OSDAV Public School Kaithal
Subject: Chemistry(043)
May Unit Test(2025-26)
Class: XI
Set-A

Time: 1:30 Hours **M.M.:35**

General Instructions:-

All questions are compulsory.

(a) There are 18 questions in this question paper.

(b) SECTION A consists of 8 multiple -choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 4short answer questions carrying 3 marks each.

(e) SECTION Dconsists of 1 long answer questions carrying 5 marks each.

(f) All questions are compulsory.

(g) Use of log tables and calculators is not allowed.

SECTION-A

Q.No.	Questions	Marks
1.	The no.of significant figures in π are? a. 1 b. 2. c 3. d Infinite	1
2.	What is the mass percent of H in Methane(CH4)? a. 0.034%. b.25.00 %. c.23.4%. d.28.7%	1
3	**Which of the following terms is temperature dependent** **a.Molarity. b.Molality. c. Mass % (w/w%) d.Mole fraction**	
4.	Which of the following properties of atom could be explained correctly by Thomson model of atom? a.Overall neutrality of atom. b.Spectra of Hydrogen atom. c.Stability of atom. d.Position of electrons ,protons and neutrons in atom.	1
5	Which of the following statement about the electron is incorrect? a.It carries negative charge. b.It is constituent of cathode rays c. Its mass is equal to that of Hydrogen atom d. It is present in each atom	
6	In the following questions (5 to6) a statement of Assertion (**A**) followed by a statement of Reason (**R**) is given. Choose the correct answer out 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 but R is not the correct explanation of A. c.A is true but R is false. d.A is false but R is true. **Assertion:** One atomic mass unit is a defined as 1/12 th of the mass of one carbon-12 atom. **Reason:** carbon 12 isotope is the most abundant isotope of carbon and has been chosen as a standard**.**	1
7	**Assertion:** Combustion of 16g of methane gives 18g of water. Reason: in the combustion of methane water is one of the products.	
8	**Assertion:** Anode rays are also called canal rays. **Reason:** Particles present in anode ray flow like water in a canal.	1
	SECTION-B	
9	State law of Multiple proportions. Explain it with one example.	1+1
10	What are the limitations of dalton atomic theory?	1+1

11	How many moles of methane are required to produce 88 g CO_2 after combustion	**2**
12	In one discharge tube, hydrogen gas is taken and in other Oxygen gas is taken. Will the electrons and positive ions in the cathode rays and in the anode rays be same or different? Give reason for your answer.	**1+1**
13	What are the conclusions of Rutherford scattering experiment?	**2**
	SECTION-C	
14	An inorganic salt gave the following percentage composition: Na=29.11, S=40.51 and O= 30.38 Calculate its empirical formula of the salt.	**3**
15	The density of 3 M solution of NaCl is 1.25 g/ml.Calculate the molality of solution and mole fraction of NaCl in solution.	**2+1**
16	How is mole related to: (a) Number of atoms/ molecules. (b) Mass of the substance (c) Volume of gaseous substance.	**1+1+1**
17	Write down any three properties of Cathode Rays and anode rays.	**3**
	SECTION-D	
18(a)	Calculate the number of atoms present in: (i) 52u of He (ii) 52 g of He	**1+1**
18(b)	2000g of N2 and 1000g of H2 are mixed to produce NH3.Calculate the mass of NH3 formed. Identify the limiting reagent in the production of NH3 in this situation.Calculate the amount of the reactant left unreacted.	**1+1+1**

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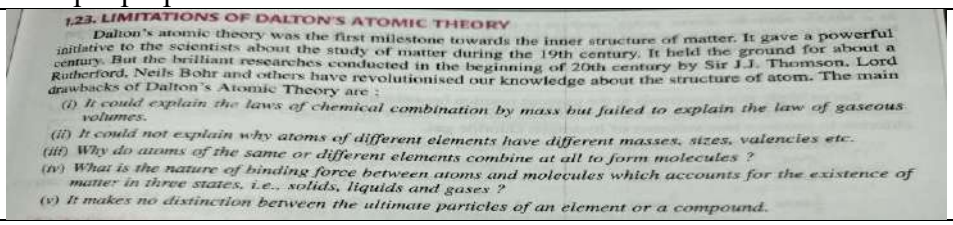
SECTION-A

