Complete Review Questions page 506 #1-15
SCH 3UI **Unit 5 Gases and Atmospheric Chemistry...**

Review:
*Matter is anything that has mass and occupies space.

***Particle Theory of Matter:**
1) Matter is made up of tiny particles...particles refer to atoms, ions or molecules

2) Particles of matter are in constant motion

3) Particles of matter are held together by strong electric forces

4) There are empty spaces between the particles of matter that are very large compared to the particles themselves

5) Each substance has unique particles of matter that are different from the particles of other substances

6) Temp affects the speed of the particles... higher T, the faster the speed of the particles

Particle theory of matter explains the following scientific phenomena:
-pure substances are homogeneous
-physical changes ie melting, evaporation, sublimation, dissolving...
-Characteristic physical properties ie density, viscosity,

11.1 Gases: Properties and Behaviour: Rd Section 11.1, pages 502-506, Complete the Worksheet and complete Review Questions #1-15 p506

*Under normal conditions matter exists as three possible states, S, L or G
- a fourth state exists called plasma exists - this is the state of matter at extremely high T > 5000°C

Properties of Solids, Liquids and Gases:

*Particles of **solids** are held together in a fixed position
-particles are arranged in a lattice structure, in this structure the particles cannot move past one another
-Therefore solids have a fixed volume and shape and are relatively incompressible compared to gases
-solid particles cannot move independently of each other
-the movement of one particle effects the movement of the other or it restricts the movement

*Particles of **liquids** are very close together, but they are not held in a fixed position
-Therefore liquids have no regular arrangement
-Liquids have a fixed volume but not a fixed shape and are also relatively incompressible compared to gases

*Particles of **gases** are spaced very far apart from other particles
-Therefore gases also have no regular arrangement
-Gases have no fixed shape, no fixed volume and are compressible
-Gas particles move freely in all directions

Copy Table 11.1 Properties and Particles of the Three States of Matter

State	Properties	Particles
Solid	-constant shape -constant volume -almost incompressible	-Particles are organized in a regular pattern, this is known as having “low disorder” and they vibrate in a fixed position
Liquid	-variable shape	-Particles are less organized than in a solid and

	-constant volume -almost incompressible	they are able to slide over and past one another
Gas	-Variable shape -Variable volume -Compressible…can be pushed or squeezed by a force to occupy a smaller volume	-Particles are much less organized than in other states and they bounce off each other and the walls of the container.

Changes of State and Forces between Particles

-Two main factors determine the state of a substance: the forces **_HOLDING_** the particles (ions, atoms, and molecules) together and the **_KINETIC__ _ENERGY_** of the particles, which tends to pull them apart. If there were no forces between particles, all substances would be **GASES**. Forces are necessary for particles to form liquids and solids. If the forces are very strong, a **_LARGE__** amount of kinetic energy is needed to pull the particles apart. If the forces are **_WEAK_** , particles with smaller amounts of kinetic energy can pull away from one another.

-The three types of forces that act between particles are…

1) Attractions between oppositely charged ions

2) Attractions between polar molecules

3) Attractions between non polar molecules

Copy Table 11.2 Attractive Forces that Influence the State of Matter

Type of Attractive Force	**State of Matter**	**Example**
-Between oppositely charged particles	Usually solid	NaCl
-Between polar molecules	S, L, G	Glucose, $C_6H_{12}O_{6(s)}$ ethanol, $CH_3CH_2OH_{(l)}$ $NH_{3(g)}$
-Between non polar molecules	S, L, G	Paraffin, $C_{30}H_{62\ (s)}$ Pentane, $C_5H_{12\ (l)}$ Carbon Dioxide $CO_{2\ (g)}$

Questions:

i) Explain why ethanol is polar and (pure) hydrogen chloride is polar but are different states at room temperature.

