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Question 1:

Choose the correct option from the bracket and explain the statement giving reason.
(Oxidation, displacement, electrolysis, reduction, zinc, copper, double displacement, decomposition)
a. To prevent rusting, a layer of ..... metal is applied on iron sheets.
b. The conversion of ferrous sulphate to ferric sulphate is ..... reaction.
c. When electric current is passed through acidulated water ..... of water takes place.
d. Addition of an aqueous solution of $ZnSO_4$ to an aqueous solution of $BaCl_2$ is an example of ..... reaction.

ANSWER:

a. To prevent rusting, a layer of zinc metal is applied on iron sheets.
b. The conversion of ferrous sulphate to ferric sulphate is oxidation reaction.
c. When electric current is passed through acidulated water of electrolysis water takes place.
d. Addition of an aqueous solution of $ZnSO_4$ to an aqueous solution of $BaCl_2$ is an example of double displacement reaction.

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Question 2:

Write answers to the following.
a. What is the reaction called when oxidation and reduction take place simultaneously? Explain with one example.
b. How can the rate of the chemical reaction, namely, decomposition of hydrogen peroxide be increased?
c. Explain the term reactant and product giving examples.
d. Explain the types of reaction with reference to oxygen and hydrogen. Illustratre with examples.
e. Explain the similarity and difference in two events, namely adding NaOH to water and adding CaO to water.

ANSWER:

a. The process in which oxidation and reduction occurs simutaneously is called as redox reaction.

- **Oxidation** is the *loss* of electrons or an *increase* in oxidation state by a molecule, atom, or ion.
- **Reduction** is the *gain* of electrons or a *decrease* in oxidation state by a molecule, atom, or ion.

For example: If we add stannous chloride solution to the yellow solution of ferric chloride then light green ferrous chloride solution and stannic chloride solution are produced.

$$2FeCl_3\ (aq)\ +\ SnCI_2\ (aq)\ \rightarrow\ 2FeCl_2(aq)\ +\ SnCI_4\ (aq)$$

Before the reaction, 3Cl atoms were attached to each iron atom. After the reaction, only two chlorine atoms are attached. That is one negative chlorine atom is released. Therefore, reduction of $FeCl_3$ happened or this reactor on the other hand, before reaction two chlorine atoms where attached with each atom of tin (stannum). Due to the above reaction the number of chlorine attached to tin atom increases to four. That is, oxidation of $SnCl_2$ has taken place. Therefore, in this reaction oxidation of one substance and reduction of another substance take place simultaneously. This is called redox reaction.

b.The rate of decomposition of hydrogen peroxide can be increased by having the reaction occurs in the presence of iodide ion. The reaction is proceed by two step mechanism:

$$Step\ 1:\ H_2O_2\ (aq)\ +\ I^-\ (aq)\ \rightarrow\ H_2O\ (l)\ +\ IO^-\ (aq)$$
$$Step\ 2:\ IO^-\ (aq)\ +\ H_2O_2\ (aq)\ \rightarrow\ H_2O\ (l) +\ O_2\ (g) +\ I^-\ (aq)$$

c.
Reactant: The substance which take part in a chemical reaction are called reactants.
Product: the substance which forms as a result of chemical reaction is called products.
The new substance produced as a result of chemical reaction is called products.
For example: When two sodium atoms react with two chlorine atoms(reactants), they give a completely new compound (product) i.e. sodium chloride (two atoms).
$2Na + Cl_2 \rightarrow 2NaCl$

d.
There are main three types of chemical reactions with reference to oxygen and hydrogen:
1.Combination Reaction
When two atoms react to form a compound, it is know as combination reaction.
For example: $2H_2\ +\ O_2 \rightarrow\ 2H_2O$

2. Decomposition Reaction
When a compound breaks into simple molecular substances from which it is made up of, it is know as decomposition reaction.
For example: $2H_2O \rightarrow\ 2H_2\ +\ O_2$

