Lesson ONE

States of Matter

Lesson Terminology

Matter
Fluids
Particle
Particle Theory
Interparticle (Intermolecular) Spaces
Brownian Motion
Diffusion
Compressibility
Plasma State
Fluid Flow

Included Skills, Values and Issues:

- **Skills:** Observation - Prediction - Concluding - Practical exercises.
- **Values:** Collaboration.
- **Issues:** Technological justice.

Cross-Cutting Concepts: Cause and effect.

Lesson Objectives:

By the end of the lesson, the student should be able to:

1. Classify substances into solids, liquids and gases.
2. Compare the physical properties of matter in its fundamental states.
3. Use particle theory to describe the behaviour of matter in the solid, liquid and gaseous states.
4. Explain some of the physical properties of the states of matter in terms of particle theory.
5. Appreciate the role of scientists in discovering the plasma state and its applications.

Lesson Preparation

The given figure shows the three states of matter.



This lesson explores ideas that will help you answer these questions:

- What are the differences between the three states of matter?
- Is there a fourth state of matter?

States of matter and their properties

You already know that:

- **Matter** is anything that has mass and occupies space (has volume).
- **The mass of matter** is a constant quantity that does not change from one place to another.



Apples have mass and occupy space

The mass of the apples is a constant quantity that does not change from one place to another

- Scientists try to observe the patterns and properties common to the materials around us... G.R.?

To facilitate their classification and study,

Such as the classification of:

- Chemical elements.
- Living organisms.

- **The following diagram shows the classification of materials according to their physical state:**

Common physical states of matter



Properties of matter according to its physical state

- The properties of substances vary according to their physical state, **and we will only study the following:**

1. **Shape and fluidity**
2. **Volume and compressibility**
3. **Diffusibility**

1 Shape and fluidity

* Materials differ in their ability to flow (fluidity) and the possibility of changing their shape when transferred from one container to another, **as shown below**:

Liquids and **Gases**

Such as: water and oil | Such as: air and oxygen

Their properties

Have the ability to flow when transferred from one container to another.

Their shape changes depending on the shape of their container (they take the shape of their container).



Liquid substances



Gaseous substances

Can flow

Solids

Such as: wood and iron

Their properties

Do not have the ability to flow when transferred from one container to another.

Their shape **does not** change (they have a fixed shape).



Solid materials

Cannot flow

* Liquids and gases are classified in one group known as fluids... G.R.?
Due to their ability to flow and change their shape according to the shape of the container in which they are held.

Fluids

Substances that have the ability to flow and take the shape of the container in which they are held.

Fluidity

The ability of fluids to flow easily.



Liquids take the shape of the container holding them

* Liquids differ in their ability to flow **according to their viscosity**. The lower the viscosity of a liquid, the greater its ability to flow, and vice versa.

Cumulative knowledge

Viscosity is a physical property that expresses the extent to which liquids resist flow.

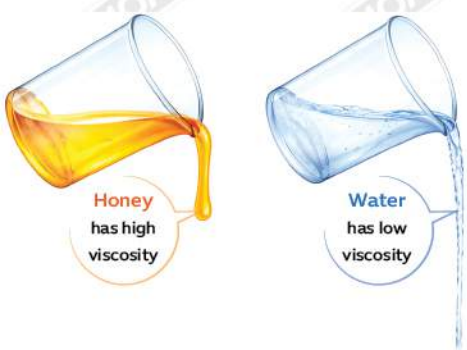
Question ? Answer

Q1 Why is the movement of sand shown in the opposite figure not considered to be flow?



A Because sand is not a fluid and pouring it does not change the shape of its grains.

Q2 **Explain:** The difference between the flow rate of honey and the flow rate of water.



A Because the viscosity of honey is greater than the viscosity of water, and the fluidity decreases with increasing viscosity.

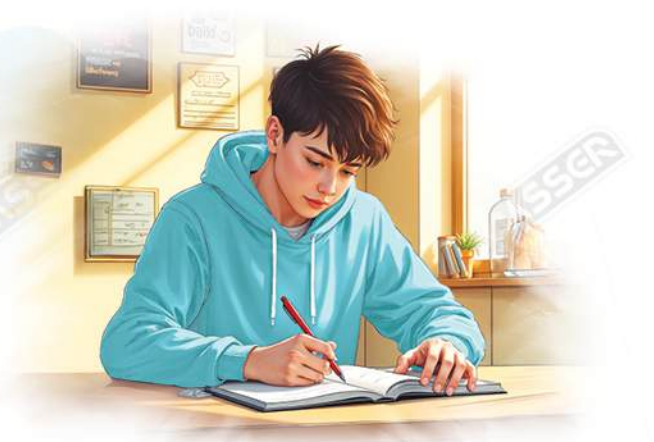
Review

The most important

- Definitions
- Explanations.....
- Results.
- Comparisons.....
- Figures .....
- Uses.....

for each lesson

In the Final Revision part included in EL-MOASSER Notebook



2 Volume and compressibility

* The compressibility of materials varies according to their physical states, **as shown in the following activity:**

Activity Compressibility of materials

Steps:

1. Seal the opening of three identical syringes tightly with a plug (stopper).
2. Put equal volumes of air, water and fine sand in the syringes.
3. Gradually press the piston of each syringe. **What do you notice?**

Observation:

Only the volume of air decreases with compression, while the volumes of both water and sand do not change.



Conclusion:

1. **Gaseous substances** are compressible (their volume decreases when compressed, without changing the volume of the particles themselves).
2. **Liquid and solid substances** are incompressible (their volumes do not change when compressed).



Gases are compressible

Compressibility of gases

The possibility of reducing the volume of gases by increasing the pressure exerted on them.

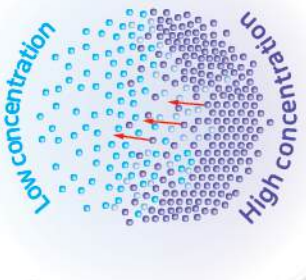
What do we mean when we say that gases are compressible.

That is, their volume decreases as the pressure on them increases.

3 Diffusibility

Diffusion

The movement of particles of a substance from a region of high concentration to a region of lower concentration.



* The diffusibility of materials varies depending on their physical states, **as shown below:**

Diffusion takes place in:

Gaseous substances	Liquid substances	Solid substances
Very quickly	At a medium speed	Very slowly



The diffusion of bromine vapour particles in the air



Diffusion of dye particles in water



Diffusion of dye particles in a sponge

Diffusion rate in gases > Diffusion rate in liquids > Diffusion rate in solids

Factors on which the diffusion rate depends:

1 Temperature of the diffusion medium

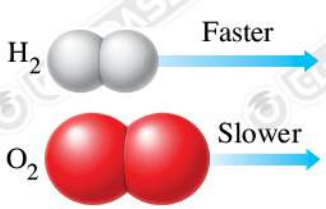
The diffusion rate increases as the temperature of the diffusion medium increases. **(Direct relationship)**



The diffusion of tea particles in hot water **is faster than** their diffusion in cold water

2 Mass of diffusing molecules

The diffusion rate decreases as the mass of the diffusing substance particles increases. **(Inverse relationship)**



The diffusion of H_2 gas (lower mass) **is faster than** the diffusion of O_2 gas (greater mass)

What happens when?

a crystal of potassium permanganate is placed in a beaker of water?

