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Comprehensive Assessment Worksheet (2026-27)

Subject: Science (Chemistry)	**Chapter 7:** Particulate Nature of Matter	**Max Marks:** 50 Marks
Name: _____	**Roll No:** _____	**Date:** _____

General Instructions: Read all questions carefully before answering. Attempt all sections in your answer booklet. All case-based scenarios provide complete self-contained context.

SECTION A: MULTIPLE CHOICE & OBJECTIVE QUESTIONS (10 MARKS)

1. Which of the following best describes the fundamental behavior of constituent particles in the liquid state? [1 Mark]

(a) Fixed in rigid lattice positions with zero motion
(b) Free to move, but restricted to a limited volume
(c) Completely free to move in all available space
(d) Stationary with high interparticle attraction

2. When two teaspoons of sugar are added to half a glass of water and stirred until dissolved, the final liquid volume is slightly less than the sum of the volumes of water and sugar. This observation directly demonstrates: [1 Mark]

(a) Destruction of matter during dissolution
(b) Occupation of interparticle spaces by sugar particles
(c) Conversion of solid sugar into gaseous state
(d) Complete absence of interparticle forces

3. An ancient Indian philosopher proposed in the Vaisheshika Sutras that matter is composed of extremely tiny, indivisible, and eternal particles called Parmanu. Identify this scholar: [1 Mark]

(a) Acharya Chanakya
(b) Acharya Kanad
(c) Aryabhata
(d) Sushruta

4. Select the correct order of melting points for the given substances based on their interparticle forces of attraction: [1 Mark]

(a) Ice (0°C) < Urea (133°C) < Iron (1538°C)
(b) Iron (1538°C) < Ice (0°C) < Urea (133°C)
(c) Urea (133°C) < Ice (0°C) < Iron (1538°C)
(d) Ice (0°C) < Iron (1538°C) < Urea (133°C)

5. Statement 1: Evaporation occurs only at the boiling point and forms visible bubbles throughout the bulk.
Statement 2: Evaporation occurs at all temperatures below the boiling point and is strictly a surface phenomenon. [1 Mark]

(a) Both statements are correct
(b) Both statements are incorrect
(c) Statement 1 is incorrect, Statement 2 is correct
(d) Statement 1 is correct, Statement 2 is incorrect

6. State whether True or False. If False, write the correct statement: [5 Marks]

(i) "The interparticle spaces between closely packed solid particles are completely filled with air." [ ]
(ii) "Suspended Particulate Matter (SPM) in air pollution refers directly to individual constituent atoms." [ ]
(iii) "Water particles in ice-cold water move faster than water particles in boiling water." [ ]
(iv) "Both liquids and gases are classified as fluids because they have the ability to flow." [ ]
(v) "A slight increase in interparticle distance causes a drastic decrease in interparticle forces." [ ]

SECTION B: SHORT ANSWER CONCEPTUAL QUESTIONS (12 MARKS)

7. A stick of chalk can be broken easily by hand into smaller pieces, and then further ground using a mortar and pestle into a fine white powder. [3 Marks]

(a) Is grinding chalk a physical or chemical change? Explain on the basis of constituent particles.
(b) If we keep grinding the chalk powder further, will we eventually reach a stage where it cannot be broken further by physical means? What are these ultimate fundamental units called?

8. Grains of rice or wheat take the shape of whichever container or jar they are placed in, similar to liquids. Explain why they are still categorized strictly as solids. [3 Marks]

9. Describe what happens when a person moves their hand through a basin filled with water versus trying to push a finger through a solid wooden plank. Explain this difference in terms of interparticle forces and particle displacement. [3 Marks]

10. Explain how soap particles assist in cleaning clothes stained with grease or oil. Describe the dual attraction/interaction of soap particles toward water and oil molecules. [3 Marks]

SECTION C: CASE-BASED & OBSERVATIONAL ANALYSIS (12 MARKS)

11. Case Study 1: Piston Compression in Different States [4 Marks]

> *Scenario: A student takes a 100 mL glass syringe fitted with a tight rubber plunger. First, they trap air inside the syringe, seal the front nozzle tightly with a rubber stopper, and apply strong inward force on the plunger. Next, they repeat the exact same procedure with the syringe completely filled with water, and finally with the syringe packed tightly with fine sand.*

(a) Describe the change in volume observed in all three cases when pressure is applied.