-Due to the OH bond in ethanol, ethanol is more polar than hydrogen chloride, therefore has stronger intermolecular forces and is a liquid at room temperature.

ii) What type of intermolecular forces do water and ammonia experience? **Hydrogen Bonding**

iii) What states are water and ammonia in at room temp? Why are they different?
-**The strength of the hydrogen bonding that is experienced with both water and ammonia is different. Shape of the molecule would play a role here. As a result water is a liquid at room temp, has stronger or greater hydrogen bonding than ammonia. Ammonia has less hydrogen bonding, therefore is a gas at room temp.**

iv) If both carbon dioxide and pentane are non polar, why are they different states at room temp?

-Pentane is a larger molecule than carbon dioxide. As a non polar molecule increases in size the attractive forces between the molecules of a substance increases. Therefore carbon dioxide is a gas at room temp and pentane is a liquid

The Kinetic Energy of Particles and Temperature of a Substance

-Particles in a substance have three types of motion and thus three types of kinetic energy.
… See Figures 11.2, 11.3 and 11.4 page 504 and draw the Figures below…

Vibration Rotation Translation

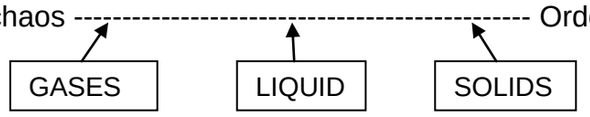
*__Solids__: can only vibrate in one spot

*__Liquids__: are free to move somewhat, ie liquids are pourable and can therefore vibrate and rotate – slipping past one another changing position

*__Gases__: vibrate, rotate and translate. Translate means particles have the ability to move from place to place independently of each particle
-gas particles move in straight lines, in random directions

ORDER:
-Identify where Solids, Liquids and Gases would be on the "Disorder-Order" line below.

Disorder aka chaos ---------- Order aka Structured



*As the Temp increases, the kinetic energy increases, which increase the particle movement, therefore weakens the attraction between the particles
*The type of forces of attraction between particles can be used as an indicator as to the state of the substance

Distinguishing Properties of Gases
-Each state of matter has physical properties that distinguish that state from another state. The following properties distinguish gases from solids and liquids.

List and explain the property, if needed on page 504

1) **Gases are compressible** – the volume of a gas decreases greatly when pressure is exerted on the gas, similarly volume of a gas increases when pressure is reduced. In contrast the volumes of liquids and solids remain almost constant during changes in pressure. Gas particles can move independently of one another. Particles in liquid and solid phase can not move independently of each other.

2) **Gases expand as the temperature is increased**, if the pressure remains constant… the volumes of liquids and solids can also increase with increasing temp, but to a much smaller degree.

3) **Gases have very low viscosity**. The viscosity of water if 55 times greater than the viscosity of air. Air and all other gases flow through pipes more freely compared to liquids. The low viscosity of gases enables them to escape quickly through small openings.
4) **Gases have a much lower densities than solids or liquids**. The density of water vapour is 1/1000 the density of liquid water.

5) **Gases are miscible**. All gases are miscible. They mix readily with each other.

KMT (Kinetic Molecular Theory) of Gases
The kinetic molecular theory of gases provides a scientific model for explaining the behaviour of gases. To develop the theory, scientists defined a hypothetical substance call an ideal gas. An ideal gas is defined by specific characteristics related to the energy and motion of the gas particles as shown in Figure 11.5. The kinetic molecular theory of gases is based on the following assumptions.
-List the 5 assumptions of KMT and define an ideal gas on page 505

1) **Gas particles are in constant, random motion**. Gas particles travel in straight lines. An ideal gas has high translational kinetic energy.

2) **Individual gas particles are considered point masses**. A point mass is a mass that has no volume, it takes up no space. The volume of an individual gas particle is negligible compared to the container holding the gas.

3) The gas particles do not exert attractive or repulsive forces on one another

4) **The gas particles interact with one another and with the walls of their container only through elastic collisions**. In elastic collisions kinetic energy is conserved. Particles can exchange kinetic energy with one another in a collision, but the total kinetic energy remains constant.

5) **The average kinetic energy of gas particles is directly related to temperature**.

Define Ideal Gas: A hypothetical gas made up of particles that have mass but no volume and no attractive forces between them.

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