PRACTICE PAPER 09 (2024-25)

CHAPTER 03 ATOMS AND MOLECULES (ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : IX **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. A change in the physical state can be brought about:
(a) Only when energy is given to the system.
(b) Only when energy is taken out from the system.
(c) When energy is either given to or taken out from the system.
(d) Without any energy change.
Ans. (c) When energy is either given to or taken out from the system.
A change in the physical state can be brought about when energy is either given to or taken out from the system. It is only because the change in energy causes the changes in attraction forces between the particles, thus helping in changing the physical state, i.e., solid, liquid and gas state of matter.

2. An ionic compound will be formed by the combination of one of the following pairs of elements. This pair of elements is:
(a) Barium and Oxygen
(b) Sulphur and Carbon
(c) Hydrogen and hydrogen
(d) Chlorine and chlorine
Ans. (a) Barium and Oxygen
Ionic compounds are made up of ions kept together by the attraction of oppositely charged ions. The positive and negative ions in ionic compounds combine together. Barium oxide molecule is formed by one barium cation Ba2+ and one oxide anion O2–. Both ions are bound by one ionic bond.

3. Which of the following are incorrect for the mass of products in a chemical reaction?
(I) Mass of reactants is more than the mass of products in a chemical reaction.
(II) Mass of reactants or products can neither be created nor be destroyed.
(III) Mass of reactants before reaction is equal to the mass of products after reaction.
(IV) Mass of reactants decreases during reaction.
Options:
(a) (I) and (II) (b) (II) and (III) (c) (III) and (IV) (d) (I) and (IV)
Ans. (d) (I) and (IV)
According to the law of conservation of mass, mass of reactants is always equal to the mass of products before or after the reaction.

4. Which of the following is correct statement ?
(a) Na_2S is Sodium sulphide, Na_2SO_3 is Sodium sulphite and Na_2SO_4 is Sodium sulphate.
(b) Na_2S is Sodium sulphite, Na_2SO_3 is Sodium sulphide and Na_2SO_4 is Sodium sulphate.

(c) Na_2S is Sodium sulphite, Na_2SO_3 is Sodium sulphate and Na_2SO_4 is Sodium sulphide
(d) Na_2S is Sodium sulphide, Na_2SO_3 is Sodium sulphate and Na_2SO_4 is Sodium thiosulphate.
Ans. (a) Na_2S is Sodium sulphide, Na_2SO_3 is Sodium sulphite and Na_2SO_4 is Sodium sulphate.

5. Which of the following statements is false about an atom?
(a) Atoms are not able to exist independently.
(b) Atoms are the basic units from which molecules and ions are formed.
(c) Atoms are always neutral in nature.
(d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch.
Ans. (a) Atoms are not able to exist independently.
Atoms of most of the elements cannot exist independently as they are very reactive. They react to form more stable substances such as ions or molecules.

6. An ion with 13 protons, 14 neutrons, and a charge of 3+ has an atomic number of:
(a) 10 (b) 13 (c) 14 (d) 27
Ans. (b) 13
An ion has +3 charge which is formed by losing 3 electrons and this ion has 10 electrons

$$A \rightarrow A^{3+} + 3e^-$$

We know an atom is neutral, which means it has 13 electrons as the number of protons are 13 and the atomic number is the number of protons.

7. The mass of a molecule is defined as:
(a) When comparing the mass of one molecule of any material to the mass of one atom of C–12.
(b) One atom's mass in comparison to a hydrogen atom's mass.
(c) Mass of a molecule compared to mass of an atom.
(d) All of the above
Ans. (a) When comparing the mass of one molecule of any material to the mass of one atom of C–12.
Mass of one molecule of any substance compared with the mass of one atom of C–12. The mass of a molecule equals the total of the masses of all the atoms in the molecule. It is used for those substances whose constituent particles are molecules.

8. From the following elements ozone, sulphur, argon and phosphorus, which has the highest and lowest atomicities?
(a) Ozone and Sulphur
(b) Phosphorus and Argon
(c) Sulphur and Argon
(d) Sulphur and Phosphorus
Ans. (c) Sulphur and Argon
The atomicity of ozone, sulphur, phosphorus and argon are 3, 8, 4 and 1 respectively.
Hence, highest atomicity out of the four elements is of Sulphur and lowest atomicity is of Argon.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. **Assertion (A):** An atom is the smallest particle in an element that possesses the element's properties.
Reason (R): Molecules are made up of two or more atoms.
Ans. (b) Both A and R are true and R is not the correct explanation of A.