The solid potassium permanganate particles gradually diffuse in the water, until the water turns purple.



Diffusion of potassium permanganate in water

* **In light of the previous part, the properties of a substance according to its physical state can be summarized in the following table:**

Properties	Solid substance	Liquid substance	Gaseous substance
1. Ability to change shape by changing the container	Its shape does not change [Its shape is fixed and definite]	Its shape changes [It takes the shape of its container]	
2. Fluidity	Cannot flow	Can flow	
3. Compressibility	Its volume does not change with compression [Its volume is fixed and definite]		Its volume decreases with compression
4. Speed of diffusion through it	Very slow	Average	Very fast

Question ? Answer

Q **From the opposite figure:**

Which of the following describes what happened inside the bottle?

ⓐ The air has flowed.

ⓑ The air has diffused.

ⓒ The volume of air has increased.

ⓓ The air was compressed.



Solution:

∵ The bottle is closed, so there will be no:

- Air flow. - Air diffusion. - Increase in the volume of air.

∴ The deformation of the bottle is due to the pressure on it, and therefore the air inside it is compressed.

A The correct choice: ⓓ

Check Your Understanding 1

Answered

1 (A) Write the scientific term for each of the following statements:

(1) Anything that has mass and occupies space. (Beni Suef 26) (.....)

(2) Substances that have the ability to flow and take the shape of the container holding them. (Beni Suef 26) (.....)

(3) The movement of the particles of a substance from the region of higher concentration to the region of lower concentration. (Beheira 26) (.....)

(4) The state of matter that is compressible and can flow. (Qena 26) (.....)

(B) Give reason for each of the following:

(1) Sugar dissolves faster in hot water than in cold water.

.....

(2) The flow speed of honey is less than the flow rate of water. (Giza 26)

.....

2 (A) Choose the correct answer:

(1) Solids are similar to liquids in ..... (Monufia 26)

ⓐ shape stability. ⓑ volume stability.

ⓒ fluidity. ⓓ the speed of diffusion through them.

(2) Fluids are materials that are .....

ⓐ only solid. ⓑ only liquid.

ⓒ solid and liquid. ⓓ liquid and gaseous.

(3) Which of the following materials has a definite shape and its volume does not change when transferred ..... (Aswan 26)

ⓐ water. ⓑ water vapour. ⓒ mercury. ⓓ wood.

(4) The diffusion rate in gases is ..... the diffusion rate in liquids. (Cairo 26)

ⓐ less than ⓑ greater than ⓒ equal to ⓓ half

(B) What do you notice when ... ?

(1) A perfume bottle is left open in a room. (Ismailia 26)

.....

(2) Pressing the piston of a syringe having a closed nozzle containing a quantity of water inside it "regarding the volume of water". (Sohag 26)

.....

Questions of Part 1

Look at pages 24 : 28

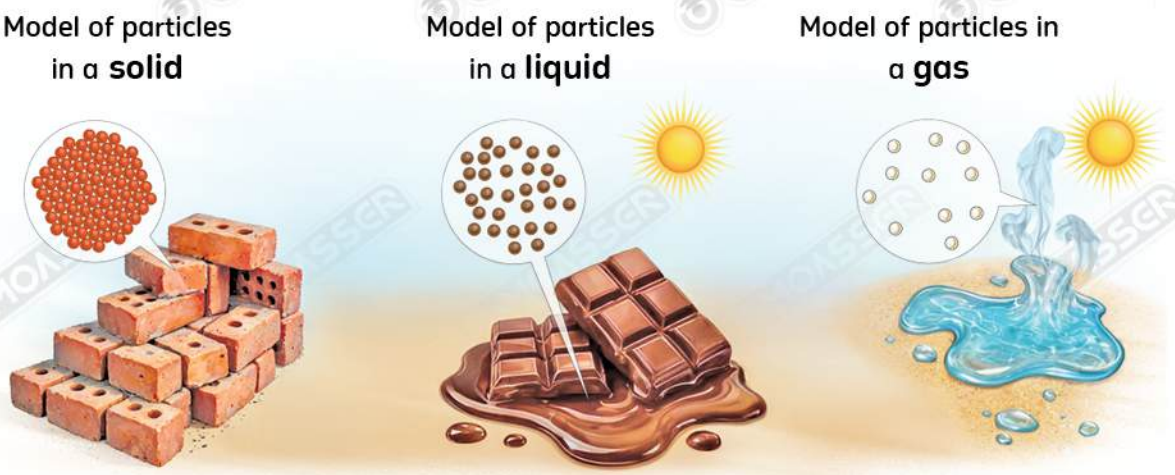
Modelling

Modelling

A way of presenting a simplified representation of objects that are either too tiny to be seen or too massive to be comprehended, which helps us to understand objects and the relationships between them.

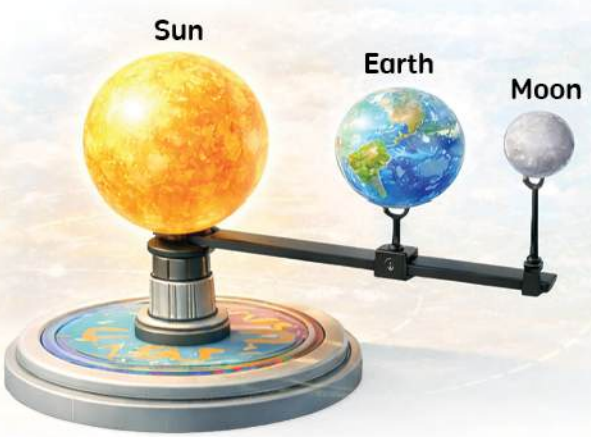
- **Educational models** are used to provide a simplified visualization **of things that are:**

1 Too tiny to be seen, like the particles making up different materials.



An enlarged model of solid, liquid and gaseous matter particles

2 Too massive to be comprehended, like the solar system.



A minimized model of our solar system

Particle theory of matter

Scientists always try to explain different natural phenomena by

Making assumptions in an attempt to understand how things work

And when these assumptions succeed in explaining many phenomena

They become a Scientific Theory



- One of the theories that has succeeded in explaining much of the behaviour and properties of matter is the **particle theory of matter**.

Particle theory of matter

Matter is made up of very minute particles that cannot be seen with the naked eye, and are in a state of continuous motion.

