NATURE OF MATTER - CHARACTERISTICS OF MATTER
SOLUTIONS
Teaching Task
JEE MAIN LEVEL QUESTIONS

1.Which state of matter does oxygen (O_2) primarily exist in at room temperature?
a) Solid b) Liquid c) Gas d) Plasma

Answer:C

Solution:Oxygen (O2) primarily exists as a gas at room temperature (around 20–25°C or 68–77°F). It only becomes a liquid at very low temperatures (below -183°C or -297°F) and a solid at even colder temperatures. Plasma, on the other hand, occurs at extremely high temperatures, much higher than room temperature.

2.What happens to iron (Fe) when heated to 1538°C?
a) It becomes a gas b) It melts into a liquid
c) It turns into plasma d) It becomes a Bose-Einstein condensate

Answer:B

Solution:At 1538°C, iron (Fe) reaches its melting point and transitions from a solid to a liquid state.

3.Which of these substances is a liquid at room temperature?
a) Sodium (Na) b) Mercury (Hg) c) Carbon (C) d) Aluminum (Al)

Answer:B

Solution:Mercury (Hg) is the only metal that is a liquid at room temperature (around 20–25°C or 68–77°F).

4.What state is carbon dioxide (CO_2) in at -78°C?
a) Gas b) Liquid c) Solid (dry ice) d) Plasma

Answer:C

Solution:At -78°C, carbon dioxide (CO_2) exists as a solid, commonly known as dry ice.

5.Why does helium (He) remain a gas even at very low temperatures?
a) Its atoms are too light to form a solid b) It turns into plasma instead
c) It becomes a superfluid first d) It needs extreme pressure to liquefy

Answer:D

Solution:Helium (He) remains a gas at very low temperatures under normal atmospheric pressure because:
It has extremely weak intermolecular forces (London dispersion forces) due to its small, nonpolar atomic structure.
At standard pressure (1 atm), helium does not solidify or liquefy, even near absolute zero (0 K or -273.15°C).
To liquefy helium, additional pressure must be applied (e.g., below 2.5 K at ~25 atm).

6.What happens to water (H_2O) when it reaches 0°C at standard pressure?

a) It evaporates b) It freezes into ice
c) It becomes a plasma d) It turns into a Bose-Einstein condensate

Answer:B

Solution:At 0°C (32°F) and standard pressure (1 atm), water undergoes a phase transition from liquid to solid, forming ice.

7.Which element is a solid at room temperature but melts in your hand?

a) Gold (Au) b) Gallium (Ga) c) Chlorine (Cl) d) Neon (Ne)

Answer:B

Solution:Gallium (Ga) has a melting point of 29.76°C (85.57°F), which is just above room temperature (~20–25°C).

When held in your hand (body temperature ~37°C), it melts into a liquid.

It's non-toxic and often used in science demonstrations for this property.

8.What state is nitrogen (N_2) in at -210°C?

a) Gas b) Liquid c) Solid d) Plasma

Answer:B

Solution:Nitrogen (N2) has a boiling point of -195.8°C and a melting point of -210°C at standard pressure.

At -210°C, nitrogen is between its melting and boiling points, meaning it exists as a liquid.

Below -210°C, it freezes into a solid.

Above -195.8°C, it becomes a gas.

9.Which of these is a property of gases like hydrogen (H_2)?

a) Fixed shape b) High density c) Compressibility d) Strong intermolecular forces

Answer:C

Solution:Gases, including hydrogen (H_2), have the following key properties:

Compressibility – Gases can be easily compressed because their particles are far apart with empty space in between.

No fixed shape or volume – They expand to fill any container.

Low density – Compared to liquids and solids, gases have much lower density.

Weak intermolecular forces – Gas particles move freely with minimal attraction between them.

10.What happens to sulfur (S) when heated above 115°C?

a) It becomes a gas b) It melts into a yellow liquid
c) It turns into plasma d) It becomes a superconductor

Answer:B

Solution:Sulfur (S) has a melting point of ~115.21°C (239.38°F).

When heated above this temperature, solid sulfur melts into a yellow, viscous liquid.

Further heating (above ~444.6°C) causes it to boil and turn into a gas.