Assertion and reason are the postulates of Dalton's Atomic Theory. An atom is the smallest particle in an element with all of the element's attributes. Molecules are made up of two or more atoms joined together. Molecules, unlike atoms, can be sub-divided into individual atoms.

10. Assertion (A): Nitrogen has an atomic mass of 14.
Reason (R): Nitrogen atoms are 14 times heavier than carbon-12 atoms of the same mass.
Ans. (a) Both A and R are true and R is the correct explanation of A.
The atomic mass of an element indicates how many times an atom of that element is heavier than a C-12 atom.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. (a) Define atomic mass unit.
(b) Distinguish between molecular mass and molar mass.
Ans. (a) It is defined as $\frac{1}{12}$th of the mass of 1 atom of C-12.
(b) Molecular mass is the mass of 1 molecule.
Molar mass is the mass of 6.022×10^{23} molecules.

12. Define atomicity. Give an example of each of monoatomic, diatomic, tetra-atomic and polyatomic molecules.
Ans. Atomicity is defined as number of atoms present in a molecule. He is monoatomic, H_2 is diatomic, P_4 is tetra-atomic and S_8 is polyatomic molecules.

13. Ravi prepared a solution of sodium chloride by mixing 5.85 g of salt in 1 litre of water. Find
(a) Molar mass of sodium chloride.
(b) Number of moles of sodium chloride dissolved.
[Atomic masses of sodium and chlorine are 23 u and 35.5 u respectively].
Ans. (a) Molar mass of NaCl = 23 + 35.5 = 58.5 g mol^{-1}
(b) Number of moles of NaCl = $\frac{\text{Mass of NaCl}}{\text{Molar mass of NaCl}} = \frac{5.85}{58.5} = 0.1\ mol$

OR

(a) Define polyatomic ion.
(b) Write the name of the compound $(NH_4)_2SO_4$ and mention the ions present in it.
Ans. (a) The ion which contains two or more than two atoms is called polyatomic ion, e.g. CO_3^{2-}, NH_4^+ are polyatomic ions.
(b) Ammonium sulphate. NH_4^+ and SO_4^{2-} ions are present in it.

14. An element 'X' forms an oxide with formula X_2O_3
(a) State the valency of X.
(b) Write the formula of (i) chloride of X, (ii) sulphate of X.
Ans. (a) Those ions which contain two or more than two atoms are called polyatomic ions.

(b) (i) Fe^{3+} SO_4^{2-} → $Fe_2(SO_4)_3$ Iron(III) sulphate

(ii) NH_4^+ CO_3^{2-} → $(NH_4)_2CO_3$ Ammonium carbonate

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. The percentage of three elements, calcium, carbon and oxygen in a sample of calcium carbonate is given as: Calcium = 40%; Carbon = 12%; Oxygen = 48%.

If the law of constant proportion is true, what weights of these elements will be present in 1.5 g of another sample of calcium carbonate? [Atomic mass of Ca = 40 u, C = 12 u, O = 16 u]
Ans.
The other compound will also contains the same percentage of elements.
Ca = 40%, C = 12% and O = 48%
100 g of $CaCO_3$ contains 40 g of Ca.

1.5 g of $CaCO_3$ contains $\frac{40}{100} \times 1.5 = 0.6$ g of calcium.

100 g of $CaCO_3$ contains 12 g of carbon.

1.5 g of $CaCO_3$ contains $\frac{12}{100} \times 1.5 = 0.18$ g of carbon.

Also, 100 g of $CaCO_3$ contains 48 g of oxygen.

1.5 g of $CaCO_3$ contains $\frac{48}{100} \times 1.5 = 0.72$ g of oxygen.

16. Write the formulae of (a) Magnesium hydroxide (b) Hydrogen sulphide (c) Potassium chloride (d) Calcium oxide (e) Barium chloride (f) Sodium carbonate
Ans.