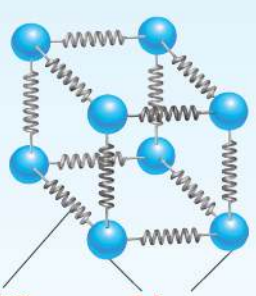
Cumulative Knowledge

- **The particles of matter** are monoatomic molecules or polyatomic molecules.
- **Polyatomic molecules** are each formed by the bonding of two or more atoms together by chemical bonds.



Assumptions of the Particle Theory of Matter

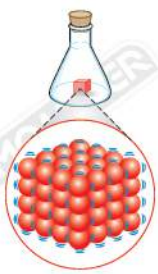
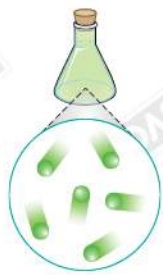
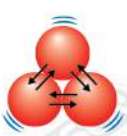
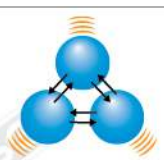
1. Matter is made up of very tiny particles that cannot be seen with the naked eye.
2. The particles of the same substance are identical, and their types differ from one substance to another.
3. There are interparticle spaces between the particles of a substance, which vary depending on its physical state.
4. The particles of matter store potential energy... G.R.? **Due to** the forces of attraction between them.
5. The particles of matter have kinetic energy ... G.R.? **Because** they are in a state of continuous motion in straight lines, and the way the particles move and their speed vary depending on the state of the matter.



Particle model of matter

Explanation of the properties of the states of matter

The properties of the states of matter differ according to the difference in the force of attraction (bonding) between their particles, **as shown in the following table:**

	Solid matter	Liquid matter	Gaseous matter
1 Particle arrangement			
2 The forces of attraction between the particles	Very strong so that they are tightly bound to each other	Relatively weak, but sufficient to hold them together	Very weak
3 Interparticle spaces	Very small	Relatively large	Very large
4 Motion of particles	 They move a vibrational (limited) motion in their fixed positions without translating to other positions	 They move relatively freely within the container holding them	 They move randomly and completely freely in all directions

G.R.?



(1) Solids have a definite shape and a definite volume.
Because the forces of attraction between their particles are very strong and the interparticle spaces between them are very small.

(2) Liquids have an indefinite shape and a definite volume.
Because the forces of attraction between their particles are relatively weak and the interparticle spaces between them are relatively large.

(3) Gases have no definite shape and no definite volume.
Because the forces of attraction between their particles are very weak and the interparticle spaces between them are very large.

G.R.?



(1) 🕮 The difficulty of breaking a piece of rock.
Because the forces of attraction between the particles of the solid rock are very strong.

(2) The ability of liquids to flow.
Because the forces of attraction between their particles are relatively weak.



(3) 🕮 The possibility of dissolving a quantity of table salt in water.
Because the particles of table salt occupy the intermolecular spaces between the water particles.

(4) The compressibility of gases.
Because the interparticle spaces between their particles are very large.

Brownian motion

Discovery:



Scientist Robert Brown

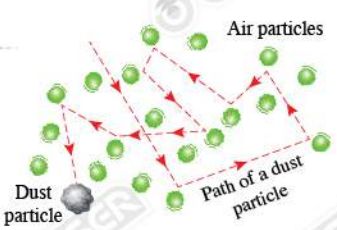
The scientist Brown discovered that pollen grains suspended in water are in a state of continuous random motion in all directions, and this motion was named **Brownian motion** after the scientist Brown.

Reason for its occurrence:

The collisions between the molecules of a fluid (liquid or gas) and the relatively large particles present in it, such as pollen grains in water or dust in the air, **lead to** the random motion of the pollen grains or dust in all directions.

Brownian motion

The random motion in all directions of relatively large particles suspended in a fluid as a result of their continuous collisions with the fluid particles.



Brownian motion of dust particles as a result of their random collisions with air particles

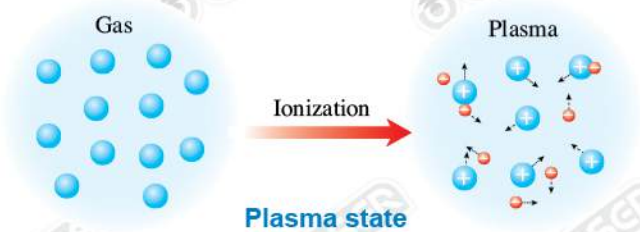
G.R.?

🕮 The diffusion of smoke from a candle wick in the air.
Because the smoke particles collide with the air particles, so they move randomly in all directions, causing them to spread (diffuse).



Plasma state

When gases (with neutral charge) are ionized, they turn into positively charged ions and free negative electrons.
This state is known as plasma, and it is the **fourth state** of matter.



Plasma state
The fourth state of matter, which consists of the ionization of gases into positively charged ions and free negative electrons.

Ionization of gases occurs when:
- They pass through a strong electric field.
- They are heated to extremely high temperatures (thousands or millions of degrees).

Characteristics of the plasma state:

Its high electrical conductivity.

Examples of its occurrence:

1. **Most of the matter in outer space** (the Sun, stars and cosmic nebulae).
2. **Lightning.**
3. **Aurora borealis (Polar lights).**

For illustration only !

* **The phenomenon of the aurora borealis (Polar lights):**
It is a natural light phenomenon that appears in the sky in the form of dazzling coloured light curtains visible from the North and South Poles of the Earth, as a result of the scattering of harmful charged cosmic radiation away from the Earth's surface.



Technological application

The plasma state is used in air conditioners ... G.R.?
To improve air quality in enclosed spaces.



Plasma air conditioning system

Its operating principle

(1) When gases pass through a strong electric field, they turn into plasma (their atoms are converted into positively charged ions and free negative charged electrons).

(2) **Charged gas ions break down** harmful air pollutants, germs and viruses.

(3) The electric field attracts dust and charged particles, **making** the air more pure.

Check Your Understanding 2

Answered

1 (A) Complete the following sentences:

(1) The particles of matter store ..... energy, due to ..... that exists between them. (Port Said 26)

(2) The forces of attraction are greatest in ..... materials, while they are almost non-existent in ..... materials. (Beheira 26)

(3) The motion of pollen grains in water or dust in the air in ..... manner is known as ..... motion.

(4) The state of ..... is used in air conditioning systems to improve indoor air quality. (Giza 26)

(B) Give reason for each of the following:

(1) A liquid substance has a fixed volume and takes the shape of the container in which it is held. (Port Said 26)

.....

(2) The difficulty of breaking a piece of iron. (Sohag 26)

.....

2 (A) Put (✓) or (✗) for each statement, with correction:

(1) Matter is composed of small particles that can be seen with the naked eye. (Port Said 26) ( )

(2) The interparticle spaces between the particles of gaseous matter are very small. (Ismailia 26) ( )

(3) The particles of solid matter move completely freely in all directions. (Beheira 26) ( )

(4) Plasma is considered the fourth state of matter. (Qena 26) ( )

(B) Answer the following:

(1) State two assumptions of the particle theory of matter.