11.Which substance can exist as a solid, liquid, and gas within Earth's normal temperature range?

a) Tungsten (W) b) Bromine (Br_2) c) Argon (Ar) d) Silicon (Si)

Answer:B

Solution:Bromine (Br2) is one of the few elements that naturally exists in all three states of matter (solid, liquid, gas) within Earth's normal environmental conditions:

Solid → Below -7.2°C (19°F)

Liquid → Between -7.2°C and 58.8°C (room temperature falls here, making it a reddish-brown liquid).

Gas → Above 58.8°C (137.8°F)

12.Why does methane (CH_4) stay a gas at room temperature?

a) Its molecules are too heavy b) It has weak intermolecular forces

c) It is always a plasma d) It only exists in solids

Answer:B

Solution:Methane (CH_4) remains a gas at room temperature because:

Weak London dispersion forces – Methane is a nonpolar molecule with very weak intermolecular attractions, so it doesn't condense into a liquid or solid unless cooled significantly.

Low boiling point (-161.5°C) – At room temperature (~20–25°C), methane is far above its boiling point, so it stays gaseous.

13.What happens to iodine (I_2) when heated gently?

a) It melts into a liquid b) It sublimes into a purple gas

c) It becomes a superfluid d) It turns into a metal

Answer:B

Solution:Iodine (I2) sublimes (transitions directly from solid to gas) when gently heated, producing a striking purple vapor.

This occurs below its melting point (113.7°C), so it bypasses the liquid phase under normal conditions.

The purple gas is diatomic iodine (I2), which is volatile even at moderate temperatures.

14.Which metal is liquid at room temperature besides mercury?

a) Sodium (Na) b) Cesium (Cs) c) Copper (Cu) d) Iron (Fe)

Answer:B

Solution:Cesium (Cs) melts at 28.5°C (83.3°F), just slightly above room temperature (~20–25°C).

In a warm room (or when held in your hand), it becomes a shiny, gold-colored liquid.

Like mercury (Hg), it's one of the few metals liquid at or near room temperature.

15.What state is neon (Ne) in at -246°C?

a) Gas b) Liquid c) Solid d) Plasma

Answer:B

Solutions:Neon (Ne) has a boiling point of -246.0°C and a melting point of -248.6°C at standard pressure.

At -246°C, neon is between its melting and boiling points, so it exists as a liquid.

Below -248.6°C, it freezes into a solid.
Above -246.0°C, it becomes a gas.

JEE ADVANCED LEVEL QUESTIONS
MULTIPLE CORRECT ANSWER TYPE

1. Which statement(s) about ice (solid H2O) is/are correct?

a) Its molecules vibrate but stay in fixed positions.
b) It has a definite volume but no definite shape.
c) It can flow like a liquid under high pressure (glaciers).
d) It turns directly into gas (sublimation) in dry climates.

Answer:A,C,D

Solution:
a) Its molecules vibrate but stay in fixed positions.
True: In solids, molecules vibrate around fixed lattice positions but do not flow.
c) It can flow like a liquid under high pressure (glaciers).
True: Ice in glaciers deforms plastically over time under immense pressure, mimicking flow (though it's still a solid).
d) It turns directly into gas (sublimation) in dry climates.
True: In low-humidity conditions (e.g., freezing deserts), ice sublimates into water vapor without melting first.
Incorrect option:
b) It has a definite volume but no definite shape.
False: Ice is a solid, so it has both a definite shape and volume. (This describes liquids, not solids.)

2.Which of the following statements about mercury (Hg) is/are true?

a) It is the only metal liquid at room temperature.
b) Its atoms are loosely packed like a gas.
c) It forms spherical droplets due to high surface tension.
d) It expands when heated, like most liquids.

Answer:C,D

Solution:c) It forms spherical droplets due to high surface tension.
True: Mercury has very high surface tension, causing it to bead into spheres (minimizing surface area).
d) It expands when heated, like most liquids.
True: Mercury uniformly expands with temperature rise, making it useful in thermometers.
Incorrect options:
a) It is the only metal liquid at room temperature.
False: While mercury is the most familiar, cesium (Cs), gallium (Ga), and francium (Fr) are also liquid near room temperature.
b) Its atoms are loosely packed like a gas.
False: Liquid mercury's atoms are still densely packed (like other liquids), just less ordered than solids. Gases have widely spaced molecules.

3.Which properties apply to both helium (He) and carbon dioxide (CO_2) gases?

a) Particles move randomly at high speeds.
b) They can be compressed into liquids under pressure.
c) They have a fixed shape and volume.
d) They fill the entire volume of their container.

