- **States of Matter** ∞
- Molecular Model ∞
- **Evaporation**

HAMMADHUSSIAN **KINETIC MODEL OF MATTER**

- State the distinguishing properties of solids, liquids and gases.
- Describe qualitatively the molecular structure of solids, liquids and gases, relating their properties to forces and distances between molecules and to the motion of the molecules.

STATES OF MATTER

STATE OF MATTER

- Matter is made up of a tiny particles called atoms and molecules. These particles are much too small to be seen by human eyes.
- The three states of matter are called solid, liquid and gas.
- Ice, water and steam are three different states of matter of the same material.















- Describe the relationship between the motion of molecules and temperature.
- Explain the pressure of a gas in terms of the motion of its molecules.

MOLECULAR MODEL

KINETIC MODEL

- The kinetic theory of matter states that all matter is made up of a large number of tiny atoms or molecules which are in continuous motion.
- The existence of particles in continuous motion has been demonstrated by Brownian motion and diffusion.

MOTION OF MOLECULES AND TEMPERATURE



When temperature increases, thermal energy is transferred to the molecules and the molecules gain kinetic energy. Hence the molecules move faster.

MOTION OF MOLECULES AND PRESSURE

- When randomly moving gas molecules hit the wall of a container they exert a force on the wall.
- As the pressure is defined as force per unit area, the force acting in the container gives rise the gas pressure.



BOYLE'S LAW





- × Kinetic energy of air molecules is constant.
- When volume of air decreases, frequency of air molecule collision increases.
- × Pressure of air increases.

CHARLES'S LAW





- Air molecules gain heat energy and convert it into kinetic energy.
- Air molecule move faster and further from each other.
- Space between air molecules expands and volume increases.

PRESSURE LAW





Describe evaporation in terms of the escape of more energetic molecules from the surface of a liquid.

ANNA

EVAPORATION

EVAPORATION

- Evaporation occurs when liquid below its boiling point changes into a gas.
- It happens because some particles in the liquid move faster than others.
- The faster one near the surface have enough energy to escape and form a gas.



Describe how temperature, surface area and draught over a surface influence evaporation

EVAPORATION

FACTOR AFFECTING THE RATE OF EVAPORATION

- Temperature the higher the temperature of the liquid, the higher the average kinetic energy of the molecules.
- Area of the exposed surface when the exposed area is large, the liquid molecules have more opportunities to leave the surface of the liquid.
- Humidity of the surrounding air if the humidity is high, there is a lot of water vapour in the air and liquid vapourisation is suppressed.

- Motion of air the motion of the air carries away the water vapour formed by evaporation.
- Pressure the lower the external pressure, the higher the rate of evaporation.
- Nature of liquids under similar conditions, a liquid with a low boiling point evaporates more rapidly.

Explain that evaporation causes cooling

AMMA

EVAPORATION

COOLING BY EVAPORATION

- * The molecules of liquid are in continuous motion.
- * They move at different speeds and the average kinetic energy of the molecules increases with temperature.
- The escape of a faster moving molecules leaves behind molecules having lower speeds.
- As average speed decreases, the average kinetic energy of the molecules remained in the liquid also decrease.
- × Therefore the temperature of the liquid falls.



EXAMPLE

- 1. What is a property of both liquids and gases?
 - A. They always fill their containers.
 - B. They are incompressible.
 - c. They can flow.
 - D. They have molecules in fixed positions.

- 2. When ice melts to become water, which force must be overcome?
 - A. the attraction between electrons and the nucleus
 - B. the attraction between the atoms in a molecule
 - c. the force between molecules
 - D. the force of gravity

3. Assuming the temperature remains constant, which combination correctly describes the volume and the shape of a gas or liquid?

$\left \right $		gas or liquid	volume	shape
//	A	gas	fixed	not fixed
	B	gas	not fixed	not fixed
	С	liquid	fixed	fixed
4	D	liquid	not fixed	fixed

B

4. Which line in the table correctly describes whether the molecules of a solid, liquid and gas are moving or stationary?

	solid	liquid	gas
Α	stationary	stationary	stationary
В	stationary	stationary	moving
С	stationary	moving	moving
D	moving	moving	moving

5. What describes the molecular structure of a liquid?

	distance between the molecules	motion of the molecules	strength of forces between the molecules
Α	close together	stationary	very strong
в	close together	random	fairly strong
С	far apart	stationary	fairly strong
D	far apart	random	weak

B

6. Which line in the table describes the properties of solids and of liquids at a fixed temperature?

	solids	liquids
Α	definite volume and definite shape	no definite volume but definite shape
в	no definite volume but definite shape	definite volume and definite shape
С	definite volume and definite shape	definite volume but no definite shape
D	no definite volume but definite shape	no definite volume and no definite shape



- A student has three sealed plastic bags.
 One bag is full of gas, one of liquid and one of solid.
- 8. The student squeezes each bag to see if it changes shape, and warms each bag to see if it expands.





Which bag contains gas?

- A. the one that changes shape easily and expands the least when heated
- B. the one that changes shape easily and expands the most when heated
- c. the one that is fixed in shape and expands the least when heated
- D. the one that is fixed in shape and expands the most when heated

- 8. A substance consists of particles that are close together and moving past each other at random.
 - The average speed of the particles is gradually increasing.
 - What best describes the substance?
 - A. a gas being heated
 - B. a liquid being heated
 - c. a solid being heated
 - D. a solid being melted

9. Which of the following contains the molecules with the highest average speed?



D

- 10. A gas cylinder is left outside on a sunny day. The Sun heats the gas inside the cylinder. What happens to the gas molecules?
 - A. They collide less often.
 - B. They expand.
 - c. They move closer together.
 - D. They move more rapidly.