* .....

.....

(2) **From the opposite figure:**

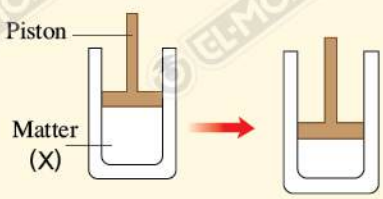
What is the physical state of matter (X)?

With explanation.

* .....

.....

.....



Questions of Part 2 Look at pages 29 : 33

Matter is anything that has mass and occupies space

Its classification according to its physical state

Solid matter

Such as:
- Wood.
- Iron.
- Ice.



- Cannot flow.
- Has definite shape.
- Incompressible.
- The motion of its particles is limited (vibrational motion).
- Diffusion through it is very slow.

The forces of attraction between their particles **are very strong.** The spaces between them **are very small.**

Liquid matter

Such as:
- Water.
- Oil.
- Alcohol.



- Can flow (fluid).
- Has indefinite shape.
- Incompressible.
- Has definite volume.
- The motion of its particles is relatively free.
- Diffusion through it is moderately fast.

The forces of attraction between their particles **are relatively weak.** The spaces between them **are relatively large.**

Gaseous matter

Such as:
- Oxygen.
- Hydrogen.
- Water vapour.



- Can flow (fluid).
- Has indefinite shape.
- Compressible.
- Has indefinite volume (decreases upon compression).
- The motion of its particles is completely free (random motion).
- Diffusion through it is very fast.

The forces of attraction between their particles **are very weak.** The spaces between them **are very large.**

Plasma is the fourth state of matter

It consists of the ionization of gases in high electric fields into positive ions and free negative electrons

Forms of its presence

1. Space (the Sun - stars - the cosmic nebulae).
2. Lightning.
3. The aurora (Polar lights).

Its properties

Its electrical conductivity is high.

Its use

Used in air conditioning systems to improve air quality.

Important Notes

Fluids:
They are liquid and gaseous substances that have the ability to flow and take the shape of the container in which they are held.

- The fluidity of fluids decreases as their viscosity increases.
- The volume of a gas decreases as the pressure exerted on it increases, without any change in the volume of its particles (molecules) themselves.
- The speed of diffusion of substances increases with an increase in the temperature of the medium and a decrease in the mass of the diffusing particles.
- The particle theory of matter explains that: matter consists of very small identical particles that cannot be seen with the naked eye, they store potential energy and possess kinetic energy.
- The particle theory of matter has succeeded in explaining the behaviour and properties of matter.

Questions ?

UNIT 1 | Lesson 1

First Questions Bank of EL-MOASSER Answered

Questions of Part 1 On the States of Matter and their Properties

1 Write the scientific term for each of the following statements:

(1) Anything that has mass and occupies space. (Sohag 26)

(2) Substances that have the ability to flow and take the shape of the container in which they are held. (Gharbia 26)

(3) The ability of fluids to flow easily. (Sharkia 26)

(4) The possibility of reducing the volume of gases when the pressure exerted on them is increased. (Monufia 26)

(5) The movement of the particles of a substance from a region of high concentration to a region of low concentration. (Dakahlia 26)

2 Choose the correct answer:

(1) All of the following represent matter, **except** .....

ⓐ iron. ⓑ milk. ⓒ music. ⓓ air.

(2) Which of the following substances is capable of flowing? (Ismailia 26)

ⓐ Wood and iron. ⓑ Wood and oil.

ⓒ Water and oxygen. ⓓ Iron and air.

(3) Which of the following substances are considered fluids?

ⓐ Ice and liquid water. ⓑ Iron and water vapour.

ⓒ Oil and iron. ⓓ Water vapour and liquid water.

(4) Which of the following has a definite shape? (Beheira 26)

ⓐ Air. ⓑ Oil. ⓒ Ice. ⓓ Water.

(5) Air is characterized by .....

ⓐ having no mass. ⓑ having a definite volume.

ⓒ having no definite shape. ⓓ occupying no space.

(6) A solid is characterized by ..... (Damietta 26)

ⓐ having no fixed volume or shape. ⓑ having a fixed volume and shape.

ⓒ having a fixed shape and a variable volume.

ⓓ having a fixed volume and a variable shape.

(7) The common property of solids and liquids is that both of them .....

ⓐ have a fixed volume. ⓑ can flow.

ⓒ have a fixed shape. ⓓ are compressible.

(8) One of the similarities between liquids and gases is ..... (Luxor 26)

ⓐ having fixed shape. ⓑ definite volume.

ⓒ both are fluids. ⓓ compressibility.

(9) Compression of matter means .....

ⓐ an increase in its volume. ⓑ a change in its mass.

ⓒ a decrease in its volume. ⓓ a change in the volume of its particles.

(10) Which of the following substances has the greatest diffusibility? (Port Said 26)

ⓐ Wood. ⓑ Sand. ⓒ Air. ⓓ Water.

(11) The rapid motion of matter particles from a high concentration region to a lower concentration region represents the process of ..... (Beheira 26)

ⓐ freezing of a liquid. ⓑ melting of a solid.

ⓒ diffusion of a substance in a liquid. ⓓ diffusion of a substance in a gas.

(12) The colour of ink spreads faster when placed in a glass of water at a temperature of ..... (Port Said 26)

ⓐ 0°C ⓑ 20°C ⓒ 40°C ⓓ 80°C

3 Complete the following sentences:

(1) Matter is anything that has ..... and occupies ..... (Ismailia 26)

(2) Substances are classified according to their common physical states into gas, ... and ..... (Sohag 26)

(3) Matter in both the ..... and ..... states are called fluids. (Monufia 26)

(4) ..... substances are capable of flowing and are compressible, while ..... substances are capable of flowing but are incompressible. (Giza 26)

(5) Diffusion through ..... is very fast, while diffusion through ..... is very slow. (Sharkia 26)

(6) The speed of diffusion of matter particles depends on ..... of the diffusion medium and ..... of the diffusing particles. (Alexandria 26)

4 Correct the underlined words:

(1) The flow of liquids varies according to **their mass**. (Port Said 26)

(2) When flow occurs, the volume of the **gas** does not change. (Beheira 26)

(3) **Liquid** substances have no specific shape or volume. (Aswan 26)

(4) **A solid** has the ability to flow and does not have the ability to be compressed. (Monufia 26)

(5) The speed of diffusion through solids is **equal to** the speed of diffusion through gases. (Gharbia 26)

5 Put (✓) or (✗) for each statement, with correction :

(1) The mass of matter is a quantity that varies from one place to another. ( )

(2) When a liquid flows, its shape and volume change. ( )

(3) Solid and liquid substances are called fluids. (Giza 26) ( )

(4) The fluidity of fluids increases with increasing viscosity. (Qena 26) ( )

(5) The molecules of a substance move from the region of high concentration to the region of low concentration. (Dakahlia 26) ( )

(6) The diffusion rate increases with the rise in temperature of the diffusion medium. ( )

(7) Molecules with lower mass diffuse more quickly. (Aswan 26) ( )

(8) The diffusion rate of hydrogen gas differs from that of oxygen gas. (Cairo 26) ( )

6 Identify the inappropriate word or phrase in the following lists, then write what relates the rest of the words or phrases:

(1) Oil / Alcohol / Water / Carbon dioxide. (Ismailia 26)

(2) Oxygen / Hydrogen / Carbon dioxide / Wood. (Port Said 26)

(3) Can flow / Compressible / Slowly diffuses / Has no definite shape.