Answer:A,B,D

Solution:a) Particles move randomly at high speeds.
True: Gas particles (for both He and CO2) exhibit rapid, random motion due to kinetic energy.
b) They can be compressed into liquids under pressure.
True:Helium liquefies under high pressure at very low temps (~4.2 K at 1 atm).
CO_2 liquefies at room temperature under ~57 atm pressure (e.g., in fire extinguishers).

d) They fill the entire volume of their container.
True: Gases expand to occupy all available space (no fixed shape or volume).
Incorrect option:
c) They have a fixed shape and volume.
False: This describes solids, not gases. Gases adapt to their container's shape/volume.

4.What is/are true about dry ice (solid CO_2) but false about regular ice?
a) It changes directly from solid to gas (sublimation).
b) It is colder than -78°C at standard pressure.
c) It can flow like a liquid (e.g., glaciers).
d) It is used to create fog effects in theaters.

Answer:A,B,D

Solution:a) It changes directly from solid to gas (sublimation).
True for dry ice: CO2 sublimes at -78.5°C (1 atm), bypassing the liquid phase.
b) It is colder than -78°C at standard pressure.
True for dry ice: Exists only below -78.5°C at 1 atm.
d) It is used to create fog effects in theaters.
True for dry ice: Sublimation creates dense, low-lying fog when mixed with water.
c) It can flow like a liquid (e.g., glaciers).-False
Dry ice is brittle and doesn't flow (sublimes instead).

5.Which statement(s) about gallium (Ga) is/are correct?
a) It melts at 29.8°C (below body temperature).
b) It expands when freezing, like water.
c) Its liquid form conducts electricity.
d) It is a gas at room temperature.

Answer:A,B,C

Solution:a) It melts at 29.8°C (below body temperature).
True: Gallium's melting point is just 29.8°C, so it liquefies in your hand (~37°C).
b) It expands when freezing, like water.
True: Gallium is one of the few materials (like water/bismuth) that expands upon freezing—its solid form is less dense than its liquid.
c) Its liquid form conducts electricity.
True: Liquid gallium retains metallic properties, conducting electricity due to free-

moving electrons.

Incorrect option:

d) It is a gas at room temperature.

False: Gallium is a solid at room temp (~20–25°C) and melts slightly above it. It only vaporizes at ~2200°C.

REASON AND ASSERTION TYPE

6.Assertion: Oxygen gas fills its container completely.

Reason: Gas particles have weak intermolecular forces and move freely in all directions.

Answer:A

Solution:Assertion (A): True.

Gases (like O_2) have no fixed shape or volume and expand to occupy the entire space of their container.

Reason (R): True.

Gas particles have negligible intermolecular forces and high kinetic energy, allowing random, free motion.

R correctly explains A: The assertion is true because gas particles move freely due to weak intermolecular forces, enabling them to fill the container uniformly.

7.Assertion: Water expands when it freezes into ice.

Reason: The hydrogen bonds in ice form a rigid, open structure that occupies more space.

Answer:A

Solution:Assertion (A): True.

Unlike most substances, water expands by ~9% when freezing due to its unique crystalline structure.

Reason (R): True.

In ice, water molecules arrange into a hexagonal lattice held by hydrogen bonds, creating empty spaces and increasing volume (lower density).

R correctly explains A: The expansion of water upon freezing is directly caused by the open hydrogen-bonded structure of ice.

8.Assertion: Mercury forms spherical droplets on glass surfaces.

Reason: Mercury has very low surface tension compared to water.

Answer:C

Solution:Assertion (A):True.

Mercury beads into perfect spheres due to its extremely high surface tension and non-wetting behavior on glass.

Reason (R):False.

Mercury's surface tension (~465 mN/m) is ~6× higher than water (~72 mN/m).

The spherical shape is caused by high surface tension, not low.

9.Assertion: Dry ice sublimes (turns directly into gas) at room temperature.

Reason: The intermolecular forces in dry ice are weaker than those in regular ice.

Answer:A

Solution:Assertion (A):True.

Dry ice (solid CO_2) sublimes at -78.5°C (1 atm), so at room temperature (~20–25°C), it bypasses the liquid phase entirely, turning directly into gas.

Reason (R): True.

Dry ice: Held by weak London dispersion forces (nonpolar CO2 molecules).