(b) What happens to the plunger position when external force is released from the air-filled syringe?

(c) Explain these observations by comparing the relative interparticle spacing and compressibility of solids, liquids, and gases.

12. Case Study 2: Dissolution and Thermal Kinetic Energy [4 Marks]

> *Scenario: In a laboratory demonstration, three identical glass beakers are filled with 200 mL of water at different temperatures: Beaker A contains ice-cold water (5°C), Beaker B contains room temperature water (25°C), and Beaker C contains hot water (75°C). A single crystal of potassium permanganate ($KMnO_4$) is dropped gently to the bottom of each beaker without stirring.*

(a) In which beaker does the purple color spread throughout the liquid most rapidly, and in which is it slowest?

(b) Describe the microscopic mechanism of how surrounding water particles cause the solid crystal to dissolve and disperse.

(c) What fundamental relationship does this experiment establish between thermal energy (temperature), particle kinetic energy, and diffusion speed?

13. Case Study 3: Gas Diffusion and Interparticle Collisions [4 Marks]

> *Scenario: Gas Jar A is filled with dense brown nitrogen dioxide vapour (NO_2) and inverted over an upright Gas Jar B containing clear, invisible air. A glass plate separating the two jars is carefully pulled out, leaving both jar mouths flush against each other. Within minutes, the brown color spreads uniformly across both jars.*

(a) What state of gas mixture is achieved after the glass plate is removed, and what does this show about gas shape and volume?

(b) Explain why the brown vapour moves upward into Jar B even against the force of gravity.

(c) Describe the continuous collisions taking place between invisible air particles and gas vapour particles during this process.

SECTION D: COMPARATIVE MATRIX & SCHEMATIC REPRESENTATIONS (8 MARKS)

14. Complete the following comparative matrix summarizing the physical states of matter: [5 Marks]

Property	Solid State	Liquid State	Gaseous State
Interparticle Spacing			
Interparticle Forces			
Particle Motion			
Definite Shape?			
Definite Volume?			

15. In your answer sheet, illustrate particle arrangement diagrams showing sphere packing for: [3 Marks]

(a) Solid State: Tightly packed ordered arrangement of particles.

(b) Liquid State: Slightly separated, randomly packed particles.

(c) Gaseous State: Widely separated particles with motion vectors.

SECTION E: HIGH-ORDER THINKING (HOTS) & PROBLEM SOLVING (8 MARKS)

16. Case Study 4: Phase Transformations of Candle Wax [4 Marks]

> *Scenario: A standard paraffin wax candle is lit and burned for 20 minutes. Near the glowing wick, liquid wax pools in a small depression. Some liquid wax travels up the wick and vaporizes into invisible wax gas that feeds the flame. When the candle is blown out, a column of white vaporous wax smoke rises from the wick, while remaining liquid wax solidifies along the sides.*

(a) Identify the three physical states of wax present during or immediately after burning.

(b) Explain the changes in particle kinetic energy and interparticle attractive forces as solid wax melts into liquid wax, and as liquid wax transforms into gaseous wax near the wick.

17. Thought Experiment — Particle Removal Analysis [4 Marks]

> *Imagine a hypothetical advanced device capable of selectively extracting 100% of the constituent particles (molecules/atoms) from a wooden chair.*

(a) Predict what physical structure or substance would remain in the room after this extraction.

(b) Justify your answer using the concept of constituent particles as basic structural building blocks.

(c) Distinguish clearly between constituent particles of matter (atoms/molecules) and macroscopic dust or Suspended Particulate Matter (SPM).

Total Score Obtained: _____ / 50 **Evaluator Signature:** _____

Remarks: _____