(4) Has a fixed volume / Cannot flow / Compressible / Has a fixed shape. (Minya 26)

7 Give one example for each of the following:

(1) Fluids. (Sohag 26)

(2) A substance with a definite shape and volume.

(3) A substance with an indefinite shape and a definite volume.

(4) A substance with an indefinite shape and volume.

(5) A substance that is capable of flowing and compressible.

(6) A substance that is capable of flowing and incompressible. (Monufia 26)

8 What is meant by:

(1) Matter. (Giza 26)

(2) Fluids. (Ismailia 26)

(3) The compressibility of gases. (Beheira 26)

(4) Diffusion. (Alexandria 26)

9 Give reason for each of the following:

(1) Liquids and gases are classified as a single group known as fluids. (Ismailia 26)

(2) Oil and oxygen are called fluids. (Beheira 26)

(3) The flow rate of honey differs from the flow rate of water. (Giza 26)

(4) The difference between oil and hydrogen in compressibility. (Dakahlia 26)

(5) Water gradually turns purple when a potassium permanganate crystal is placed in it.

10 What happens when:

(1) Transferring a quantity of water from one container to another "with respect to the volume and shape of the water". (Giza 26)

(2) Pressing the piston of a syringe whose nozzle is closed and contains an amount of air "with respect to the volume of the air and the volume of the air particles". (Gharbia 26)

(3) Pressing on an empty, sealed plastic bottle "with respect to the volume of air". (Sharkia 26)

(4) Adding a few crystals of potassium permanganate to a beaker containing a quantity of water. (Beni Suef 26)

(5) Opening a perfume bottle in a corner of a room. (Cairo 26)

(6) Increasing the temperature of the diffusion medium "with respect to the speed of diffusion through it". (Alexandria 26)

11 Compare between each of the following:

(1) Ice and water vapour "**in terms of:** shape - volume". (Cairo 26)

(2) Iron, oil and hydrogen "**in terms of:** the possibility of changing volume by increasing pressure". (Beheira 26)

(3) Oil and oxygen "**in terms of:** compressibility". (Cairo 26)

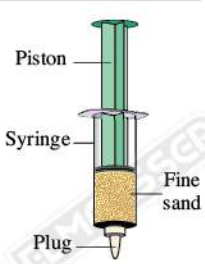
(4) Solid matter and liquid matter "**in terms of:** fluidity - speed of diffusion through them". (Port Said 26)

(5) Liquid matter and gaseous matter "**in terms of:** the speed of diffusion through them". (Fayoum 26)

12 Study the following figures, then answer:

① In the opposite figure:

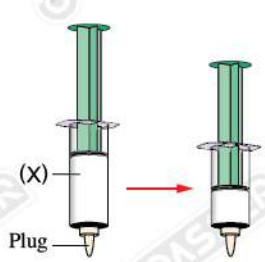
Why does the volume of sand in the syringe not change when the piston is pressed?



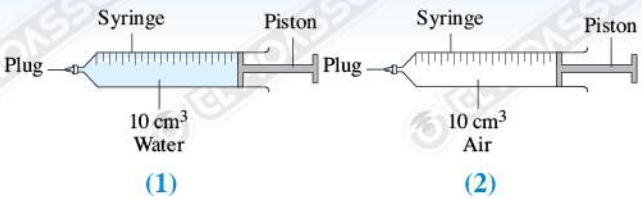
② In the opposite figure:

(1) **What** is the physical state of matter (X)?

(2) **Is** matter (X) capable of flowing?
With explanation.



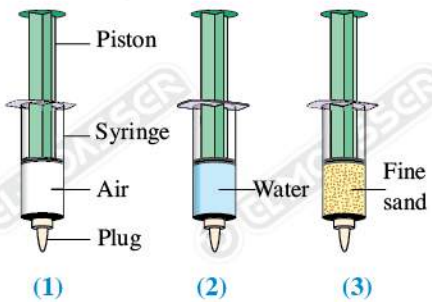
③ **From the two opposite figures:**
What happens when the piston is pushed inwards in cases (1) and (2)?



④ **From the opposite figures:**

(1) **In which** of the cases does the volume of the substance change when the piston is pressed?

(2) **What** is the common property of the three substances in the syringes?



13 Variant questions:

① **From the opposite table:**

(1) **Classify** these groups according to their physical state.

(2) **Identify** the groups that are not classified as fluids.

Group (1)	Group (2)	Group (3)
Water vapour	Dewdrops	Iron
Air	Raindrops	Ice

② **What is the relationship** between the viscosity of a liquid and its flow speed?

③ **From the opposite table:**

(1) **Classify** each of the substances (A), (B), (C) according to its physical state.

(2) **Which** of these substances is compressible?

Substance (A)	Substance (B)	Substance (C)
It has no definite shape	It has a definite shape	It has no definite shape
It has no definite volume	It has a definite volume	It has a definite volume

④ **There are materials that have the ability to flow and change their shape according to the shape of the container in which they are held:**

(1) **What** is the scientific term given to these materials?

(2) **Give an example** of one of these materials that has the following properties:

1- It has a definite volume and an indefinite shape.

2- It has no definite volume or shape.

⑤ **What** are the factors affecting the speed of diffusion in fluids? (Cairo 26)

Questions of Part 2 From Modelling and The Particle Theory of Matter till the End of the Lesson

1 Write the scientific term for each of the following statements.

(1) A way in which we present a simplified representation of very minute things that we do not see or of very large things that we do not perceive, which helps us to understand things and perceive the relationships between them.

(2) A theory that explains the behaviour and properties of matter. (Alexandria 26)

(3) The random motion in all directions of relatively large particles suspended in a fluid. (Damietta 26)

(4) The fourth state of matter. (Gharbia 26)

(5) The state in which gases are in the form of a mixture of positively charged ions and free negative electrons. (Sohag 26)

2 Choose the correct answer:

(1) The particles of matter cannot be seen with the naked eye, because they are .....

ⓐ very small. ⓑ vibrating. ⓒ moving freely. ⓓ moving randomly.