3. Oxidation and reduction reaction:
Oxidation:
(i) The addition of oxygen to a substance is called oxidation.
(ii) The removal of hydrogen to a substance is called oxidation.
Reduction:
(i) The addition of hydrogen to a substance is called reduction.
(ii) The removal of oxygen to a substance is called reduction.
For example: $CuO\ + H_2 \rightarrow Cu\ +\ H_2O$
In the above reaction, copper oxide is changing to Cu. That is, oxygen is being removed from copper oxide. So, copper oxide is being reduced to copper.
In the above reaction, H_2 is changing into H_2O. That is , oxygen is being added to hydrogen. So, hydrogen is being oxidised to water.

e.
Chemical equations involved:

$$1)\ NaOH\ (s)\ +\ H_2O(l)\ \rightarrow Na^+(aq)\ +\ OH^-(aq)\ +\ \Delta(HEAT)$$
$$2)CaO(s)\ + H_2O(l)\ \rightarrow\ Ca(OH)_2\ (aq)\ +\ \Delta(HEAT)$$

Similarities:
1) Both of the equations are exothermic. It means a lot of heat is evolved during the reaction.
2) Both reaction form strong basic solution.
Differences :
1) Sodium Hydroxide is strong base dissociates to form Naâ□° and OHâ□» ion. While Calcium oxide added water to form Calcium Hydroxide which further dissociates.
2) NaOH is a monoacidic base. and CaO is a Di-Acidic base.
3) NaOH, CaO should be added to water gradually with constant stirring.CaO on reacting with water produces basic solution called as Calcium hydroxide which is used for white washing and this reaction is more dangerous as compare to NaOH.

Question 3:

Explain the following terms with examples.
a. Endothermic reaction
b. Combination reaction
c. Balanced equation
d. Displacement reaction

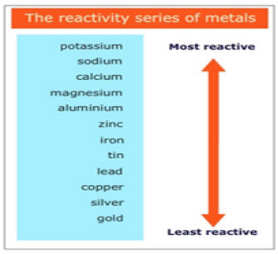
ANSWER:

a. Endothermic reaction:
An exothermic reaction is a chemical reaction that releases energy in the form of heat and light. It is the opposite of an endothermic reaction. Exothermic Reaction means "exo" meaning releases and "thermic" means heat. So the reaction in which there is release of heat with or without light is called exothermic reaction.
Expressed in a chemical equation: reactants → products + energy.
For example: Combustion is exothermic reaction.
The chemical reaction between zinc granules and dilute sulphuric acid is exothermic reaction.

b. Combination reaction:
Those reactions in which two or more substances combine to form single substance is called combination reaction
For example: Magnesium and oxygen combine, when heated, to form magnesium oxide.
$2Mg + O_2 \rightarrow 2MgO$

c. Balanced equation:
A balanced equation is an equation for a chemical reaction in which the number of atoms for each element in the reaction and the total charge are the same for both the reactants and the products. In other words, the mass and the charge are balanced on both sides of the reaction.
The balanced equation is:
$2\ Fe_2O_3 + 3\ C \rightarrow 4\ Fe + 3\ CO_2$
Both the left and right sides of the equation have 4 Fe, 6 O, and 3 C atoms. When you balance equations, it's a good idea to check your work by multiplying the subscript of each atom by the coefficient. When no subscript is cited, consider it to be 1. It's also good practice to cite the state of matter of each reactant. This is listed in parentheses immediately following the compound. For example, the earlier reaction could be written as:
$2\ Fe_2O_3(s) + 3\ C(s) \rightarrow 4\ Fe(s) + 3\ CO_2(g)$
where s indicates a solid and g is a gas state of matter.

d. Displacement reaction:
Displacement reaction is a chemical reaction in which a more reactive element displaces a less reactive element from its compound. Both metals and non-metals take part in displacement reactions.
Chemical reactivity of metals is linked with their relative positions in the activity series.
A metal placed higher in the activity series can displace the metal that occupies a lower position from the aqueous solution of its salt.