Regular ice: Held by stronger hydrogen bonds (polar H2O molecules).

R correctly explains A: Weaker intermolecular forces in dry ice allow molecules to escape easily into the gas phase without needing to pass through a liquid phase.

10.Assertion: Gallium metal melts in your hand.

Reason: Gallium has a melting point higher than human body temperature.

Answer:C

Solution:Assertion (A): True.

Gallium melts at 29.8°C, which is below the human body temperature (~37°C). Therefore, it will liquefy when held in hand.

Reason (R): False.

The melting point of gallium (29.8°C) is actually lower than human body temperature (~37°C), which is why it melts in your hand.

STATEMENT TYPE

11. Statement-I: Helium gas fills any container it is placed in completely.

Statement-II: Gas particles have negligible intermolecular forces and move randomly at high speeds.

Answer:A

Solution:Statement-I: True – Gases (like helium) expand to occupy the entire volume of their container due to free particle motion.

Statement-II: True – Gas particles move freely and randomly because intermolecular forces are weak compared to their kinetic energy.

Statement-II directly explains Statement-I. The random, high-speed motion and weak forces allow helium to fill the container uniformly.

12. Statement-I: Mercury forms spherical droplets when spilled on a flat surface.

Statement-II: Mercury has stronger cohesive forces between its atoms than adhesive forces with glass.

Answer:A

Solution:

Statement-I: True – Mercury beads into spheres due to its high surface tension and non-wetting behavior.

Statement-II:True – Mercury's cohesive forces (Hg-Hg) are stronger than its adhesive forces (Hg-glass), causing it to minimize contact with surfaces.

Statement-II correctly explains Statement-I. The dominance of cohesive forces over adhesive forces leads to spherical droplet formation.

COMPREHENSION TYPE

COMPREHENSION -I

13. What gives solids their definite shape and volume?

a) Particles moving freely in all directions

b) Particles arranged in a fixed, orderly pattern

c) Particles spread far apart from each other

d) Particles changing positions constantly

Answer:B

Solution:Solids have a rigid structure because their particles (atoms, molecules, or ions) are tightly packed in a fixed, repeating arrangement (e.g., crystalline solids like ice or salt). This prevents them from flowing or changing shape easily.

14. Which of the following is NOT a characteristic of solids?

a) Definite shape b) Definite volume

c) Particles in constant random motion d) Tightly packed particles

Answer:C

Solution:Solids have vibrational motion (particles wiggle in place), but they do not move randomly or freely like gas/liquid particles. This is a key difference.

Other options (definite shape, definite volume, tightly packed particles) are all true for solids.

15.How are particles arranged in a solid compared to a gas?

a) More spread out with no pattern b) Closely packed in a fixed arrangement

c) Loosely packed but still moving d) Far apart with weak forces

Answer:B

Solution:Solids: Dense, ordered, and rigid (e.g., diamond's crystal lattice).

Gases: Particles are far apart (option a) and move chaotically (no fixed arrangement).

COMPREHENSION -II

16.Why can liquids flow and take the shape of their container?

a) Particles are in a fixed, rigid arrangement

b) Particles are closely packed but can slide past each other

c) Particles are far apart and move randomly

d) Particles vibrate but cannot change position

Answer:B

Solution:Liquids have particles that are close together (like solids) but not locked in place. This allows them to flow and adapt to their container's shape.

17. How does the movement of particles in a liquid compare to a solid?

a) Particles move freely in all directions (like a gas)

b) Particles vibrate in place but cannot move

c) Particles have some freedom to slide past each other

d) Particles are completely stationary

Solution:Liquids: Particles can move/slide past neighbors (enabling flow).

Solids: Particles only vibrate in place (no sliding or flowing).

Answer:C

INTEGER TYPE:

18. If you cool liquid water at 1 atm pressure, how many state changes will it undergo before reaching -50°C?

Answer:1

Solution:Starting Point (Liquid Water):
At room temperature (~20°C), water is a liquid at 1 atm.
First State Change (Liquid ? Solid):
At 0°C, water freezes into ice (solid H2O).
This is 1 state change.
Cooling Below 0°C:
From 0°C to -50°C, ice remains a solid—no further phase changes occur.