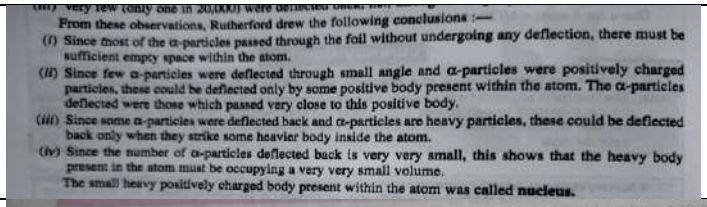
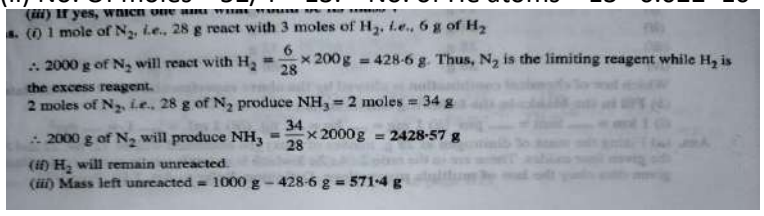
Q.No.	Questions	Marks
1.	The no.of significant figures in 0.0025 are? a. 1 b. 2. c 3. d Infinite	1
2.	What is the mass percent of carbon in Glucose($C_6H_6O_6$)? a. 25%. b.35.00 %. c.40%. d. 45%	1
3	Which of the following terms is temperature independent? a.Molarity. b.Strength c. Normality d.Mole fraction	1
4.	Which of the following feature of atom is not a direct result of Rutherford 's experiment? a. Extraordinary hollow nature of atom. b. Existence of circular electronic orbits. c. Small size of the nucleus. d. Exceptionally high density of the nucleus.	1
5	The number of water molecules is maximum in a.18g of water b. 18u of water c. 1.5 moles d. 2moles of water	1
6	In the following questions (6 to8) a statement of Assertion (**A**) followed by a statement of Reason (**R**) is given. Choose the correct answer out 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 but R is not the correct explanation of A. c.A is true but R is false. d.A is false but R is true. **Assertion:**The properties of a compound are same as those of its constituents**.** **Reason:** A compound is always made up of the same elements combined together in a fixed ratio by mass.	1
7	**Assertion:** The amount of the product formed in a reaction depends on the amount of limiting reactant**.** Reason: limiting rectant is consumed completely in the reaction.	
8	**Assertion:** Anode rays are also called canal rays. **Reason:** Particles present in anode ray flow like water in a canal.	1
	SECTION-B	
9	State law of Definite proportions. Explain it with one example.	1+1
10	Write down main postulates of Dalton's atomic theory.	1+1

11	How many moles of methane are required to produce 88 g CO_2 after combustion	**2**
12	In one discharge tube, hydrogen gas is taken and in other Oxygen gas is taken. Will the electrons and positive ions in the cathode rays and in the anode rays be same or different? Give reason for your answer.	**1+1**
13	What are the observations of Rutherford scattering experiment?	**2**
	SECTION-C	
14	A compound contain 4.07% hydrogen ,24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g.What are its empirical and molecular formulas?	**2+1**
15	Calculate the concentration of nitric acid in moles per litre in a sample which has a density 1.41g/ml and mass percent of nitric acid in itbeing 69%.	**3**
16	How is mole related to: (a) Number of atoms/ molecules. (b) Mass of the substance (c) Volume of gaseous substance.	**1+1+1**
17	Write down any three properties of Cathode Rays and anode rays.	**3**
	SECTION-D	
18(a)	Calculate the mass percent of different elements present in sodium sulphate (Na2SO4).	**2**
18(b)	2000g of N2 and 1000g of H2 are mixed to produce NH3.Calculate the mass of NH3 formed. Identify the limiting reagent in the production of NH3 in this situation.Calculate the amount of the reactant left unreacted.	**1+1+1**

