

OFFICIAL ANSWER KEY & EVALUATION SCHEME

Comprehensive Assessment Worksheet (2026-27)

Subject: Science (Chemistry)	Chapter 7: Particulate Nature of Matter	Max Marks: 50 Marks
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SECTION A: MULTIPLE CHOICE & OBJECTIVE QUESTIONS (10 MARKS)

1. **Correct Answer: (b) Free to move, but restricted to a limited volume** [1 Mark]

Explanation: Liquid particles possess sufficient kinetic energy to slip past one another, allowing flow, but strong interparticle attraction keeps them confined within a definite volume.

2. **Correct Answer: (b) Occupation of interparticle spaces by sugar particles** [1 Mark]

Explanation: When dissolved, sugar molecules break apart and fit into the intermolecular voids existing between water molecules without causing a significant overall volume increase.

3. **Correct Answer: (b) Acharya Kanad** [1 Mark]

Explanation: Acharya Kanad, an ancient Indian philosopher, postulated the concept of ultimate indivisible particles called *Parmanu* in the Vaisheshika Sutras.

4. **Correct Answer: (a) Ice (0°C) < Urea (133°C) < Iron (1538°C)** [1 Mark]

Explanation: Melting point correlates directly with strength of interparticle forces: Ice (hydrogen bonding/molecular) < Urea (molecular organic) < Iron (metallic bonds).

5. **Correct Answer: (c) Statement 1 is incorrect, Statement 2 is correct** [1 Mark]

Explanation: Boiling is a bulk phenomenon occurring at a fixed temperature with bubble formation. Evaporation is a surface phenomenon occurring continuously below the boiling point.

6. **True / False Evaluation:** [5 Marks]

- (i) **False.** Correct Statement: Interparticle spaces in solids are empty voids (vacuums) between particles, not air-filled.
- (ii) **False.** Correct Statement: SPM consists of macroscopic aggregates of thousands/millions of atoms or soot particles, not individual atoms.
- (iii) **False.** Correct Statement: Water particles in boiling water (100°C) possess significantly higher kinetic energy and speed than at 0°C.
- (iv) **True.** Both liquids and gases can flow due to weak interparticle attraction relative to kinetic energy.
- (v) **True.** Interparticle attractive forces decrease sharply as the distance between particles increases.

SECTION B: SHORT ANSWER CONCEPTUAL QUESTIONS (12 MARKS)

7. **Chalk Grinding Analysis** [3 Marks]

- (a) **Physical Change.** Grinding merely reduces bulk size into smaller particle aggregates. Chemical composition (calcium carbonate molecules) remains completely unchanged. [1.5 Marks]
- (b) **Yes.** Physical grinding reaches a microscopic limit at constituent molecules/atoms. The ultimate fundamental building block is the **Parmanu / Molecule** (CaCO_3). [1.5 Marks]

8. **Grains of Rice/Wheat Classification** [3 Marks]

Each individual grain of rice or wheat maintains a fixed, rigid shape and volume regardless of container shape. The apparent fluidity of a bulk heap is due to individual solid particles sliding over one another, not fluid flow of the material itself. [3 Marks]

9. **Water Displacement vs. Wooden Plank** [3 Marks]

In water (liquid), interparticle forces are moderate, enabling hand displacement to break weak interparticle bonds easily. In wood (solid), particles are bound by strong covalent lattice forces, preventing finger insertion without severe mechanical force. [3 Marks]

10. **Soap Cleaning Mechanism** [3 Marks]

Soap molecules are amphiphilic. The hydrophobic tail interacts with non-polar grease/oil droplets, while the hydrophilic head bonds with water molecules. This forms micelles that lift grease off fabrics into suspension. [3 Marks]

SECTION C: CASE-BASED & OBSERVATIONAL ANALYSIS (12 MARKS)**11. Case Study 1 Solutions (Syringe Compression)****[4 Marks]**

- (a) Volume decreases drastically in air-filled syringe, while virtually no volume change is observed in water or sand. [1.5 Marks]
 (b) The plunger pushes back outward due to high compressed gas pressure. [1 Mark]
 (c) Air (gas) has large interparticle spaces making it highly compressible. Water (liquid) and sand (solid) have tightly packed particles with minimal intermolecular space. [1.5 Marks]

12. Case Study 2 Solutions (Thermal Dissolution)**[4 Marks]**

- (a) Fastest in Beaker C (75°C); slowest in Beaker A (5°C). [1 Mark]
 (b) Fast-moving water molecules collide with the crystal lattice surface, breaking interparticle bonds and carrying KMnO_4 ions into solution. [1.5 Marks]
 (c) Direct proportionality: Higher Temperature $\rightarrow$ Increased Kinetic Energy $\rightarrow$ Faster Diffusion Rate. [1.5 Marks]

13. Case Study 3 Solutions (Gas Diffusion)**[4 Marks]**

- (a) Homogeneous gas mixture; proves gases have no fixed shape or volume and expand to fill all available space. [1.5 Marks]
 (b) High thermal kinetic energy causes gas particles to move rapidly in all directions, overcoming gravity via kinetic motion. [1 Mark.5]
 (c) Continuous elastic interparticle collisions occur between NO_2 and air molecules, scattering particles randomly until uniform concentration is achieved. [1 Mark]

SECTION D: COMPARATIVE MATRIX & SCHEMATIC REPRESENTATIONS (8 MARKS)**14. Matrix Answer Solution:****[5 Marks]**

Property	Solid State	Liquid State	Gaseous State
Interparticle Spacing	Minimal / Very closely packed	Moderate / Slightly separated	Maximum / Large voids
Interparticle Forces	Extremely Strong	Moderate	Negligible / Very Weak
Particle Motion	Vibrates about fixed position	Translational & rotational motion	Rapid, random continuous motion
Definite Shape?	Yes	No (Takes container shape)	No
Definite Volume?	Yes	Yes	No

15. Schematic Diagram Guidance:**[3 Marks]**

- (a) Solid: Rigid lattice grid of tightly touching circles.
 (b) Liquid: Randomly arranged circles touching partially with minor voids.
 (c) Gaseous: Widely separated circles with directional arrows showing random velocities.

SECTION E: HIGH-ORDER THINKING (HOTS) & PROBLEM SOLVING (8 MARKS)**16. Case Study 4 Solutions (Candle Wax Phase Changes)****[4 Marks]**

- (a) Solid (candle body), Liquid (melted pool), Gas (vaporized wax feeding flame / white smoke). [1.5 Marks]
 (b) Heating increases kinetic energy, overcoming interparticle attraction. Solid $\rightarrow$ Liquid weakens bonds; Liquid $\rightarrow$ Gas completely ruptures attractive forces. [2.5 Marks]

17. Thought Experiment Solutions (Particle Removal)**[4 Marks]**

- (a) Nothing / Complete Vacuum in the space previously occupied by the chair. [1 Mark]
 (b) Matter is defined entirely by its constituent particles; removing 100% of particles destroys all physical mass, shape, and structure. [1.5 Marks]
 (c) Constituent particles (atoms/molecules) are sub-microscopic basic units of matter ($\sim 10^{-10} \text{ m}$); SPM consists of macroscopic solid/liquid dust aggregates ($\sim 2.5\text{-}10 \mu\text{m}$). [1.5 Marks]