

PHYSICAL SCIENCE NOTES – FOR CHEMISTRY PRE-TEST

CHAPTER 1 NOTES:

hypothesis – an educated guess based on knowledge and observation

independent variable – this is changed and this causes change in another variable

dependent variable – this changes in response to the change in other variables

constant – a variable that does not change during the experiment is a

control – the standard to which test results can be compared

Density - the ratio of an object's mass to its volume $D = \text{mass}/\text{volume}$

- ❑ The density of pure water is 1.00 g/cm^3 or 1.00 g/mL
- ❑ Each metal on the Periodic Table of Elements has a specific density value – these values can be found in chemistry books and on the Internet
- ❑ Substances that have a density of less than 1.00 g/mL will float on water

CHAPTER 2 NOTES:

Matter – anything that has mass and takes up space (has volume) is matter

- a. **Pure substance** – matter that always has exactly the same composition (ex: table salt, sugar). Every sample of a given substance has the same properties because a substance has a fixed, uniform composition.

Examples: elements and compounds

- b. **Mixture** – a material consisting of two or more substances. The properties of a mixture can vary because the composition of a mixture is not fixed.
 1. **Heterogeneous mixture** – a combination of two or more substances that are not uniformly dispersed (often composed of more than one phase of matter that separate into layers)
 2. **Homogenous mixture** – a combination of two or more substances that ARE uniformly dispersed and do not separate into layers (often called solutions)

Physical Properties – any characteristic of a material that can be observed or measured without changing the composition of the substances in the material

Examples: color, size, mass, viscosity, conductivity, malleability, melting point, boiling point, density

Chemical Properties – a property of matter that describes a substance's ability to participate in chemical reactions (and therefore change the composition of matter)

Examples: flammability and reactivity

Physical versus Chemical Changes

Physical Change – occurs when some of the properties of a material change, but the substances in the material remain the same (ex: heating butter, folding paper, braiding hair)

Some physical changes can be reversed while some cannot be reversed (ex: cutting hair, slicing a tomato)

Chemical Change – occurs when a substance reacts and forms one or more new substances. (ex: baking a cake, burning paper, dying hair)

There are four common types of evidence for a chemical change

1. Color Change (jewelry tarnishes)
2. Production of a Gas (baking soda with vinegar makes carbon dioxide)
3. Formation of a **Precipitate** – any solid that forms and separates from a liquid mixture
4. Gain or loss of heat

CHAPTER 3 NOTES:

Classifications of Matter – materials can be classified as solids, liquids, or gases based on whether their shapes and volumes are definite (will not change) or variable (changing).

- a. **Solid** – the state of matter in which materials have a definite shape and volume.
- Atoms are packed close together and are arranged in a regular pattern.
- b. **Liquid** – the state of matter in which a material has a definite volume but NOT a definite shape.
- Atoms are close together but their arrangement is more random than atoms in a solid.
- c. **Gas** – the state of matter in which a material has neither a definite shape nor a definite volume.
- Atoms are not arranged in a regular pattern and are spread far apart.

Phase Changes – the reversible physical change that occurs when a substance changes from one state of matter to another.

- a. The temperature of a substance does not change during a phase change.
- b. During a phase change, energy is transferred between a substance and its surroundings.
- c. **Melting** – the particles in solid absorb energy, overcome their forces of attraction, and it becomes a liquid
- d. **Freezing** – the particles in a liquid releases energy, start moving more slowly, their forces of attraction become stronger, and it becomes a solid
- e. **Vaporization** – the phase change in which a substance changes from a liquid into a gas. The particles in a liquid absorb energy, overcome their forces of attraction, and it becomes a gas
There are two vaporization processes:
 1. **Evaporation** – the process that changes a substance from a liquid to a gas at temperatures below the substance's boiling point. Some particles near the surface of the water are moving fast enough to escape the liquid and become vapor.
 2. **Boiling** – when a substance reaches its boiling point some molecules below the surface have enough kinetic energy to overcome the attraction of neighboring molecules. This causes bubbles of water vapor to rise through the liquid and be released.
- f. **Condensation** – the phase change in which a substance changes from a gas to a liquid
- g. **Sublimation** – the phase change in which a substance changes from a solid to a gas without changing to a liquid first
- h. **Deposition** – the phase change when a gas changes directly into a solid without first changing to a liquid

CHAPTER 4 NOTES:

Nucleus – a dense, positively charged mass located in the center of the atom (the plural of nucleus is nuclei).