OSDAV Public School, Kaithal
Marking Scheme
May Unit Test(2025-26)
Subject: CHEMISTRY(043)
Class:XI

SET-A

1	**d**	**1**
2	b	1
3	a	1
4	a	1
5	c	
6	b	1
7	d	1
8.	c	1
9	The law of multiple proportions states that if two elements combine to form more than one compound, the different masses of one element that combine with a fixed mass of the other element will be in a simple whole-number ratio to each other. For example, consider the compounds carbon monoxide (CO) and carbon dioxide (CO_2). In carbon monoxide, 12 grams of carbon combine with 16 grams of oxygen. In carbon dioxide, 12 grams of carbon combine with 32 grams of oxygen. The ratio of the masses of oxygen that combine with a fixed mass of carbon (12 grams) is 16:32, which simplifies to 1:2. This simple whole-number ratio illustrates the law of multiple proportions.	1 1
10	 1.23. LIMITATIONS OF DALTON'S ATOMIC THEORY Dalton's atomic theory was the first milestone towards the inner structure of matter. It gave a powerful initiative to the scientists about the study of matter during the 19th century. It held the ground for about a century. But the brilliant researches conducted in the beginning of 20th century by Sir J.J. Thomson, Lord Rutherford, Neils Bohr and others have revolutionised our knowledge about the structure of atom. The main drawbacks of Dalton's Atomic Theory are : (i) It could explain the laws of chemical combination by mass but failed to explain the law of gaseous volumes. (ii) It could not explain why atoms of different elements have different masses, sizes, valencies etc. (iii) Why do atoms of the same or different elements combine at all to form molecules ? (iv) What is the nature of binding force between atoms and molecules which accounts for the existence of matter in three states, i.e., solids, liquids and gases ? (v) It makes no distinction between the ultimate particles of an element or a compound.	2
11	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ 44g of CO_2 requires 16g of CH_4. 88g of CO_2 requires? = 88 x 16/44 = 32g of CH_4 = 2 mole of methane.	1+1
12	In cathode rays, the electrons will be the same, regardless of the gas used in the discharge tube. However, the positive ions in anode rays will be different, depending on the gas used. Reasoning: Cathode Rays: Cathode rays consist of electrons, and the electrons originate from the cathode material. The nature of the gas used in the discharge tube does not affect the source of electrons. Anode Rays: Anode rays are formed by the ionization of the gas molecules in the discharge tube. When a high potential difference is applied, the gas molecules are ionized, and the positively charged ions (like hydrogen ions for hydrogen gas and oxygen ions for oxygen gas) are attracted towards the negative electrode (cathode). The type of gas in the discharge tube dictates the type of positive ions produced in anode rays.	1+1