(*a*) $Mg^{2+}\ OH^-$ → $Mg(OH)_2$

(*b*) $H^+\ S^{2-}$ → H_2S

(*c*) $K^+\ Cl^-$ → KCl

(*d*) $Ca^{2+}\ O^{2-}$ → CaO

(*e*) $Ba^{2+}\ Cl^-$ → $BaCl_2$

(*f*) $Na^+\ CO_3^{2-}$ → Na_2CO_3

17. (a) Define the term mole.
(b) Calculate the no. of
(i) atoms
(ii) molecules in 124 grams of phosphorus, P_4
[Given atomic mass of P = 31.0 u, $N_A = 6.023 \times 10^{23}\ mol^{-1}$]
Ans. (a) Mole is defined as counting unit and is equal to 6.022×10^{23} particles.

(*b*) (*i*) $$\text{No. of atoms} = \frac{\text{Mass of phosphorus}}{\text{Molar mass of phosphorus}} \times \text{Atomicity} \times 6.022 \times 10^{23}$$

$$= \frac{124}{124} \times 4 \times 6.022 \times 10^{23}$$

$$= 24.088 \times 10^{23} = 2.4088 \times 10^{24} \text{ atoms}$$

(*ii*) $$\text{No. of molecules} = \frac{\text{Mass of phosphorus}}{\text{Molar mass}}$$

$$= \frac{124}{124} \times 6.022 \times 10^{23} = 6.022 \times 10^{23} \text{ molecules}$$

OR

(a) Define one mole. How is it related to Avogadro's constant.
(b) Find the number of sodium ion in one mole of sodium sulphate.
Ans. (a) 1 mole is defined as equal to 6.022×10^{23} particles. It is also equal to molar mass in grams.
1 mole = Avogadro's constant = 6.022×10^{23}
(b) 1 mole of Na_2SO_4 contains 2 moles of Na^+
2 moles of $Na^+ = 2 \times 6.022 \times 10^{23} = 12.044 \times 10^{23} = 1.2044 \times 10^{24}$ Na^+ ions.

SECTION – D

Questions 18 carry 5 marks each.

18. (a) Calculate the number of oxygen atoms in 0.10 mole of $Na_2CO_3.10H_2O$.
(b) If one mole of sulphur weighs 32 grams, what is the mass (in grams) of 1 atom of sulphur?
(c) Identify the correct formula for ammonium sulphate from the following formula:
$(NH_4)(SO_4)_3$,$(NH_4)_2SO_4$,$NH_4(SO_4)_2$

Ans. (a) 1 mole of $Na_2CO_3.10H_2O$ contains $13 \times 6.022 \times 10^{23}$ atoms of oxygen
0.10 moles of $Na_2CO_3.10H_2O$ will contain = $0.10 \times 13 \times 6.022 \times 10^{23}$
$= 7.83 \times 10^{23}$ oxygen atoms.

(b) 1 mole of sulphur = 32 g
Also 1 mole of sulphur = 6.022×10^{23} atoms
Now, 6.022×10^{23} atoms of sulphur weigh = 32 g

1 atom of sulphur weighs = $\frac{32}{6.022 \times 10^{23}} g = 5.31 \times 10^{-23}$ g

(c) $(NH_4)_2SO_4$

OR

(a) Write chemical formulae of all the compounds that can be formed by the combination of the following ions: Ca^{2+}, K^+, Fe^{3+}, Cl^-, SO_4^{2-}

(b) Molar mass of nitrogen is 14u. What will be the mass of one atom of nitrogen in grams?

Ans.

(a) $Ca^{2+}\ Cl^- \rightarrow CaCl_2$; $Ca^{2+}\ SO_4^{2-} \rightarrow CaSO_4$; $K^+\ Cl^- \rightarrow KCl$; $K^+\ SO_4^{2-} \rightarrow K_2SO_4$; $Fe^{3+}\ Cl^- \rightarrow FeCl_3$; $Fe^{3+}\ SO_4^{2-} \rightarrow Fe_2(SO_4)_3$

(b) 1 mole of nitrogen atoms = 14 g
1 mole of nitrogen atoms = 6.022×10^{23} atoms
6.022×10^{23} atoms of nitrogen weigh = 14 g