19. How many state changes occur when graphite is heated from room temperature to 5000°C at 1 atm?

Answer:1

Solution:Room Temperature to ~3650°C:
Graphite remains a solid (no phase change).
At ~3650–3800°C (Sublimation Point):
Graphite sublimes directly into a gas (bypassing the liquid phase) because carbon's triple point (where solid, liquid, and gas coexist) occurs at ~100 atm. At 1 atm, liquid carbon does not exist.
This is the 1st and only state change (solid →gas).

Beyond 3800°C to 5000°C:
Carbon remains a gas (no further phase changes).

MATRIX MATCH TYPE :

20.**Answer:A-i,B-ii,C-iii,D-iv**

Solution:

Column-I (Substances)	Column-II (Properties)
A) Oxygen (O_2) gas	i) Takes the shape of its container, no fixed volume
B) Ice (H_2O solid)	ii) Particles vibrate in fixed positions
C) Liquid Mercury (Hg)	iii) Flows but has a fixed volume
D) Plasma (Sun's core)	iv) Made of charged particles at extremely high temperatures

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1.Which state of matter has a fixed shape and volume?

a) Gas b) Liquid c) Solid d) Plasma

Answer:C

Solution:Solids have a fixed shape and volume because their particles (atoms/molecules) are tightly packed in a rigid, orderly arrangement.

2.What allows liquids like water to pour easily?

a) Rigidity b) Fluidity c) Elasticity d) Density

Answer:B

Solution:Fluidity is the property that allows liquids (like water) to flow and pour easily because their particles can slide past one another.

3.Why does perfume spread quickly in a room?

a) Liquid particles evaporate into gas b) Solid particles break apart

c) Plasma conducts smell d) Bose-Einstein condensate traps odors

Answer:A

Solution:Perfume is a liquid that evaporates (turns into gas) at room temperature.

The gas particles then diffuse rapidly through the air (Brownian motion), spreading the scent.

4.Which state fills its container completely, including the corners?

a) Solid b) Liquid c) Gas d) All of the above

Answer:C

Solution:Gases expand to fill their entire container, including corners, because their particles move freely and rapidly in all directions (no fixed shape or volume).

5.What happens to the particles in a solid when heated?

a) They stop moving b) They vibrate faster but stay in place

c) They turn into plasma d) They disappear

Answer:B

Solution:In a solid, particles are locked in a fixed position but vibrate due to thermal energy.

When heated, they vibrate more intensely (gain kinetic energy) but remain in place until melting occurs.

6.Why does ice (solid H_2O) float on water?

a) It's less dense than liquid water b) It's a gas c) It's a plasma d) It's heavier

Answer:A

Solution:Ice floats because its density (~0.92 g/cm³) is lower than liquid water (~1.00 g/cm³)

7.Which metal is a liquid at room temperature?

a) Iron (Fe) b) Mercury (Hg) c) Gold (Au) d) Aluminum (Al)

Answer:B

Solution:Mercury (Hg) is the only metal that is a liquid at room temperature (~20-25°C).

Melting point: -38.8°C (stays liquid even in cold climates).
Used in thermometers due to its uniform expansion.

8.What state is dry ice (solid CO_2) when it "smokes"?
a) Melting into liquid b) Subliming into gas
c) Freezing into plasma d) Becoming a Bose-Einstein condensate
Answer:B
Solution:Dry ice is solid CO_2, which sublimes (turns directly from solid to gas) at -78.5°C (no liquid phase at normal pressure).
The "smoke" is water vapor condensing from cold CO_2 gas mixing with humid air—not the CO_2 itself.

9.Why can't you hold a gas like oxygen (O_2) in your hand?
a) It's invisibleb) It has no fixed shape or volume c) It's too sticky d) It's a solid
Answer:B
Solution:Gases (like oxygen) expand to fill any container because their particles move freely and are not tightly packed.
You can't "hold" a gas in your hand because it escapes—no fixed boundaries.

10.Which state of matter is lightning?
a) Solid b) Liquid c) Gas d) Plasma
Answer:D
Solution:Lightning is a plasma—a superheated, ionized gas where electrons are stripped from atoms, creating charged particles.

11.What happens to helium (He) gas when cooled near absolute zero?
a) It becomes a superfluid (Bose-Einstein condensate) b) It turns into a plasma
c) It disappears d) It becomes a solid
Answer:A

Solution:At temperatures near absolute zero (-273.15°C), helium-4 (4He) undergoes a phase transition into a superfluid:
Zero viscosity: Flows without friction (can climb walls!).
Bose-Einstein condensate (BEC): A quantum state where atoms act as a single wave.
Helium-3 (^{3}He) also becomes a superfluid but at even lower temps (~0.0025 K).

