Nature of substances

1. Nature of substances : Simple particles react faster than complex particles. In complex molecules more bonds have to be broken. This means more energy is needed to form the activated complex. Particles such as atoms or ions in solution react more quickly than complex molecules.

Surface area of reactants : The greater the surface area of the reactants the faster the reaction will take place. This is because a greater surface area means more collisions between reacting particles. When a substance is ground into a powder this increases its surface area.

Concentration of reactants (or pressure of gases) : An increase in concentration increases the rate of a reaction. The increased concentration means more collisions between reacting particles.

Temperature : An increase in temperature increases the rate of a reaction. At a higher temperature particles move faster and have more kinetic energy. When particles collide they do so with enough energy to reach the activated complex. Heating a reaction means there will be a larger number of collisions and more of these collisions will be effective. A temperature increase of 10˚C, will double the rate of a reaction.

Use of Catalysts : A catalyst is a substance that will speed up a reaction without undergoing any permanent change. Catalysts lower the activation energy in a reaction by holding particles onto their surface and pointing them in the correct direction for a product to form. A substance that slows down a chemical reaction and makes it harder for a product to form is called an inhibitor.

2. The term “ quantitative approach” (the determination of the absolute or relative abundance (often expressed as a concentration) of one, several or all particular substance(s) present in a sample.) is often used in comparison (or contrast) with “ qualitative approach”, which seeks information about the identity or form of substance present. For instance, a chemist might be given an unknown solid sample. He or she will use “ qualitative” techniques (perhaps NMR or IR spectroscopy) to identify the compounds present, and then quantitative techniques to determine the amount of each compound in the sample. Careful procedures for recognizing the presence of different metal ions have been developed, although they have largely been replaced by modern instruments; these are collectively known as qualitative inorganic analysis. Similar tests for identifying organic compounds (by testing for different functional groups) are also known.

Many techniques can be used for either qualitative or quantitative measurements. For instance, suppose an indicator solution changes colour in the presence of a metal ion. It could be used as a qualitative test: does the indicator solution change colour when a drop of sample is added? It could also be used as a quantitative test, by studying the colour of the indicator solution with different concentrations of the metal ion. (This would probably be done using ultraviolet-visible spectroscopy.)

3. To ensure no residue is left to affect further experiments by either contamination or to ensure a powder is not mixed.

4. a)Litmus Paper is a paper containing dyes which change colour when exposed to acids or bases. It is used to identify acid and bases

b)A mixture of 10-15 natural dyes obtained from lichens (mainly *Roccella tinctoria*) that turns red in response to acidic conditions (pH < 7) and blue under alkaline conditions (pH > 7). When the pH is neutral (pH = 7) then the dye is purple.

c)To allow the litmus paper to absorb the pH of a solid object.

5. Precipitation is the formation of a solid in a solution during a chemical reaction. When the reaction occurs, the solid formed is called the precipitate, and the liquid remaining above the solid is called the supernate.

6. Mix acid with water, water first and next acid. The reason is that when you mix acid to water the concentration of the acid is immediately diluted by water and the gradient or the concentration difference between the water and the acid keeps decreasing gradually so is the liberation of heat and is safer. Mixing concentrated acid and water is highly exothermic in some cases the amount of heat generated can instantly boil. So if you add water to the concentrated acid the small amount of water will instantly boil and splatter hot acid all over the place. Some acids will generate Hydrogen gas and will ignite and explode. If you add the acid to the water the water can absorb most of the heat and it won’t splatter or explode.

7. Light the match first. If one was to turn the gas valve on before lighting the match, then the gas could build up and cause an explosion once the match is lit. This is why it is important to light the match first then turn on the gas valve.

8. a)To test for the presence of oxygen gas, collect a sample of the gas in a small container such as a test tube. Light a wooden splint. Blow out the flame, but make sure that the tip of the splint has a reddish, glowing tip. Insert the glowing splint into the mouth of the test tube.

If the glowing splint bursts into flame, the gas is oxygen.

b)To test for the presence of hydrogen gas, collect a sample of the gas in a small container such as a test tube. Light a wooden splint, but do not blow out the flame. Insert the burning splint into the mouth of the test tube.

If the gas is hydrogen, you will hear a slight explosive “ pop” sound.

c)To test for the presence of carbon dioxide gas, collect a sample of the gas in a small container such as a test tube. Add a small amount (2 to 3 ml) of lime water to the test tube and shake the test tube to mix the gas and the lime water.

If the lime water solution turns a milky white, the gas is carbon dioxide.

This test works because lime water and carbon dioxide gas react to form a white precipitate.

A second test is to light a wooden splint. Place the burning splint into the mouth of the test tube.

If the flame is extinguished, the gas may be carbon dioxide.

Since carbon dioxide is neither explosive nor does it support combustion, placing a burning splint into the mouth of the test tube containing carbon

dioxide extinguishes the flame. This second test is not a positive test for carbon dioxide however since other gases may also extinguish a flame since they too do not support burning. Therefore, the first test is better.

9. Place an Alka Seltzer tablet in the bottom of a balloon or plastic sandwich bag. Tie the encased tablet tightly with a rubber band or string, then fill the remainder of the balloon or bag with water and seal it with another rubber band or a piece of string. Carbon dioxide gas can be produced by loosening the rubber band or string around the tablet and allowing the water to reach the tablet.

10. Oxygen

11. a)A balanced equation contains equal numbers of each element on the reactant and on the product side of the equation.

b)i) (s) Solid

ii) ( )

iii) (g) Gaseous

iv) (ag) Aqueous ;;; f v) (↑) kjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjj g vi) (↓) kjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjjj g vii) (=)

12. a) A chemical reaction in which heat is absorbed, because the products are higher in energy than the reactants

b) A chemical reaction in which heat is released, because the products are of lower energy than the reactants

c) Redox (shorthand for reduction-oxidation reaction) describes all chemical reactions in which atoms have their oxidation number (oxidation state) changed. This can be either a simple redox process such as the oxidation of carbon to yield carbon dioxide or the reduction of carbon by hydrogen to yield methane (CH4), or it can be a complex process such as the oxidation of sugar in the human body through a series of very complex electron transfer processes.

d) Thermal decomposition, also called thermolysis, is defined as a chemical reaction when a chemical substance breaks up into at least two chemical substances when heated. The reaction is usually endothermic as heat is required to break chemical bonds in the compound undergoing decomposition.

e)

f)

13. 1 dm^3 = cm^3 = m^3 = ml = l

14. a)

b) Litres (l) or cubic metre (m3)

c)

d)

e)

f) Second (s)

g) Kilogram (kg)

h) Grams per mole (g/mol or gmol-1)