(2) According to the particle theory, the diffusion of smoke particles in the air is due to ..... (Monufia 26)

ⓐ the forces of attraction between them.
ⓑ the stability of their shape.
ⓒ their random motion.
ⓓ their compressibility.

(3) The forces of attraction are very strong between the molecules of ..... (Qena 26)

ⓐ iron. ⓑ water. ⓒ air. ⓓ oil.

(4) Which of the following describes gas particles? (Damietta 26)

ⓐ The distances between them are small.
ⓑ They are incompressible.
ⓒ The forces of attraction between them are very weak.
ⓓ They move with limited motion.

(5) Liquid substances have the following properties, **except** that .....

ⓐ they can flow.
ⓑ they have a moderate speed of diffusion.
ⓒ they take the shape of the container holding them.
ⓓ they are compressible.

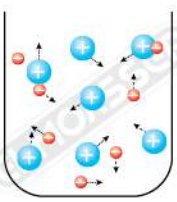
(6) The interparticle spaces are maximum between the particles of ..... (Fayoum 26)
ⓐ iron. ⓑ oxygen. ⓒ water. ⓓ oil.

(7) The motion of gas molecules is ..... (Sohag 26)
ⓐ circular. ⓑ vibrational. ⓒ random. ⓓ wave-like.

(8) When comparing water molecules to oxygen molecules, water molecules are .....
ⓐ slower and farther apart from each other.
ⓑ faster and farther apart from each other.
ⓒ slower and closer to each other.
ⓓ faster and closer to each other.

(9) When gases are ionized into positively charged ions and free negative electrons, the matter is in the ..... state. (Alexandria 26)
ⓐ solid ⓑ liquid ⓒ gaseous ⓓ plasma

(10) From the opposite figure:
What is the physical state of the substance represented in the figure?
ⓐ Solid. ⓑ Liquid. ⓒ Gaseous. ⓓ Plasma



(11) Each of the following is an example of the plasma state, **except** ..... (Sohag 26)
ⓐ lightning. ⓑ sand. ⓒ the Sun. ⓓ Aurora

(12) The matter used in indoor air conditioning systems to purify air is in the ..... state. (Alexandria 26)
ⓐ solid ⓑ liquid ⓒ gaseous ⓓ plasma

3 Complete the following sentences:

(1) The ..... has succeeded in explaining much of the behaviour and ..... of matter. (Alexandria 26)

(2) The particles of the same substance are ....., but they ..... from one substance to another. (Port Said 26)

(3) The particles of matter store ..... energy due to the presence of ..... between them. (Beheira 26)

(4) The particles of matter have ..... energy because of their continuous motion. (Beni Suef 26)

(5) The particles of a gaseous substance move with a ..... motion, while the particles of a solid substance move with a ..... motion. (Qena 26)

(6) The intermolecular spaces between iron molecules are ....., while the intermolecular spaces between hydrogen molecules are ..... (Beni Suef 26)

(7) The scientist ..... discovered the random motion of particles suspended in fluids, which became known as ..... (Giza 26)

(8) Brownian motion occurs as a result of the collision between ..... and ..... (Alexandria 26)

(9) When gases pass through a high electric field, their atoms are converted into ..... and ..... (Beheira 26)

(10) The plasma state is found in ..... and ..... (Cairo 26)

(11) In air conditioning systems, charged gas ions act to ..... harmful air pollutant particles, making the air .....

4 Correct the underlined words:

(1) The forces of attraction between the particles of **a liquid** substance are maximum. (Cairo 26)

(2) The intermolecular spaces between the molecules of liquid substances are **equal to** the intermolecular spaces between the molecules of gaseous substances. (Gharbia 26)

(3) The suspended particles in **solids** move randomly in a motion known as Brownian motion. (Dakahlia 26)

(4) Most of the matter in outer space is in the **gaseous** state. (Sharkia 26)

5 Put (✓) or (✗) for each statement, with correction :

(1) The particles of the same substance are different from each other. (Beheira 26) ( )

(2) The spaces between the particles of matter vary according to their physical state. ( )

(3) The particles of matter are in a state of continuous motion. (Fayoum 26) ( )

(4) The forces of attraction between water molecules are relatively weak, while between air molecules they are minimum. (Dakahlia 26) ( )

(5) The motion of gaseous matter particles is limited. (Giza 26) ( )

(6) The pollen grain moves randomly in one direction in water. ( )

(7) The materials that make up the Sun and the stars are in the gaseous state. ( )

6 Arrange each of the following in ascending order:

(1) Water / Ice / Water vapour "**in terms of:** the speed of motion of the particles".

(2) Wood / Oxygen / Oil "**in terms of:** the forces of attraction between particles".

(3) Hydrogen / Alcohol / Iron "**in terms of:** the spaces between the particles".

7 What is meant by:

(1) Modelling.

(2) Particle theory of matter. (Ismailia 26)

(3) Brownian motion. (Giza 26)

(4) Plasma state. (Monufia 26)

8 Give reason for each of the following:

(1) Solids have a definite shape and volume. (Sohag 26)

(2) Liquids have an indefinite shape and a definite volume. (Beheira 26)

(3) Gaseous substances have no definite shape or volume. (Cairo 26)

(4) The compressibility of gaseous substances. (Minya 26)

(5) Gases can fill the space in which they are contained.

(6) Gas particles move randomly with complete freedom. (Sohag 26)

(7) The fragrance spreads throughout the room when a perfume bottle is left open.

(8) The diffusibility of substances varies according to their physical states. (Dakahlia 26)

(9) A solid retains its shape regardless of the shape of the container in which it is placed. (Fayoum 26)

(10) It is easy to divide a quantity of water into small parts. (Monufia 26)

(11) The difficulty of breaking a piece of rock. (Port Said 26)

(12) The dissolution of table salt in water. (Giza 26)

(13) The diffusion of smoke from a candle wick in the air. (Gharbia 26)

9 What are the consequences of each of the following:

(1) Increasing the spaces between particles with respect to the forces of attraction. (Giza 26)

(2) Stirring a spoonful of sugar in a glass of water. (Sohag 26)

(3) The relatively large particles suspended in a fluid collide continuously with the fluid particles.

(4) Passing gases through a strong electric field. (Giza 26)

10 Compare between each of the following:

(1) Solid matter and gaseous matter "**in terms of:** the forces of attraction between particles". (Giza 26)

(2) Iron and water "**in terms of:** particle motion - interparticle spaces". (Alexandria 26)

(3) Liquid matter and gaseous matter "**in terms of:** interparticle spaces - interparticle attraction forces". (Cairo 26)

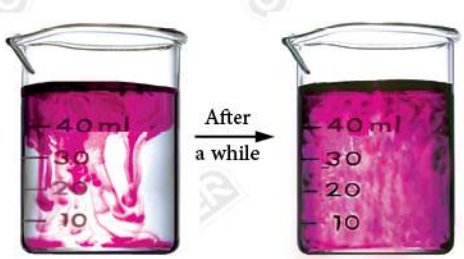
(4) Gases and plasma "**in terms of:** electric charge". (Qena 26)

11 Study the following figures, then answer:

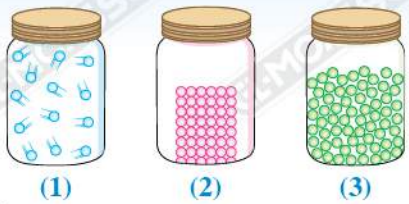
① **From the opposite figure:**

(1) **Explain** the reason for the diffusion of the colour of the dye in the glass of water in light of the particle theory.

