

# Physical and Chemical Changes Notes

## I. Physical Changes

- a. Physical changes are about \_\_\_\_\_ and \_\_\_\_\_

When you step on a can and crush it, you have forced a physical change. The shape of the object has changed. It wasn't a change in the state of matter, but something changed.

When you melt an ice cube you have also forced a physical change (adding energy). That example caused a change in the state of matter.

Melting a sugar cube is a physical change because the substance is still sugar.

- b. You can cause physical changes with forces like \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

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## II. Chemical Changes

- a. Chemical changes happen on a \_\_\_\_\_.
- b. Chemical changes happen on a much \_\_\_\_\_ scale. While some experiments show obvious chemical changes such as a color change, most chemical changes happen between \_\_\_\_\_ and are \_\_\_\_\_.

Burning a sugar cube is a chemical change. The energy of the fire has broken down the chemical bonds.

## III. States of Matter

States are also known as \_\_\_\_\_.

\_\_\_\_\_ and \_\_\_\_\_ can move from one phase to another phase when special \_\_\_\_\_ forces are present.

One example of those forces is \_\_\_\_\_. The phase or state of matter can change when the temperature changes. Generally as the temperature \_\_\_\_\_, matter moves to a more active state.

### a. SOLIDS

- i. Solids are usually hard because \_\_\_\_\_. The closer your molecules are, the harder you are.

- ii. Solids also can hold their own shape. A rock will always look like a rock unless something happens to it. The same goes for a diamond. Even when you grind up a solid into a powder, you will see little tiny pieces of that solid under a microscope. Liquids will move and fill up any container. Solids like their shape.
- iii. In the same way that a solid holds its shape, the atoms inside of a solid are not allowed to move around too much. This is one of the \_\_\_\_\_ of solids.
- iv. Atoms and molecules in liquids and gases are bouncing and floating around, free to move where they want. The molecules in a \_\_\_\_\_ are stuck. The atoms still spin and the electrons fly around, but \_\_\_\_\_.

**b. LIQUIDS**

- i. Liquids are an \_\_\_\_\_ state of matter. They can be found in between the solid and gas states.
- ii. One characteristic of a liquid is that it takes the \_\_\_\_\_ of the container.
- iii. Another trait of liquids is that they are difficult to \_\_\_\_\_. When you compress something, you take a certain amount of substance and force it into a smaller space.
- iv. Liquids already have their atoms close together, so they are hard to compress. Many shock absorbers in cars compress liquids
- v. Liquids have \_\_\_\_\_ (sticky) forces at work that hold the molecules together.

**c. GASES**

- i. Gases are spread out and the atoms and molecules are full of \_\_\_\_\_. They are bouncing around constantly.
- ii. Gases can fill a container of any \_\_\_\_\_ or \_\_\_\_\_.
- iii. Gases hold huge amounts of energy, and their molecules are spread out as much as possible.
- iv. These molecules can be \_\_\_\_\_. Combinations of \_\_\_\_\_ and decreasing \_\_\_\_\_ force gases into tubes that we use every day. You might see compressed air in a spray bottle or feel the CO<sub>2</sub> rush out of a can of soda. Those are both examples of gas forced into a space smaller than it would want, and the gas escapes the first chance it gets.

**d. PLASMA**

- i. Plasmas are a lot like gases, but the atoms are different because they are made up of \_\_\_\_\_ and \_\_\_\_\_ of the element.

Fluorescent light bulbs are not like regular light bulbs. Inside the long tube is a gas. Electricity flows through the tube when the light is turned on.

- ii. The electricity acts as that special energy and \_\_\_\_\_ up the gas. This charging and \_\_\_\_\_ of the atoms creates glowing plasma inside the bulb.

You don't find plasmas too often when you walk around. They aren't things that happen regularly on Earth. If you have ever heard of the Northern Lights or ball lightning, you might know that those are types of plasmas.

- iii. You also see plasma when you look at stars. **Stars** are big balls of gases at very high temperatures. The high \_\_\_\_\_ charge up the atoms and create plasma.

- iv. Stars are another good example of how the temperature of plasmas can be very different. Fluorescent lights are cold compared to really hot stars. They are still both forms of plasma, even with different \_\_\_\_\_ characteristics

#### IV. Bose-Einstein Condensate (5<sup>th</sup> State of Matter)

- a. Predicted in 1924 by Albert Einstein, who built on the work of Satyendra Nath Bose, the condensation occurs when individual atoms meld into a "superatom" behaving as a single entity at just a few hundred billionths of a degree above absolute zero.
- b. The atoms within the condensate obey the laws of quantum physics and are as close to absolute zero—minus 273.15 Celsius or minus 459.67 degrees Fahrenheit—as the laws of physics will allow. The physicists likened it to an ice crystal forming in cold water.
- c. The team led by Cornell and Wieman used laser and magnetic traps to create the BEC, a tiny ball of rubidium atoms that are as stationary as the laws of quantum mechanics permit. The condensate was formed inside a carrot-sized glass cell. Made visible by a video camera, the condensate looks like the pit in a cherry except that it measures only about 20 microns in diameter or about one-fifth the thickness of a sheet of paper.
- d. Wieman's technique cooled the atoms to about 10 millionths of a degree above absolute zero, still far too hot to produce Bose-Einstein condensation. About 10 million of these cold atoms were captured in the light trap. Once the atoms were trapped, the researchers turned off the laser and kept the atoms in place by a magnetic field. Most atoms act like tiny magnets because they contain spinning charged particles like electrons. The atoms can be trapped, or held in place, if a magnetic field is properly arranged around them.