Proton – a positively charged subatomic particle that is found in the nucleus of an atom. Each proton is assigned a charge of +1.

Electron – a negatively charged subatomic particle that is found in the space outside the nucleus. Each electron has a charge of -1.

Neutron – a subatomic particle that is found in the nucleus of an atom. It has a charge of 0 (uncharged) and has a mass almost exactly equal to that of a proton.

Atomic Number – the atoms of a specific element always have the same number of protons and this number is called the atomic number (ex: each oxygen atom has 8 protons, atomic number = 8). Atoms of different elements have different numbers of protons, therefore, different atomic numbers.

In a neutral atom, each positive charge is balanced by a negative charge so the atomic number of an element also equals the number of electrons in an atom.

Mass Number/Atomic Mass – the sum of the protons and neutrons in the nucleus of an atom. (Ex: an atom of Aluminum with 13 protons and 14 neutrons has a mass number of 27)

Isotopes – atoms of the same element that have different numbers of neutrons and different mass numbers.

Isotopes of an element still have the same atomic number because the number of protons stays the same.

Energy levels – the possible energies that electrons in an atom can have.

Electron cloud – a visual model of the most likely locations for electrons in an atom. The cloud is denser at those locations where the probability of finding an electron is high.

CHAPTER 5 NOTES:

The Periodic Table of Elements

Period: each row in the table of elements is a different period

- Each new period has an additional energy level of electrons.
- The first energy level can hold only 2 electrons, so only 2 elements are in the first period.
- The second energy level can hold only 8 additional electrons, so only 8 elements are in the second period.
- The third energy level can hold only 8 additional electrons, so only 8 elements are in the third period.

Group: each column on the periodic table is a different group

The elements within a group have similar properties.

Valence electron – an electron that is in the highest occupied energy level of an atom.

- These electrons play a key role in chemical reactions – atoms want to have a full outer energy level so they will gain or lose electrons to make this happen
- Properties vary across a period because the number of valence electrons increases from left to right
- Elements in a group have similar properties because they have the same number of valence electrons.

Element Characteristics

Metals – elements that are good conductors of electric current and heat

Most metals are malleable

Most metals are **ductile** – can be drawn into thin wires

Nonmetals – elements that are poor conductors of heat and electric current

Most are gases, but others are brittle solids

Metalloids – elements with properties that fall between those of metals and nonmetals
Ability to conduct electric current varies with temperature

CHAPTER 6 NOTES:

Ion- an atom that has a net positive or negative electric charge (the number of electrons has changed so that it no longer equals the number of protons)

Cation- an ion with a positive charge. The name of the element does not change: Na^{+1} is a sodium cation

Anion- an ion with a negative charge. The name of the element is shortened, then the suffix *-ide* is added, so Cl^{-1} is the chloride anion and S^{-2} is the sulfide anion

Ionic bond- the force that holds cations and anions together.

Ionic bonds form between metals and nonmetals

Ionic bonds form when electrons are transferred from one atom to another

Covalent bond- a chemical bond in which two atoms (two non-metals!!!) share a pair of valence electrons

CHAPTER 7 NOTES:

Chemical Reactions – when a substance undergoes a chemical change, a chemical reaction has taken place.

- The Law of Conservation of Mass** – states that mass is neither created nor destroyed
- A chemical reaction is written as Reactants \rightarrow Products
- Reactants** – the substances that undergo change
- Products** – the new substances formed as a result of that change
- Balancing Chemical Equations – this must be done to follow the Law of Conservation of Mass
 - Write the reaction in symbol form.
 - Draw a line down from the arrow and, on each side, write the symbols of each of the atoms present.
 - Count and record the numbers of each atom present on each side of the arrow.
 - Use coefficients to increase the number of atoms until they are balanced – DO NOT CHANGE THE SUBSCRIPTS ALREADY PRESENT IN THE REACTION!
- Coefficients**- the numbers that appear before the chemical formulas in a reaction.

CHAPTER 8 NOTES:

Acid – a compound that produces hydronium ions (H_3O^+) when dissolved in water.

Some general properties of acids include sour taste, reactivity with metals, and ability to produce color change in indicators.

Base – a compound that produces hydroxide ions (OH^-) when dissolved in water.

Some general properties of bases include bitter taste, slippery feel, and ability to produce color changes in indicators.

pH – number scale from 0 to 14 to describe the concentration of hydronium ions in a solution.

A pH of 7 indicates a neutral solution. Acids have a pH less than 7. Bases have a pH greater than 7.