(2) **Clarify** the effect of raising the temperature of the water on the speed at which the colour of the dye diffuses in it.



② **The opposite figure represents particles of three substances in different physical states:**



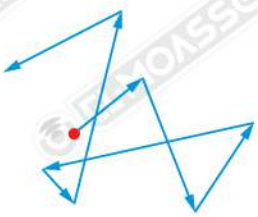
(1) What is the physical state of substance (2)?

(2) Which of these substances is classified as a fluid? (Monufia 26)

(3) In which of these substances is diffusion very fast? (Suez 26)

---

③ **The opposite figure shows the motion of a pollen grain in still water:**



(1) What is the scientific name for this motion?

(2) Explain why this motion occurs.

---

12 Variant questions:

① **State the assumptions** of the particle theory of matter. Four only are sufficient. (Giza 26)

---

② **Fluid particles move with a random motion known as Brownian motion:**

(1) To whom is the discovery of Brownian motion in fluids attributed? (Luxor 26)

(2) Give an example of Brownian motion. (Alexandria 26)

---

③ List the four states of matter, **giving an example for each.**

---

④ **Upon extreme heating of gases, the fourth state of matter is formed:**

(1) What is the name given to this state of matter?

(2) What are the characteristics of this state?

(3) Where is this state found?

---

⑤ **State two** natural phenomena that represent the fourth state of matter.

---

⑥ **Mention a technological application** of the plasma state, explaining the idea behind its operation. (Alexandria 26)

---

⑦ **State the importance** of plasma in air conditioning systems. (Port Said 26)

Higher-Order Questions (Answered)

13 Choose the correct answer:

(1) An empty, sealed solid container with a volume of 250 cm^3, from which 40 cm^3 of the air inside was withdrawn.

What is the volume of air remaining in the container?

ⓐ 200 cm^3. ⓑ 210 cm^3. ⓒ 250 cm^3. ⓓ 290 cm^3.

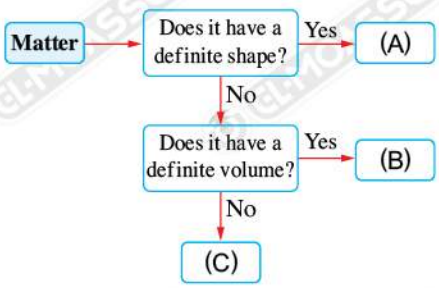
(2) The ratio between the speed of diffusion of matter particles through liquids and the speed of diffusion of matter particles through gases is ..... one.

(Cairo 26)

ⓐ greater than ⓑ less than ⓒ equal to ⓓ double

14 In the opposite flowchart for each of (A), (B), (C), determine which of the following is appropriate:

- Sand.
- Air.
- Honey.



15 From the opposite table:

(1) **Arrange** the substances (A), (B), (C) in ascending order, according to the forces of attraction between their particles.

(2) **Which** of these substances can flow? **With explanation.**

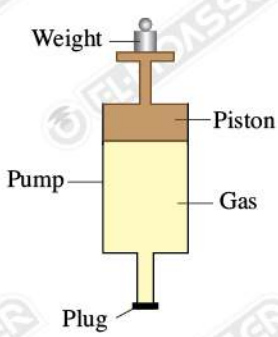
Substance	(A)	(B)	(C)
Properties	Compressible	Definite shape	Definite volume and indefinie shape

16 From the opposite figure, state what happens when the number of weights placed on top of the piston is increased, with respect to:

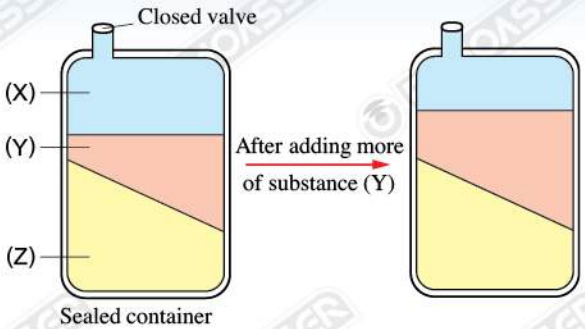
(1) The volume of the gas.

(2) The spaces between the gas particles.

(3) The volume of the gas particles themselves.



17 **The opposite figure shows a sealed container holding three different substances. When more of substance (Y) is added to it, only the volume of substance (X) decreases:**

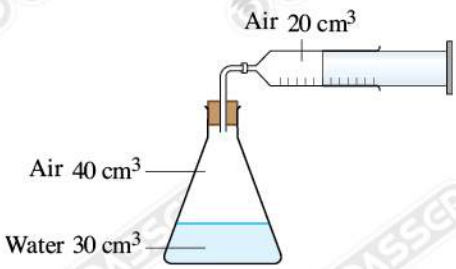


(1) **What** are the physical states of (X), (Y), and (Z)?

(2) **Which** particles of these substances can move completely freely?

18 **From the opposite figure:**

What is the volume of water and air in the flask after pumping 20 cm^3 of air from the syringe into the flask?



19 **Three metal cylinders, each with a volume of:**

(A) : 150 cm^3

(B) : 90 cm^3

(C) : 200 cm^3

Which of these cylinders can be pumped with 180 cm^3 of air ? **With explanation.**

20 **Explain the following statement:**

A closed container with a volume of 100 cm^3 can hold 120 cm^3 of air but not the same volume of water.

Second ? School Book Questions

1 Choose the correct answer:

(1) Air and water are similar in that they both ..... (Sohag 26)

ⓐ have mass. ⓑ can be seen.

ⓒ have a fixed shape. ⓓ have a fixed volume.

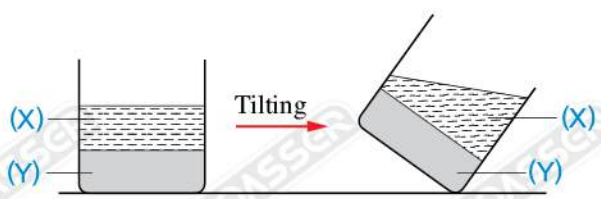
(2) You have two groups of substances, which are:

- Group (X): oil, wood and marble.
- Group (Y): oxygen, nitrogen and hydrogen.

Which of the following represents one of the properties of groups (X) and (Y)?

