Cosmo School

Chemistry

Class-10

Chapter-7

Chemical reactions

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Revision worksheet with lecture sheet-1

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Unit-1: Physical changes

Different types of changes are going on around us. These changes occur due to heat, pressure and contact with other substances. There are two types of changes: physical changes and chemical changes.

A chemical substance is composed of one or more elements. All chemical substances have a certain percent of composition of its elements.

Sometimes, changes occur only in physical states of substances leaving their chemical composition unchanged. For example, if we place a piece of ice in open air, it will convert into liquid by absorbing heat from the surroundings and if we heat the liquid up to 100^0 C, water vapor will produce.

$$H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$$

The chemical formula of ice, liquid water and water vapor is H_2O. That means in all the three phases two hydrogen atoms and one oxygen atom are present. The percent composition of H and O in all the three states of water are the same. This is a perfect example of physical change.

Physical change is a usually reversible change in the physical properties of a substance.

A physical change involves a change in physical properties. Examples of physical properties include melting, transition to a gas, change of strength, change of durability, changes to crystal form, textural change, shape, size, color, volume and density.

Often, physical changes can be undone, if energy is input.

No new chemical substances or species forms in a physical change. Changing the state of a pure substance between solid, liquid, and gas phases of matter are all physical changes since the identity of the matter does not change.

Examples of Physical Changes

- Crumpling a sheet of aluminum foil
- Melting an ice cube
- Casting silver in a mold
- Breaking a glass bottle
- Boiling or freezing water
- Evaporating alcohol
- Shredding paper
- Sublimation of dry ice into carbon dioxide vapor

Exercise-1:

1. What is meant by physical changes?
2. Sublimation of dry ice into carbon dioxide vapor is a physical change. Explain.

Unit-2: Chemical changes

Sometimes, when a substance changes due to heat, pressure and contact with other substances, new substances are produced with new chemical formula through changes in the percent composition of the existing elements in substances. This change is called chemical change. A chemical change results from a chemical reaction.

Chemical changes cannot be undone easily, The only way to reverse a chemical change is to do another chemical reaction.

The new substance can form from the elements of the previous substance by the dissociation or the addition of any element.

A new compound (product) results from a chemical change as the atoms rearrange themselves to form new chemical bonds through the breaking the existing bonds between atoms in reactants.

Examples of chemical Changes

- Burning wood
- Souring milk
- Mixing acid and base
- Digesting food
- Cooking an egg
- Heating sugar to form caramel
- Baking a cake
- Rusting of iron

Burning of wax is an example of both physical and chemical change, because it includes melting of wax (physical change) and burning that produces Carbon dioxide and water vapor (producing new products, thus chemical change)

How to tell whether it's a physical or chemical change?

- Look for an indication that a chemical change occurred. Chemical reactions release or absorb heat or other energy or may produce a gas, odor, color or sound. If you don't see any of these indications, a physical change likely occurred. Be aware a physical change may produce a dramatic change in the appearance of a substance. This doesn't mean a chemical reaction occurred.
- In some cases, it may be hard to tell whether a chemical or physical change occurred. For example, when you dissolve sugar in water, a physical change occurs. The form of the sugar changes, but it remains the same chemically (sucrose molecules). However, when

you dissolve the salt in water the salt dissociates into its ions (from NaCl into Na^+ and Cl^-) so a chemical change occurs. In both cases, a white solid dissolve into a clear liquid and in both cases, you can recover the starting material by removing the water, yet the processes are not the same.

Exercise-2:

1. What is meant by chemical change?
2. Burning cooking gas is a chemical change. Explain.
3. What is both a physical and chemical change?
4. How to tell whether it's a physical or chemical change?

Unit-3: Irreversible and reversible reactions

Watch the lecture video-1 on chapter-7 and read the text book properly for these topics and answer the following questions.

Exercise-3:

1. What is irreversible reaction and reversible reaction? Give examples.
2. What is meant by forward and backward reaction?
3. The reversible reactions never go to completion if performed in a closed container. Explain.
4. How can we convert a reversible reaction into irreversible reaction?
5. Explain esterification is a reversible reaction.

