation of the orbital

Correct Answer - (a) size of the orbital
Explanation - Principal quantum number (n) determines the size of an orbital as- n = 1, 2, 3, 4, … and shells = K, L, M, N, …

Q5. Which of the following quantities can only be a whole number?

(a) Atomic radius
(b) Atomic number
(c) Maa number
(d) Equivalent weight

Correct Answer - (b) Atomic number

Q6. What are nucleons? What is the name given to those atoms which have a same number of nucleons in them?

Answer. A nucleon is a name given to two important subatomic particles: neutrons and protons. ISOBARS is the name given to atoms that have the same number of nucleons.

Q7. How many unpaired electrons are there in a carbon atom in the ground state?

Answer. The electronic configuration of carbon is $1s^2$, $2s^2$, $2p_x^1$, $2p_y^1$. Therefore there are only 2 unpaired electrons in a carbon atom in the ground state.

Q8. What is the minimum number of quantum numbers required to specify an orbital? Name them.

Answer. There are three quantum numbers. These are as follows-

- Principal quantum no. (n)
- Azimuthal quantum No. (l)
- Azimuthal quantum No. (l)

Q9. Describe the important properties of cathode-rays. What is concluded about the nature of these rays?

Answer. The cathode rays have the following characteristics:

- Travel in straight lines perpendicular to the cathode's surface.
- Material particles make up this substance.
- Have got the heating effect.
- It is made up of negatively charged particles.
- When they collide with hard metals such as copper, tungsten, or platinum, they emit X-rays.
- When they strike glass or certain other materials, such as zinc sulphide, they emit fluorescence.
- Permeate thin aluminium foils and other metals.
- Influence the photographic plates

Q10. What is meant by the dual nature of radiation?

Answer. The fact that light energy is carried in the form of energy packets (i.e., photons), as proposed by Planck's theory, indicates that light has a particle character. At the same time, light has a wave-like character. These experimental findings led Einstein to propose that light has a dual nature, that it behaves both as a wave and as a particle.

Q11. An atom of an element has two electrons in the outermost M-shell. State its
(a) Electronic configuration
(b) Number of protons
(c) Atomic number
(d) Nature whether metal or non-metal
(e) Valency
(f) Name of the element.

Answer.
(a) Since the atom has two electrons in the outermost M-shell, the K and L shells are already filled. As a result, the electronic configuration is 2, 8, 2. This means that the number of electrons of the atom is 12.
(b) The number of protons equals the number of electrons. Therefore, the number of protons will be 12.
(c) The atomic number equals the number of protons, which is 12.
(d) A metal. This is due to the fact that metallic elements have valence electrons less than 3.
(e) The element's valency = the number of outermost electrons = 2.
(f) The element in question is magnesium (Mg).

Q12. Explain Bohr and Bury rules for the distribution of electrons into different shells.

Answer.

- The maximum number of electrons that can be present in an atom's energy shell is given by $2n^2$. 'n' denotes the number of energy shells or energy levels.
- According to the first rule, the outermost energy shell in an atom cannot have more than eight electrons, even if it has the capacity to accept more electrons.
- It is not necessary for a given shell to finish before another shell begins to form. In general, a new shell is formed when the outermost shell acquires eight electrons.

Q13. Define atomicity.

Answer. The number of atoms in an element's molecule is referred to as its atomicity.
It is classified as follows:

- Monoatomic molecules: Xenon is an example of a monoatomic molecule (Xe)
- Diatomic molecule: a molecule with two atoms, such as oxygen (O_2).
- Triatomic molecule: a molecule with three atoms, such as ozone (O_3).
- Tetratomic molecule: a molecule with four atoms, such as phosphorus (P_4).
- Polyatomic molecule: a molecule with more than four atoms, such as sulphur (S_8).

Q14. Define the terms
(a) isotope
(b) isobar giving one example in each case.
(c) Name the element whose isotope is used in
(i) nuclear reactor,
(ii) treatment of cancer.

Answer.
(a) The majority of the elements can be found in nature. Some atoms of a given element may have different mass numbers. Their atomic numbers, however, are the same. These are known as isotopes. Isotopes are thus defined as different atoms of the same element with the same atomic number but different mass numbers.
(b) Isobars are atoms from different elements that have the same mass number but different atomic number.
(c)
(i) The U-235 isotope is used as a fuel in nuclear reactors.
(ii) Co-60 isotope is used in cancer treatment.

Q15. Write any five features of Dalton's atomic theory.

Answer. The five features of Dalton's atomic theory are as follows-

- Every substance is made up of extremely small particles known as atoms.
- Atoms are the ultimate matter particles and cannot be subdivided into smaller particles.
- Atoms cannot be created or destroyed during a physical or chemical change.
- All atoms of a given element are identical in every way. This means they have the same mass, size, and chemical properties.
- Different elements' atoms have different masses, sizes, and chemical properties.