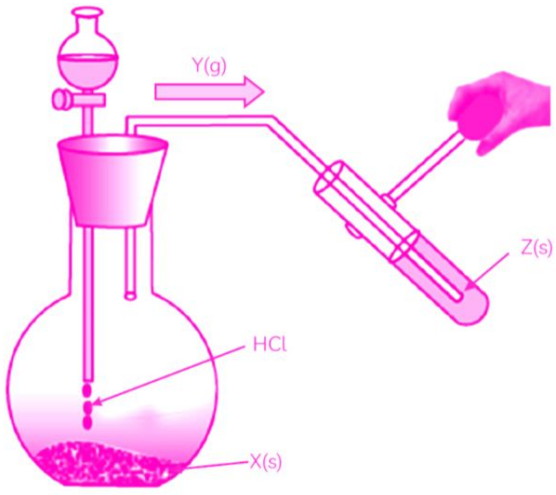
1 atom of nitrogen weighs = $\frac{14}{6.022 \times 10^{23}} g = 2.324 \times 10^{-23}$ g

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the following information and answer the questions based on information and related studied concepts.

House flooring is usually made from one of the forms of the naturally occurring solid compound X. Brisk effervescence is produced when a few drops of weak hydrochloric acid are added to X. When 60 grams of reactant X were heated rapidly, 32 grams of gas Y and 28 grams of solid Z were formed as products. When dilute HCl is added to X, gas Y exhibits a rapid effervescence. Solid Z is utilised for whitewashing, while gas Y causes global warming.



(a) Name X (solid), Y (gas) and Z (solid).
(b) From 60 grams of X, what is the total mass of Y and Z?
(c) What mass of sodium sulphate solution will react with 5.85 g of barium chloride solution to produce 14.35 g of precipitates of barium sulphate and 8.5 g of sodium chloride solution if the law of conservation of mass is true?
Ans: (a) Solid X is the Calcium Carbonate ($CaCO_3$) used for house flooring.
Gas Y is Carbon dioxide (CO_2) which causes global warming.
Solid Z is Calcium Oxide (CaO) is used to whitewash the house.
(b) Y and Z are formed when 60 g of reactant X is heated. The law of conservation of mass states that the same quantity of Y and X will be produced. As a result, heating 60 g of X will yield 60 g of Y and Z.
(c) The reaction is:
Sodium sulphate + Barium chloride → Barium sulphate + Sodium chloride
If the law of conservation of mass is true,
Total mass of reactants = Total mass of products + Mass of reactants
RHS = Mass of Barium sulphate + Mass of sodium chloride
14.35 + 8.5 = 22.85 g
LHS X + 5.85
Mass of reactants = Mass of products
X + 5.85 = 22.85
X = 22.85 – 5.85 = 17.0 g
∴ Mass of sodium sulphate = 17.0 g.

20. Read the given passage and answer the questions that follow based on the passage and related studied concepts.
Several natural sources yield a liquid chemical X with a molecular mass of 18 amu. Liquid X is required for the life of all creatures and plants. When an electric current is carried through 100 grams of pure liquid X, 78 grams of gas Y and 22 grams of gas Z are created under ideal conditions. The positive electrode produces gas Y, while the negative electrode produces gas Z. Furthermore, gas Y promotes combustion, whereas gas Z self-combusts, resulting in explosions.

(a) Name the following: (i) Liquid X (ii) Gas Y (iii) Gas Z
(b) Write the balanced equation of liquid X when electrolysis is done.
(c) Calculate the molecular mass of gas Y and gas Z.
Ans. (a) When an electric current is passed through liquid X, it produces two elements Y and Z.
X → Y + Z
Molar mass of liquid X is 18 amu and it is essential for living things for survival. Hence, compound liquid X is water molecule (H_2O).
When electrolysis is done, it produces gases O_2 and H_2. Oxygen gas is produced on the positive electrode and hydrogen gas is produced on the negative electrode. Hence, gas Y is oxygen and Z is hydrogen gas.

(b) Balanced equation after electricity is passed

$2H_2O \rightarrow 2H_2 + O_2$

Hydrogen burns itself, generating explosions, whereas oxygen helps in combustion.

(c) Gas Y is oxygen and gas Z is hydrogen.

Molecular mass of Y (oxygen):

∴ Atomic mass of oxygen = 16 u

∴ Formula of oxygen gas = O_2

∴ Molecular mass of $O_2 = 2 \times 16 = 32$ u

Molecular mass of Z (hydrogen):

∴ Atomic mass of hydrogen = 1 u

∴ Formula of Hydrogen gas = H_2

∴ Molecular mass of $H_2 = 2 \times 1 = 2$ u