CHEMISTRY

GASES

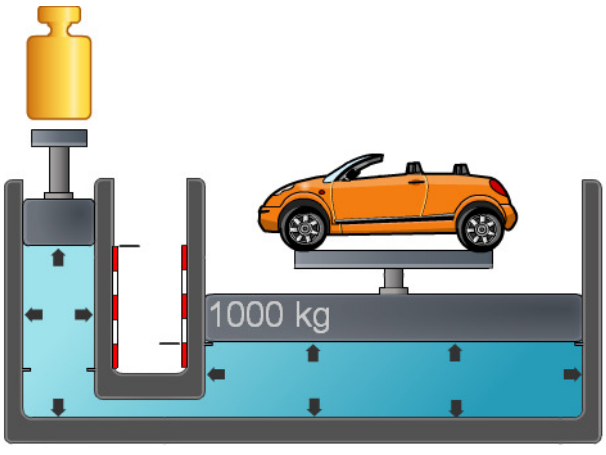
STATES OF MATTER AND THE KINETIC MOLECULAR THEORY

Molecular Theory

Most of the universe consists of plasma, a state of matter that exists above 5000°C. Here on Earth, the temperature fluctuations allow for three states of matter solids, liquids, and gases. Regardless of what state matter is in, it is always comprised of tiny interacting particles called atoms or molecules.

Solids and Liquids

Solids and liquids are incompressible. This means that the particles involved cannot squeeze closer together, or compress. This is due to the strong interaction between neighboring particles. Moving one particle has a direct effect on the ones beside it.

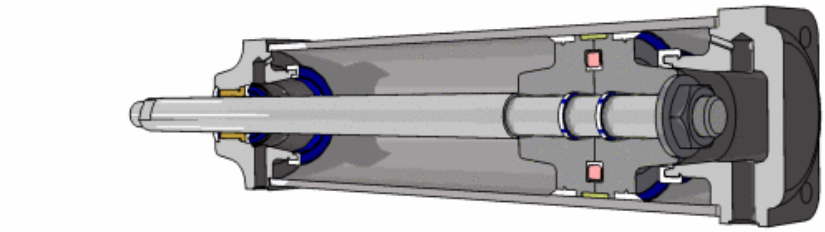


CHEMISTRY

GASES

Gases

Unlike solids and liquids, particles in a gas are able to move freely or independent of one another. Gas particles move much faster than those found in liquids. Liquids particles will always sink towards the bottom of a container. Gas molecules move so fast and are so small that they can defy gravity. Because of this they are free to travel in all directions and will completely fill the container that they are placed in. Since gas particles have very little effect on one another they can be compressed. If one were to compress a gas to the point where the individual particles came in close contact, the gas would then ***condense*** back into a liquid (***Ex: A BBQ Tank***).



Another way to condense a gas (other than by mechanical compression) is to cool the gas so the particles slow down and come in closer proximity to one another.

CHEMISTRY

GASES

KINETIC MOLECULAR THEORY OF GASES

- A gas will expand to fill its container. As such it will spread itself out so far, that the majority of the container is empty space.
- There are neither attractive, nor repulsive forces between gas particles.
- Gas particles randomly move in all directions, traveling in straight lines.
- Gas particles will change directions when they collide with one another.
- The speed of a gas molecule depends on the surrounding temperature. The higher the temperature, the faster the speed.