12.Why does plasma (like in the Sun) glow?
a) It reflects light b) Charged particles emit energy as light
c) It's cold d) It's a solid
Answer:B
Solution:Plasma (like in the Sun, lightning, or neon signs) glows because:
Charged particles (ions and electrons) collide and release energy as light (photons).
This process is called emission (e.g., the Sun's light comes from hydrogen plasma fusion).

13.Which state of matter has particles with the MOST energy?
a) Solid b) Liquid c) Gas d) Plasma
Answer:D
Solution:Plasma particles have the highest energy because:
They are ionized (electrons stripped from atoms) at extremely high temperatures (thousands to millions of degrees).
Examples: Lightning (30,000°C), the Sun's core (15 million°C), and stars.

14.What makes glass different from other solids?
a) It's a supercooled liquid b) It's a gas c) It's a plasma d) It has no particles
Answer:A
Solution:Glass is an amorphous solid (not a true liquid or crystalline solid).
It behaves like a supercooled liquid: Its molecules are disordered, as in a liquid, but rigid like a solid due to rapid cooling.

15.If you cool a gas enough, what can it become?
a) A liquid, then a solid b) A plasma c) A black hole d) A new element
Answer:A
Solution:Gas → Liquid (Condensation):When cooled below its boiling point, a gas condenses into a liquid (e.g., water vapor → dew).
Liquid → Solid (Freezing):Further cooling below its freezing point turns the liquid into a solid (e.g., water → ice).

JEE MAIN LEVEL QUESTIONS

1. Which of the following is a property of ice (solid water)?
A) Can flow like a liquid B) Has a fixed shape and volume
C) Can be easily compressed D) Particles move freely
Answer:B
Solution:Ice (solid H_2O) is a crystalline solid, meaning its molecules are locked in a rigid, repeating pattern. This gives it:
A fixed shape (e.g., an ice cube keeps its form).
A fixed volume (doesn't expand to fill a container).
2. Which state of matter is oxygen gas in at room temperature?
A) Solid B) Liquid C) Gas D) Plasma
Answer:C
Solution:Oxygen (O2) exists as a gas at room temperature (~20-25°C) and standard pressure (1 atm).
3. What happens to mercury (a liquid metal) when heated?
A) It becomes a solidB) It expands and may evaporate
C) It turns into a plasma D) Its volume decreases
Answer:B
Solution:Expansion:Mercury expands uniformly when heated (used in thermometers because of this reliable property).

Evaporation:If heated to its boiling point (356.7°C), it evaporates into mercury vapor (a toxic gas).

4. Why does salt (sodium chloride) maintain a fixed shape in its solid form?
A) Its particles move freely B) Its particles are tightly packed
C) It can be compressed easily D) It has no intermolecular forces
Answer:B
Solution:Solid salt (NaCl) is an ionic crystal, meaning its sodium (Na^+) and chloride (Cl^-) ions are:
Arranged in a rigid, repeating lattice (tightly packed).
Held by strong electrostatic forces, preventing movement.
This gives solids like salt their fixed shape and volume.

5. Which of the following is true about carbon dioxide gas?
A) It has a definite shape B) It can be compressed
C) Its particles do not move D) It cannot fill a container
Answer:B
Solution:Carbon dioxide (CO_2) gas can be compressed because:
Gas particles are far apart with empty space between them.
Under pressure (e.g., in a fire extinguisher), CO_2 gas is compressed into a liquid.

6. What happens to wax when it melts?
A) It changes from liquid to solid B) Its particles gain energy and move freely
C) It becomes a gas immediately D) Its volume decreases
Answer:B
Solution:When wax melts:
Heat energy causes its particles to vibrate faster, breaking the rigid structure.
The particles slide past each other, turning the wax into a liquid (free movement but still close together).

7. Which of the following is a property of iron (Fe) in solid state?
A) Low density B) High compressibility
C) Definite shape and volume D) Particles far apart
Solution:C
Solution:Solid iron (Fe) is a crystalline metal, meaning its atoms are:
Tightly packed in a fixed, orderly arrangement.
Held by strong metallic bonds, giving it:
A definite shape (e.g., an iron nail doesn't flow).
A definite volume (can't be squeezed into smaller space).