13	 From these observations, Rutherford drew the following conclusions :— (*i*) Since most of the α-particles passed through the foil without undergoing any deflection, there must be sufficient empty space within the atom. (*ii*) Since few α-particles were deflected through small angle and α-particles were positively charged particles, these could be deflected only by some positive body present within the atom. The α-particles deflected were those which passed very close to this positive body. (*iii*) Since some α-particles were deflected back and α-particles are heavy particles, these could be deflected back only when they strike some heavier body inside the atom. (*iv*) Since the number of α-particles deflected back is very very small, this shows that the heavy body present in the atom must be occupying a very very small volume. The small heavy positively charged body present within the atom was called **nucleus.**	2
14	**Sample Problem 1** An inorganic salt gave the following percentage composition : Na = 29·11, S = 40·51 and O = 30·38 **Calculate the empirical formula of the salt.** **Solution.** Calculation of empirical formula **Element** / **Symbol** / **Percentage of element** / **At. mass of element** / **Moles of the element = Percentage / At. mass (Relative no. of moles)** / **Simplest molar ratio** / **Simplest whole no. molar ratio** Sodium / Na / 29·11 / 23 / $\frac{29·11}{23} = 1·266$ / $\frac{1·266}{1·266} = 1$ / 2 Sulphur / S / 40·51 / 32 / $\frac{40·51}{32} = 1·266$ / $\frac{1·266}{1·266} = 1$ / 2 Oxygen / O / 30·38 / 16 / $\frac{30·38}{16} = 1·897$ / $\frac{1·89}{1·266} = 1·5$ / 3 Thus, the Empirical Formula is $Na_2S_2O_3$.	1 1 1
15	**Solution.** Molality = $\frac{\text{Moles of the solute}}{\text{Mass of the solvent in kg}}$ 3 M NaCl solution means that 3 moles of NaCl are present in 1 L of the solution. Mass of 1 L, *i.e.*, 1000 mL of the solution = Volume × Density = 1000 mL × 1·25 g mL^{-1} = 1250 g Mass of 3 moles of solute (NaCl) = 3 mol × 58·5 g mol^{-1} = 175·5 g ∴ Mass of solvent = 1250 − 175·5 g = 1074·5 g = 1·0745 kg ∴ Molality of the solution = $\frac{3\,\text{mol}}{1·0745\,\text{kg}}$ = 2·79 mol kg^{-1} = 2·79 m	1 1 1
16	A mole is a unit that relates the number of particles (atoms or molecules) in a substance to its mass and volume. Specifically, one mole contains 6.022 × 10^{23} particles (Avogadro's number). It's also directly linked to the molar mass (grams per mole) of a substance and the volume it occupies at standard temperature and pressure (STP).	1 1 1
17	Cathode Rays: 1. Negative Charge: Cathode rays consist of negatively charged particles, which are now known as electrons. 2. Straight Line Trajectory: They travel in straight lines, creating sharp shadows when an object is placed in their path. 3. Deflection by Electric and Magnetic Fields: Cathode rays are deflected by electric and magnetic fields, bending towards the positive electrode in an electric field. Anode Rays: 1. Positive Charge: Anode rays consist of positively charged particles, typically ions of the gas in the tube. 2. Deflection by Electric and Magnetic Fields: Anode rays are deflected by electric and magnetic fields, bending towards the negative electrode in an electric field. 3. Slower Speed: Anode rays travel at a slower speed compared to cathode rays.	1 1 1 1
18	(a) (i)Divide the total mass of helium by the atomic mass of helium: 52/4 = 13 Atoms (ii) No. Of moles = 52/4 = 13. No. of He atoms = 13× 6.022×10^23 (b)  (*i*) 1 mole of N_2, *i.e.*, 28 g react with 3 moles of H_2, *i.e.*, 6 g of H_2 ∴ 2000 g of N_2 will react with $H_2 = \frac{6}{28} \times 200\,g = 428·6$ g. Thus, N_2 is the limiting reagent while H_2 is the excess reagent. 2 moles of N_2, *i.e.*, 28 g of N_2 produce NH_3 = 2 moles = 34 g ∴ 2000 g of N_2 will produce $NH_3 = \frac{34}{28} \times 2000\,g$ = **2428·57 g** (*ii*) H_2 will remain unreacted. (*iii*) Mass left unreacted = 1000 g − 428·6 g = **571·4 g**	11 1 1 1 1 1