Practise Questions on Atomic

Q1. Which of the following quantum numbers determines an electron's spin direction?

(a) n
(b) l
(c) m
(d) s

Correct Answer - (d) s
Explanation - The spin quantum number, denoted by s, represents the direction of the spin of an electron.
If the electron rotates clockwise around the nucleus, then s = +1/2.
If the electron rotates anticlockwise around the nucleus, s = -1/2.

Q2. Name the element which is used as the reference for atomic mass.

(a) Carbon
(b) Oxygen
(c) Helium
(d) Chlorine

Correct Answer- (a) Carbon

Q3. Using s, p, d notations, describe the orbital with the following quantum numbers.
(a) n=1, l=0;
(b) n = 3; l=1;
(c) n = 4; l =2;
(d) n=4; l=3.

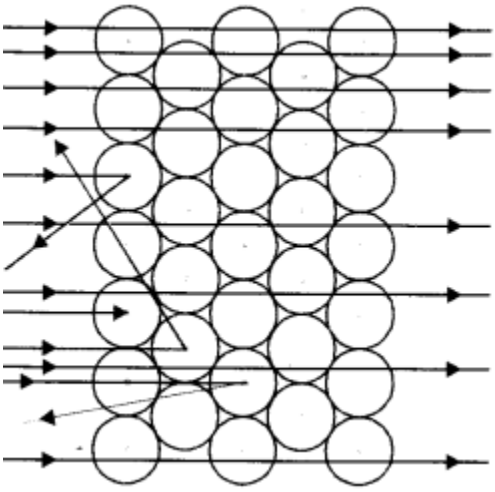
Answer.
n denotes principle shell
L denotes azimuthal quantum number
Therefore, for
s orbital l = 0
p orbital l = 1
d orbital l = 2
f orbital l = 3

The orbital with the quantum numbers listed below is given.
(a) n=1, l=0 will have 1s orbital
(b) n = 3; l=1 will have 3p orbital
(c) n = 4; l =2 will have 4d orbital
(d) n=4; l=3 will have 4f orbital

Q4. An atom has 2 K, 8 L, and 5 M electrons. Write down the atom's electronic configuration. What is the number of unpaired electrons in the atom?

Answer. Total number of electrons will be 2 + 8 + 5 = 15. Therefore, the electronic configuration of the element will be $1s^2$, $2s^2$ $2p^6$ $3s^2$ $3p_x^1$, $3p_y^1$, $3p_z^1$. The number of unpaired electrons in the atom will be 3.

Q5. a) Which popular experiment is shown in the figure?



(b) List three observations of this experiment.
(c) State conclusions drawn from each observation of this experiment.
(d) State the main features of the above experiment.

Answer.
(a) The experiment is Rutherford Model
(b) Observations-

- The majority of the alpha particles passed through the gold foil undeflected.
- Small angles deflected some of these particles.
- A very few alpha particles (one out of approximately 12000) experienced significant deflections and even returned in the same direction.

(c) Conclusions-

- The fact that the majority of the alpha particles passed through undeflected indicates that they did not encounter any obstacles in their path. As a result, the majority of the space in an atom is expected to be empty.
- Because a few alpha particles experienced minor deflections and only a few major deflections, these must have encountered some obstacles along their path.
- This major obstacle must be:
  (i) It was extremely small, obstructing only a few particles.
  (ii) Each alpha particle has a mass of 4u and is quite heavy. It could easily push aside a minor impediment and pass through it.

(d) Main features-

- An atom is made up of two parts. These are the nucleus and the extraneous nuclear portion.
- The nucleus is located in the centre of the atom and is surrounded by extra nuclear material.
- The radius of an atom's nucleus is approximately 10-15m, while the radius of the atom is approximately 10-10m. As a result, the nucleus is very small in comparison to the atom.
- The nucleus accounts for the majority of the atom's mass. The nucleus contains all of the protons and neutrons (later discovered by Chadwick).
- The positive charge on the nucleus is caused by the presence of protons (each proton has one unit positive charge).

- The extra-nuclear space around the nucleus contains all of the electrons.
- The total positive charge of the nucleus due to the presence of protons is equal to the total positive charge of the electrons present in the extra nuclear space. As a result, the atom is electrically neutral as a whole.
- Electrons in the extra nuclear portion of the nucleus are not stationary. These are revolving at high speeds around the nucleus in a circular path.
- The revolving electrons do not approach or are drawn to the nucleus because their force of attraction towards the nucleus is balanced by the same magnitude centrifugal force. It's aimed away from the nucleus.