8. Why does alcohol evaporate faster than water at room temperature?
A) It has weaker intermolecular forces B) It is a solid
C) It cannot mix with air D) Its particles do not move
Answer:A
Solution:Alcohol (e.g., ethanol) evaporates faster than water because:

Its intermolecular forces (hydrogen bonds + London forces) are weaker than water's strong hydrogen bonds.
Less energy is needed for alcohol particles to escape as gas.
Water's stronger hydrogen bonds make it evaporate slower.

9. What happens to nitrogen gas when cooled to a very low temperature?
A) It becomes a liquid B) It turns into a plasma
C) It becomes a solid immediately D) It disappears
Answer:A
Solution:Nitrogen gas (N_2) liquefies when cooled below its boiling point (-195.8°C at 1 atm).
This liquid nitrogen is used in cryogenics, freezing, and scientific applications.
Further cooling to -210°C turns it into a solid.

10. Which of the following is an example of a good conductor of heat in solid state?
A) Wood B) Plastic C) Aluminum D) Glass
Answer:C
Solution:Aluminum is a metal with high thermal conductivity because:
Its free electrons transfer heat energy rapidly through the material.

ADVANCED LEVEL QUESTIONS
MULTIPLE CORRECT ANSWER TYPE

1. Choose the incorrect statement(s) about liquid mercury (Hg):
A) Mercury has a definite shape but no fixed volume.
B) Mercury cannot flow like other liquids.
C) Mercury expands when heated, just like solids.
D) Mercury does not take the shape of its container.
Answer:A,B,D
Solution:A)False: Liquids have no definite shape (they take the container's shape) but have a fixed volume.
B)False: Mercury flows easily (it's a liquid), though its high surface tension makes it bead up.
D)False: Like all liquids, mercury adapts to its container's shape (but forms droplets due to high cohesion).
C) True: Mercury's uniform expansion is why it's used in thermometers.

2. Which of the following is true about carbon dioxide (CO_2) gas?
A) CO_2 molecules are tightly packed like in solids.
B) CO_2 fills any container completely.
C) CO_2 can be compressed into a liquid under high pressure.
D) CO_2 has a free surface when stored in a closed container.
Solution:
B)True: Like all gases, CO2 expands to occupy the entire volume of its container.

C)True: At room temperature, CO2 liquefies under ~57 atm pressure (e.g., in fire extinguishers).
A) False: Gas molecules (including CO2) are far apart with empty space between them.
D) False: Gases fill the entire container—no "free surface" exists unless condensed into a liquid/solid.

Answer:B,C

REASON AND ASSERTION TYPE

3. Assertion (A): Ice (solid water) has a fixed shape, while liquid water takes the shape of its container.
Reason (R): The particles in ice are tightly packed in a rigid structure, whereas in liquid water, they can slide past each other.
Solution:A) True: Solids have fixed shapes; liquids adapt to containers.
R) True: Ice's rigid hydrogen-bonded lattice vs. liquid water's mobile molecules.
R explains A: The difference in particle arrangement directly accounts for their shape behavior.

Answer:A

4.Assertion (A): Helium gas fills an entire balloon, but an iron nail does not change its shape.
Reason (R): Gas particles have weak forces of attraction and move freely, while solid particles are tightly packed in a fixed arrangement.
Solution:A) True: Gases expand; solids maintain shape.
R) True: Gas particles move freely; solids have fixed positions.
R explains A: The particle behavior described in R directly justifies A.

Answer:A

5.Assertion (A): Mercury (a liquid metal) flows but cannot be compressed, while oxygen gas can be compressed easily.
Reason (R): Liquids have moderate intermolecular spaces, whereas gases have large empty spaces between particles
Solution:A) True:Mercury flows (liquid property) but is nearly incompressible (like all liquids).
Oxygen gas is highly compressible (gas property).
R) True:Liquids have particles close together (small compressibility).
Gases have large empty spaces (high compressibility).
R explains A: The intermolecular spacing directly explains compressibility differences.

Answer:A

COMPREHENSION TYPE

6.How is plasma formed?
A) By cooling a gas to absolute zero
B) By heating a gas to extremely high temperatures or applying a strong electromagnetic field
C) By compressing a liquid under high pressure
D) By freezing a solid rapidly

Answer:B

Solution:Plasma forms when gases are heated to thousands/millions of degrees (e.g., stars) or ionized by strong electric/magnetic fields (e.g., lightning, neon signs).