Choices	Group (X)	Group (Y)
ⓐ	Occupies space	Does not occupy space
ⓑ	Has a fixed shape	Has no fixed shape
ⓒ	Has a fixed volume	Does not have a fixed volume
ⓓ	Can be compressed	Cannot be compressed

(3) When a container containing two substances (X) and (Y) is tilted, their positions become as shown in the opposite figure:



Which of the following determines the state of substances (X) and (Y)?

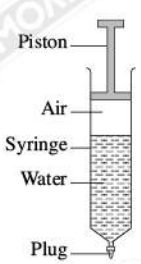
ⓐ (X): Solid, (Y): Liquid.

ⓑ (X): Liquid, (Y): Liquid.

ⓒ (X): Liquid, (Y): Solid.

ⓓ (X): Solid, (Y): Gas.

(4) In the opposite figure:



What happens to the volume of each of water and air, respectively, when the piston of the syringe is pressed?

ⓐ Decreases, decreases.

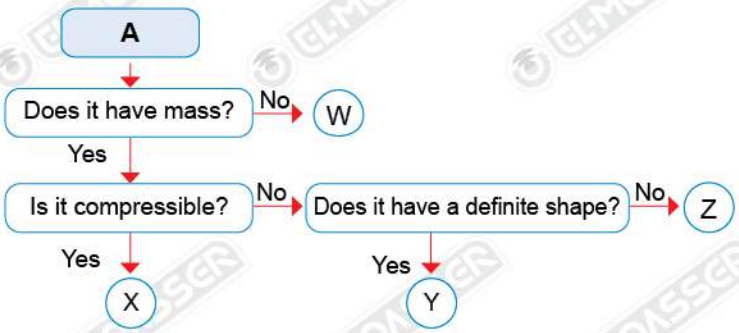
ⓑ Remains unchanged, increases.

ⓒ Remains unchanged, decreases.

ⓓ Increases, decreases.

2 **From the opposite chart, match each of W, X, Y and Z with the appropriate option below:**

- Juice.
- Air.
- Light.
- Heat.
- Iron.
- Carbon dioxide.

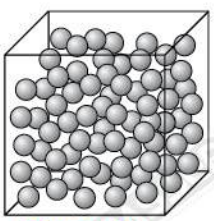


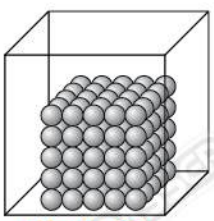
3 **The two opposite figures represent two states of matter:** (Beheira 26)

(1) **Which** of the two figures represents a fluid, **and what** is its state?

(2) **Compare** the states of matter shown in the two figures, **in terms of:**

1. The forces of attraction between the particles.
2. The movement of the particles.


Figure (1)


Figure (2)

Answers and Ideas of Solution of School Book Questions

1 **(1) Idea of solution:**

∵ Air is a gaseous mixture that cannot be seen and it has no definite shape or fixed volume.

∴ Choices ⓑ , ⓒ , and ⓓ are eliminated.

Solution: The correct choice is: ⓐ

(2) Idea of solution:

∵ Group (X) includes liquid substances (oil) and solid substances (wood, marble).

∴ Choices ⓑ and ⓓ are eliminated.

∵ Group (Y) includes gaseous substances.

∴ Choice ⓐ is eliminated.

Solution: The correct choice is: ⓒ

(3) Idea of solution:

∵ The shape of substance (X) changes when the container is tilted, while the shape of substance (Y) remains fixed and both remain inside the container.

∴ (X): Liquid substance.

(Y): Solid substance.

Solution: The correct choice is: (c)

(4) Idea of solution:

∵ Water is an incompressible liquid and air is a compressible gas.

∴ The volume of water does not change, while the volume of air decreases.

Solution: The correct choice is: (c)

2 Idea of solution:

∵ (W) doesn't have mass.
∴ (W) is not matter.

∵ (X) is a compressible substance.
∴ (X) is a gaseous substance.

∵ (Y) is an incompressible substance with a definite shape.
∴ (Y) is a solid.

∵ (Z) is an incompressible substance with no definite shape.
∴ (Z) is a liquid substance.

Solution:

- (W): light, heat.
- (X): Air, carbon dioxide.
- (Y): Iron.
- (Z): Juice.

3 (1) Figure (1) / Liquid.

(2)

	Figure (1)	Figure (2)
1. The forces of attraction between particles	Relatively weak	Very strong
2. The movement of particles	They move relatively freely in the container holding them	They move in a vibrating motion in their fixed positions without translating to another position

Third Test on Lesson One

15 marks

1 **Ⓐ Choose the correct answer:** ..... 2 marks

(1) Liquid substances have ..... (Dakahlia 26)

ⓐ fixed volume and fixed shape.

ⓑ fixed volume and variable shape.

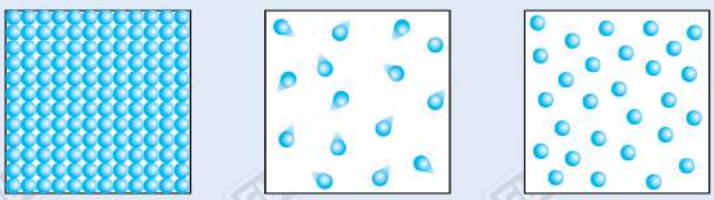
ⓒ variable volume and fixed shape.

ⓓ variable volume and variable shape.

(2) Most matter in outer space exists in the ..... state.

ⓐ solid ⓑ liquid ⓒ gaseous ⓓ plasma

Ⓑ The following figures represent substances in three different states: ..... 3 marks



(1) (2) (3)

(1) What type of motion do the particles of substance (1) have?

* .....

(2) Which of these substances is capable of flowing and compressible?

* .....

(3) Which of these substances are considered fluids? (Suez 26)

* .....

2 **Ⓐ Give reason for each of the following:** ..... 2 marks

(1) The dissolution of table sugar in water.

* .....

(2) The shape of a piece of copper does not change when it is transferred from one container to another. (Ismailia 26)

* .....

Ⓑ Write the scientific term for each of the following statements: ..... 3 marks

(1) The random motion of relatively large particles suspended in a fluid as a result of their collisions with it. (Giza 26)

(2) Anything that has mass and volume. (Qena 26)

(3) The motion of matter particles from a region of high concentration to a region of low concentration. (Dakahlia 26)

3 Ⓐ Compare between:

2 marks

(1) Air and water "**in terms of:** compressibility". (Beheira 26)

* .....

(2) Solids and gases "**in terms of:** the speed of diffusion through them". (Cairo 26)

* .....

Ⓑ Answer the following questions:

(1) **Mention two factors** that affect the speed of diffusion of matter particles through fluids. (Alexandria 26)

3 marks

* .....

(2) **State two assumptions** of the particle theory. (Aswan 26)

* .....

(3) **What is the importance** of plasma in air conditioning systems? (Port Said 26)

* .....