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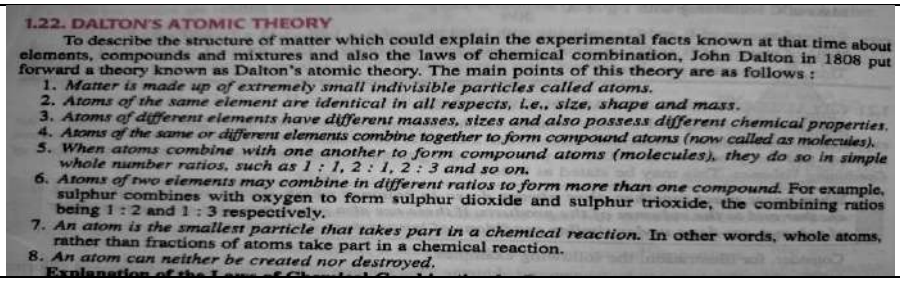
SET-B

1	**b**	**1**
2	c	1
3	d	1
4	b	1
5	d	1
6	d	1
7	a	1
8.	c	1
9	In simpler terms, a pure chemical compound will always have the same elemental composition by mass, regardless of its origin or how it was produced. For example, water (H_2O) will always contain hydrogen and oxygen in a 1:8 ratio by mass.	1 1
10	 **1.22. DALTON'S ATOMIC THEORY** To describe the structure of matter which could explain the experimental facts known at that time about elements, compounds and mixtures and also the laws of chemical combination, John Dalton in 1808 put forward a theory known as Dalton's atomic theory. The main points of this theory are as follows : 1. *Matter is made up of extremely small indivisible particles called atoms.* 2. *Atoms of the same element are identical in all respects, i.e., size, shape and mass.* 3. *Atoms of different elements have different masses, sizes and also possess different chemical properties.* 4. *Atoms of the same or different elements combine together to form compound atoms (now called as molecules).* 5. *When atoms combine with one another to form compound atoms (molecules), they do so in simple whole number ratios, such as 1 : 1, 2 : 1, 2 : 3 and so on.* 6. *Atoms of two elements may combine in different ratios to form more than one compound.* For example, sulphur combines with oxygen to form sulphur dioxide and sulphur trioxide, the combining ratios being 1 : 2 and 1 : 3 respectively. 7. *An atom is the smallest particle that takes part in a chemical reaction.* In other words, whole atoms, rather than fractions of atoms take part in a chemical reaction. 8. *An atom can neither be created nor destroyed.*	2
11	$CH4(g) + 2O2(g) \rightarrow CO2(g) + 2H2O(g)$ 44g of CO2 requires 16g of CH4. 88g of CO2 requires? = 88 x 16/44 = 32g of CH4 = 2 mole of methane.	1+1
12	In cathode rays, the electrons will be the same, regardless of the gas used in the discharge tube. However, the positive ions in anode rays will be different, depending on the gas used. Reasoning: Cathode Rays: Cathode rays consist of electrons, and the electrons originate from the cathode material. The nature of the gas used in the discharge tube does not affect the source of electrons. Anode Rays: Anode rays are formed by the ionization of the gas molecules in the discharge tube. When a high potential difference is applied, the gas molecules are ionized, and the positively charged ions (like hydrogen ions for hydrogen gas and oxygen ions for oxygen gas) are attracted towards the negative electrode (cathode). The type of gas in the discharge tube dictates the type of positive ions produced in anode rays.	1+1
13	Most particles passed straight through. Some particles were deflected. Very few particles bounced back.	2