7. Why is plasma an excellent conductor of electricity?
A) Because it contains only neutral atoms
B) Because it has tightly packed particles like solids
C) Because it contains free electrons and positive ions
D) Because it has no charged particles
Answer:C
Solution:The charged particles (ions + free electrons) in plasma allow it to conduct electricity, unlike neutral gases.

8.Which of the following is a real-world example of plasma?
A) Ice cubes B) The Sun C) Liquid mercury D) Solid iron
Answer:B
Solution:The Sun and all stars are plasmas (ionized hydrogen/helium at ~15 million°C).

9. What property of plasma allows neon signs to emit light?
A) High density
B) Emission of light when ions recombine with electrons
C) Fixed shape and volume
D) Low energy levels
Answer:B
Solution:In neon signs, electricity excites neon gas into plasma, and light is emitted when electrons recombine with ions.

10.How does plasma differ from gases?
A) Plasma has a fixed volume, but gases do not
B) Plasma is electrically neutral with no charged particles
C) Plasma contains ionized particles, while gases have neutral atoms/molecules
D) Plasma cannot respond to magnetic fields
Answer:C
Solution:Gases: Neutral particles (no charge).
Plasma: Ionized particles (conducts electricity, responds to magnetic fields).

INTEGER TYPE:
11. Among iron, water, oxygen, and sand, how many are liquids at room temperature?
Answer:1
Solution:Iron (Fe): Solid,Water (H_2O): Liquid,Oxygen (O_2): Gas,Sand (SiO_2): Solid

12. Among helium, mercury, wood, and carbon dioxide, how many can conduct elec-

tricity in their natural state?

Answer:1

Solution:Helium (He): Gas (insulator),Mercury (Hg): Liquid metal (conducts electricity) ,Wood: Solid (insulator),Carbon dioxide (CO_2): Gas (insulator)

13.At 0°C (273K), how many of the following exist as solids?
[Ice, wax, nitrogen, gold]

Answer:3

Solution:Ice (H2O): Solid (melts at >0°C)
Wax: Solid (melting point typically >40°C)
Nitrogen (N2): Gas (boiling point: -196°C)
Gold (Au): Solid (melting point: 1064°C)

14.Among neon sign (plasma), steam, graphite, and honey, how many are fluids?
Solution:Neon sign (plasma): Fluid (ionized gas flows freely)

Answer:3

Steam (gas): Fluid
Graphite: Solid (rigid carbon layers)
Honey: Liquid (viscous fluid)

15.When dry ice (solid CO_2) sublimes, how many new states of matter are formed?

Answer:1

Solution:Dry ice transitions directly from solid ? gas (sublimation). No liquid forms at 1 atm.

MATRIX MATCH TYPE :

16. **Column-I (States of Matter)**

A) Solids
B) Liquids
C) Gases
D) Plasma

Column-II (Examples/Properties)

i) Helium gas (in balloons)
ii) Iron nail (rigid structure)
iii) Molten lava (flows but dense)
iv) Lightning (ionized particles)

Answer:A-ii,B-iii,C-i,D-iv

Solution:

A) Solids — ii) Iron nail (rigid structure)
B) Liquids — iii) Molten lava (flows but dense)
C) Gases — i) Helium gas (in balloons)
D) Plasma — iv) Lightning (ionized particles)

KEY

				Teaching Task					
				JEE MAIN LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
C	B	B	C	D	B	B	B	C	B
11	12	13	14	15					
B	B	B	B	B					
				JEE ADVANCED LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
A,C,D	C,D	A,B,D	A,B,D	A,B,C	A	A	C	A	C
11	12	13	14	15	16	17	18	19	20
A	A	B	C	B	B	C	1	1	A-I,B-ii,C-i
				Learners Task		(CUQ's)			
1	2	3	4	5	6	7	8	9	10
C	B	A	C	B	A	B	B	B	D
11	12	13	14	15					
A	B	D	A	A					
				JEE MAIN LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
B	C	B	B	B	B	C	A	A	C
				ADVANCED LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
A,B,D	B,C	A	A	A	B	C	B	B	C
11	12	13	14	15	16				
1	1	3	3	1	A-ii,B-iii,C-I,D-iv				