Unit-4: Endothermic reactions and Exothermic reactions

Any chemical reaction is accompanied by/with heat change.
The heat change may occur in two ways- they are Exothermic and Endothermic reactions.
An endothermic reaction is one which absorbs energy (heat)causing a temperature drop in the surroundings.
In an experiment, an amount of water is taken in a test tube and its temperature is measured with a thermometer. An amount of solid NH_4Cl is added to it and the temperature is measured again. The second temperature reading is lower than the previous one. This experiment proves that the reaction is endothermic.

An exothermic reaction is one ……
……
……

H' stands for 'heat' and the 'ΔH' represents the heat/enthalpy change in a chemical reaction.
The units of 'ΔH' are kJ mol^{-1}
Its value is positive for an endothermic reaction and negative for an exothermic reaction.

Exothermic energy changes are shown as negative because energy has been transferred from the chemicals (system) to surroundings.
Endothermic energy changes are shown as positive because energy has been transferred from surroundings to the chemicals (system).

Example 1:

$H_2 + O_2 \rightarrow H_2O \qquad \Delta H = -242\ kJmol^{-1}$

This means that when
1 mole of hydrogen is burnt completely in air 242 kJ heat is given out to the surroundings.

Example 2:

$N_2 + O_2 \rightarrow 2NO \qquad \Delta H = +187\ kJmol^{-1}$

This means that when
……. of nitrogen is reacted with oxygen…… kJ heat is……. from the surroundings causing …… in the surroundings.
Physical changes (phase changes) can be also endothermic and exothermic. When something freezes, it goes from liquid to solid, then energy(heat) is given out from liquid to surrounding. So, freezing is exothermic.

Exercise-4:

1. Make a comparison between exothermic and endothermic reactions.

Unit-5: Redox reactions (Oxidation-reduction reactions)

The simple definition of redox reaction is, in redox reaction electrons move between atoms.

The oxidation is loss of electrons and the reduction is gain of electrons.

[We can use two terms 'Oil' and 'Rig' as a trick to remember what is oxidation and reduction. 'Oil' means oxidation is loss of electrons and 'Rig' means reduction is gain of electrons.]

Let's take a chemical reaction where oxidation and reduction are taking place.

$Na + Cl \rightarrow Na^+Cl^-$

Sodium and chlorine coming together to make sodium chloride. NaCl is an ionic compound which means it is made up of ions (Na^+ and Cl^-) and these two ions attach together because these have opposite charges and opposite charges attract. But Na and Cl didn't always have charges. Before they combined, they have no charge. They are two electrically neutral atoms. So, in order to come together and make sodium chloride, these two atoms have to get charges.

So, sodium gives one of its electrons to chlorine and the charges come in and form ions. Na atom loses one electron so it becomes Na^+ and Cl atom gains an electron and becomes Cl^-. So, these two ions with opposite charges attach making NaCl.

Now using the oxidation and reduction concept we can describe what is happening to Na and Cl.

Na is giving up an electron, it is losing an electron. That means Na is undergoing oxidation and being oxidized.

On the other hand, Cl is ……. an electron, it is …… an electron. That means Cl is undergoing ……. and being …….

So, there is oxidation and reduction going on in a chemical reaction. We can express the oxidation and reduction writing chemical equations

Oxidation: $Na \rightarrow Na^+ + e^-$ [half reaction]

Reduction: $Cl + e^- \rightarrow Cl^-$ [half reaction]

Redox reaction: $Na + Cl \rightarrow Na^+Cl^-$

These two are called half reactions, because they individually can represent half process of the whole reaction. So, for every redox reaction we can write two half reactions. And now we can easily understand oxidation and reduction always have to happen at same time because if one atom is gaining an electron, that electron had to come from somewhere, so another atom had to give up that electron. Atoms cannot gain electrons from air. In case of NaCl, the electron that Cl atom is gaining, is the same electron that Na atom was releasing. So, oxidation and reduction have to always happen at the same time in parallel.

Exercise-5:

1. What is meant by redox reaction?
2. What is oxidation and reduction?
3. Why oxidation and reduction are called half reactions?
4. Oxidation-reduction occurs simultaneously. Analyze.