11. The diagram represents gas molecules contained in a cylinder. The piston is moved slowly downwards and the temperature of the gas stays the same.



Why does the pressure of the gas increase?

- A. The molecules collide harder with the walls.
- B. The molecules collide more often with the walls.
- c. The molecules move more quickly.
- D. The number of molecules increases.

12. Driving a car raises the temperature of the tyres.

This causes the pressure of the air in the tyres to increase.

Why is this?

- A. Air molecules break up to form separate atoms.
- B. Air molecules expand with the rise in temperature.
- c. The force between the air molecules increases.
- D. The speed of the air molecules increases.

13. A balloon is inflated in a cold room. When the room becomes much warmer, the balloon becomes larger

How does the behaviour of the air molecules in the balloon explain this?

- A. The molecules become larger.
- B. The molecules evaporate.
- c. The molecules move more quickly.
- D. The molecules repel each other.

14. A cylinder is filled with a gas and then sealed, so that the gas has a fixed volume.
15. The gas molecules are given energy so that their average speed increases.
16. What happens to the pressure and to the temperature of the gas in the cylinder?



- 15. A liquid is heated.
- 6. Which statement is incorrect?
 - A. The molecules expand.
 - B. The molecules gain energy.
 - c. The molecules move further apart.
 - D. The molecules move faster.

- 16. Some air is trapped inside a small balloon. The average kinetic energy of the air molecules in the balloop is increased.
- 17. What remains the same?
 - A. the density of the air in the balloon
 - B. the mass of the air in the balloon
 - c. the temperature of the air in the balloon
 - D. the volume of the air in the balloon

17. Air is pumped slowly into a car tyre to increase the pressure. The temperature of the air does not change?

Which line in the table is correct?

	number of molecules hitting 1 cm ² of the tyre each second	average speed at which molecules hit the tyre
Α	increases	increases
в	increases	unchanged
С	unchanged	increases
D	unchanged	unchanged

- A fixed mass of gas at constant temperature is compressed to reduce its volume.
- 19. How do the molecules of gas now strike the walls of the container?
 - A. less often than before with a higher velocity
 - B. less often than before with the same velocity
 - c. more often than before with a higher velocity
 - D. more often than before with the same velocity

- 19. A piston traps a certain mass of gas inside a cylinder. Initially the piston is halfway along the length of the cylinder.
- 20. The piston is now moved towards the open end of the cylinder. The temperature of the gas remains constant.



How are the density and the pressure of the gas affected by moving the piston?

	density	pressure
Α	decreases	decreases
в	decreases	unchanged
С	increases	decreases
D	increases	unchanged

Α

20. The pressure of a fixed mass of gas in a cylinder is measured. The volume of the gas in the cylinder is then slowly decreased.

21. Which graph could show the change of pressure of the gas during this process?

Kinetic Model of Matter



- 21. Some water molecules escape from the surface of a lake.
- 22. Which name is given to this process?
 - A. boiling
 - **B.** convection
 - c. evaporation
 - D. radiation

Thermal Properties of Matter

22. The diagram shows a cross-section through a rain-water puddle formed in a shallow hole in a road surface.

road surface

Over a period of time, air temperature, wind speed and wind direction remain constant.

- 2. What happens to the rate of evaporation of water from the puddle?
 - A. It decreases, because the surface area decreases.
 - B. It increases, because the puddle gets shallower.
 - c. It increases, because the surface area decreases.
 - D. It remains constant.

23. A liquid evaporates rapidly

- 24. Why does it cool?
 - A. Air molecules remove heat by contact with the liquid surface.
 - B. Energy is lost by convection currents.
 - c. Fewer molecules are left in the liquid.
 - D. Some of the most energetic molecules leave the liquid.

Thermal Properties of Matter

24. A student is investigating the evaporation of water.

The student can change:
 + the depth of the water;
 + the surface area of the water;
 + the temperature of the water.

Thermal Properties of Matter

How many of these changes, if any, would alter the rate at which evaporation occurs? HAMADHUS

A. 0 в. 1 c. 2 3

- 25. Some of the more energetic molecules in a liquid leave the surface, leaving the rest of the liquid slightly cooler.
- What is the name given to this process?
 - A. boiling
 - B. condensation
 - c. evaporation
 - D. freezing

- 26. A swimmer climbs out of a swimming pool on a warm, dry day. Almost immediately he begins to feel cold.
 Why is this?
 - A. The water allows a convection current to remove heat from his skin.
 - B. The water takes latent heat from his body in order to evaporate.
 - c. The water on his skin is a good conductor of heat.
 - The water prevents infra-red radiation from reaching his body.

27. A beaker of liquid is placed under a bell jar. The pressure of the air above the liquid is reduced and some of the liquid evaporates. This causes the liquid to become colder.



- Why does the temperature of the liquid fall?
- A. The air molecules blow away the liquid molecules.
- B. The air molecules cool down the liquid.
- c. The higher energy molecules leave the liquid.
- D. There are fewer molecules of liquid in the beaker.

28. Water spilled on the ground on a hot day evaporates.

29. Which diagram represents the change in arrangement of the particles in the water as it evaporates?



С

29. A drop of liquid falls on a student's skin and quickly evaporates.

- 30. What is the effect on the skin and the reason?
 - A. The skin cools because the most energetic molecules escape from the liquid.
 - B. The skin cools because the most energetic molecules remain in the liquid.
 - c. The skin warms because the most energetic molecules escape from the liquid.
 - D. The skin warms because the most energetic molecules remain in the liquid.