14	**Solution. Step 1.** *To calculate the empirical formula* **Element** | **Symbol** | **Percentage of element** | **At. mass of element** | **Moles of element = Percentage / At. mass (Relative no. of moles)** | **Simplest molar ratio** | **Simplest whole no. molar ratio** Carbon | C | 24·27 | 12 | $\frac{24·27}{12} = 2·02$ | $\frac{2·02}{2·02} = 1$ | 1 Hydrogen | H | 4·07 | 1 | $\frac{4·07}{1} = 4·07$ | $\frac{4·07}{2·02} = 2$ | 2 Chlorine | Cl | 71·65 | 35·5 | $\frac{71·65}{35·5} = 2·02$ | $\frac{2·02}{2·02} = 1$ | 1 Hence, the empirical formula of the compound is CH_2Cl **Step 2.** *Calculation of empirical formula mass* E.F. mass of $CH_2Cl = 12 + 2 \times 1 + 35·5 = 49·5$ **Step 3.** *Calculation of value of n* $n = \frac{\text{Molecular mass}}{\text{E.F. mass}} = \frac{98·96}{49·5} = 2$ **Step 4.** *Calculation of molecular formula* Molecular formula $= n \times$ E.F. $= 2 \times (CH_2Cl) = \mathbf{C_2H_4Cl_2}$	1 1 1
15	**Ans.** Mass percent of 69% means that 100 g of nitric acid solution contain 69 g of nitric acid by mass. Molar mass of nitric acid (HNO_3) = 1 + 14 + 48 = 63 g mol^{-1} $\therefore$ Moles in 69 g $HNO_3 = \frac{69\text{ g}}{63\text{ g mol}^{-1}} = 1·095$ mole Volume of 100 g nitric acid solution $= \frac{100\text{ g}}{1·41\text{ g mL}^{-1}} = 70·92$ mL $= 0·07092$ L $\therefore$ Conc. of HNO_3 in moles per litre $= \frac{1·095\text{ mole}}{0·07092\text{ L}} = 15·44$ M	1 1 1
16	A mole is a unit that relates the number of particles (atoms or molecules) in a substance to its mass and volume. Specifically, one mole contains 6.022×10^{23} particles (Avogadro's number). It's also directly linked to the molar mass (grams per mole) of a substance and the volume it occupies at standard temperature and pressure (STP).	1 1 1
17	Cathode Rays: 1. Negative Charge: Cathode rays consist of negatively charged particles, which are now known as electrons. 2. Straight Line Trajectory: They travel in straight lines, creating sharp shadows when an object is placed in their path. 3. Deflection by Electric and Magnetic Fields: Cathode rays are deflected by electric and magnetic fields, bending towards the positive electrode in an electric field. Anode Rays: 1. Positive Charge: Anode rays consist of positively charged particles, typically ions of the gas in the tube. 2. Deflection by Electric and Magnetic Fields: Anode rays are deflected by electric and magnetic fields, bending towards the negative electrode in an electric field. 3. Slower Speed: Anode rays travel at a slower speed compared to cathode rays.	1 1 1
18	(a)1 Molar mass of Na_2SO_4: Calculate the molar mass by adding the atomic masses of each element: 2(23.0) + 32.0 + 4(16.0) = 142.0 g/mol. 2. Mass percent of sodium (Na): (Mass of Na in Na_2SO_4 / Molar mass of Na_2SO_4) * 100 = (46.0 / 142.0) * 100 = 32.39%. 3. Mass percent of sulfur (S): (Mass of S in Na_2SO_4 / Molar mass of Na_2SO_4) * 100 = (32.0 / 142.0) * 100 = 22.54%. 4. Mass percent of oxygen (O): (Mass of O in Na_2SO_4 / Molar mass of Na_2SO_4) * 100 = (64.0 / 142.0) * 100 = 45.07%.	1/2 1/2 1/2 1/2 1

	(b)	(*iii*) If yes, which one and what would be its mass ? (*i*) 1 mole of N_2, *i.e.*, 28 g react with 3 moles of H_2, *i.e.*, 6 g of H_2 $\therefore$ 2000 g of N_2 will react with $H_2 = \frac{6}{28} \times 200\,g = 428{\cdot}6$ g. Thus, N_2 is the limiting reagent while H_2 is the excess reagent. 2 moles of N_2, *i.e.*, 28 g of N_2 produce $NH_3 = 2$ moles = 34 g $\therefore$ 2000 g of N_2 will produce $NH_3 = \frac{34}{28} \times 2000\,g$ = **2428·57 g** (*ii*) H_2 will remain unreacted. (*iii*) Mass left unreacted = 1000 g – 428·6 g = **571·4 g**	1 1