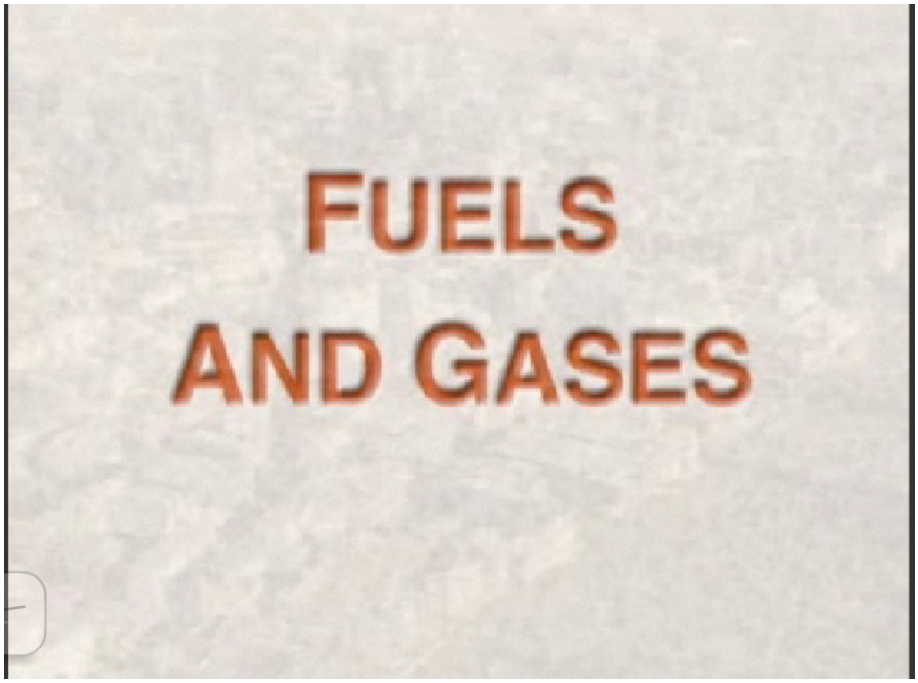
CHEMISTRY

GASES

Cheesy Chemistry Movies

CHEMISTRY

GASES



CHEMISTRY

GASES

Pg. 503 & Pg. 506

Learning Check

1. Using water as an example, name and distinguish between the three physical states of matter.
2. How is the state of a substance related to the attractive forces between its particles?
3. How is the state of a substance related to the arrangement of its particles?
4. Why would all substances be gases if there were no forces between particles?
5. Describe the relationship between the state of a substance and the kinetic energy of its particles.
6. Use a graphic organizer to distinguish the three types of forces between particles of substances.

Review Questions

1. K/U What is the relationship between the strength of the attractive forces between the particles of a substance and the state of matter of the substance?
2. K/U How does the polarity of a molecule affect the state of a substance composed of that molecule?
3. C Draw a diagram that shows the attractive forces that occur for methanol, CH_3OH, and phosphine, PH_3. Based on these forces, identify the molecule that you predict would be a gas at room temperature, and explain why. (**Hint:** To draw methanol, the carbon atom is bonded to three hydrogen atoms and the oxygen atom. The fourth hydrogen atom is bonded to the oxygen.)
4. T/I Ammonia, $NH_3(g)$, is a gaseous compound with a boiling point of $-33.34°C$. Why is its boiling point substantially lower than the boiling point of water? Explain your answer.
5. K/U Describe two properties of matter in the solid or liquid state that distinguish it from matter in the gas state.
6. T/I A party balloon filled with helium gas is left to float in a room. Over time, the balloon falls back to the floor. Explain the behaviour of the balloon. (**Hint:** There are microscopic pores in the surface of the material that is used to make a party balloon.)
7. K/U For each property, explain how a gas differs from a liquid.
   - **a.** viscosity
   - **b.** compressibility
   - **c.** density
   - **d.** miscibility
8. A Identify a property of gases that is important in hot-air ballooning. Explain why you think it is important.
9. T/I Use the kinetic molecular theory to explain how a basketball is inflated.
10. A Which property of gases best explains each of the following situations? Explain your reasoning.
    - **a.** A full propane tank can provide enough fuel to run a propane barbecue for several months.
    - **b.** A carbon monoxide leak in the lower level of a building causes carbon monoxide gas to spread quickly throughout the whole building.
    - **c.** Forced air heating is often a better choice for home heating than hot water (radiator-type) heating.
11. A Hand pumps are often used to fill deflated bicycle tires with air. In a hand pump, a piston is pushed through a cylinder and air is transferred to the deflated tire. How do the properties of compressibility, low resistance to flow, and even and complete mixing relate to the inflation of tires?
12. K/U How does an elastic collision differ from an inelastic collision? To visualize an inelastic collision, imagine throwing a ball of putty against a wall.
13. K/U Describe the characteristics of an ideal gas. How do real gases differ from this hypothetical model?
14. T/I The images below show three possible paths for a gas molecule moving inside a filled volleyball. Which of these diagrams represents the most likely path of the gas molecule? Justify your choice in terms of the kinetic molecular theory of gases.

15. C Draw diagrams to show how the kinetic molecular theory can explain the following:
    - **a.** why a heated gas expands to fill its container
    - **b.** why gases can be easily compressed