For example:

$Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$

$2Al(s) + 3CuSO_4(aq) \longrightarrow 3Cu(s) + Al_2(SO_4)_3(aq)$

$Fe(s) + CuSO_4(aq) \longrightarrow Cu(s) + FeSO_4(aq)$

$Pb(s) + CuCl_2(aq) \longrightarrow PbCl_2(aq) + Cu(s)$

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Question 4:

Give scientific reasons.
a.When the gas formed on heating limstone is passed through freshly prepared lime water, the lime water turns milky.
b. It takes time for pieces of Shahabad tile to disappear in HCl, but its powder disappears rapidly.
c.While preparing dilute sulphuric acid from concentrated sulphuric acid in the laboratory, the concentrated sulphuric acid is added slowly to water with constant stirring.
d. It is reccommended to use air tight container for storing oil for long time.

ANSWER:

Give scientific reasons.

a.
Limestone is made up of calcium carbonate.When calcium carbonate is heated Carbon dioxide is evolved. Lime water is made up of Calcium hydroxide.
When carbon dioxide is passed through lime water, the Carbon dioxide reacts with calcium hydroxide to form Calcium carbonate which is a white precipitate, then lime water turns milky as there is formation of calcium carbonate.

$$CaCo_3 \rightarrow CaO + CO_2$$
$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3$$

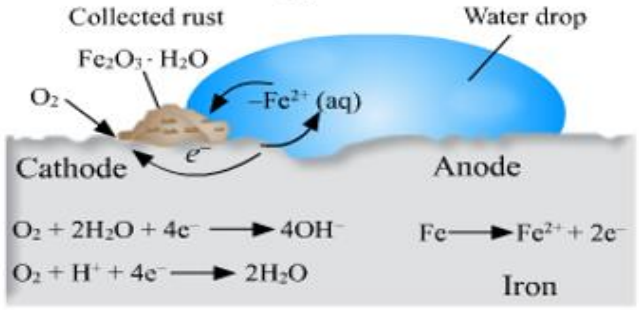
b. It takes time for pieces of Shahabad tile to disappear in HCl, but its powder disappears rapidly because in pieces of the tile, the surface atoms can only react with HCl but in powdered form all the atoms can react with HCl. This makes the difference in their reactivity. Powders are simpler substances of the pieces and they take lesser time for the reaction as compare to whole piece of tile, which is a compound.
for example: powdered salt react and water will dissolve, but salt rocks and water will not dissolve.

c.While preparing dilute sulphuric acid from concentrated sulphuric acid in the laboratory, the concentrated sulphuric acid is added slowly to water with constant stirring because sulphuric acid (H_2SO_4) reacts very vigorously with water, it is a highly exothermic reaction. If you add water to concentrated sulphuric acid, it can boil and bump out due to which you may get a nasty acid burn.Water is a good absorber of heat, so we add acid to the water, slowly and with constant stirring.

d. It is recommended to use air tight container for storing oil for long time in order to avoid the problem of rancidity. Rancidity is the condition produced by aerial oxidation of fats and oils marked by unpleasant smell and taste.

Question 5:

Observe the following picture a write down the chemical reaction with explanation.



ANSWER:

The rusting of iron is an oxidation process. The rust on iron does not form by a simple reaction between oxygen and iron surface. The rust is formed by an electrochemical reaction. 'Fe' oxidises to $Fe_2O_3.XH_2O$ (Rust) is on one part of iron surface while oxygen gets reduced to H_2O in another part of the surface. Different regions on the surface of iron become anode and cathode.

(1) Fe is oxidised to Fe^{2+} in the anode region.

$$\mathrm{Fe\,(s) \longrightarrow Fe^{2+}\,(aq) + 2\,e^-}$$

(2) O_2 is reduced to form water in the cathode region.

$$\mathrm{O_2\,(g) + 4\,H^+\,(aq) + 4\,e^- \longrightarrow 2\,H_2O\,(l)}$$

When Fe^{2+} ions migrate from the anode region they react with water and further get oxidised to form Fe^{3+} ions.

A reddish coloured hydrated oxide is formed from Fe^{3+} ions. It is called rust. It collects on the surface.

$$\mathrm{2\,Fe^{3+}\,(aq) + 4\,H_2O\,(l) \longrightarrow Fe_2O_3 \cdot H_2O\,(s) + 6\,H^+\,(aq)}$$

Due to various components of the atmosphere, oxidation of metals takes place, consequently resulting in their damage. This is called 'corrosion'. Iron rusts and a reddish coloured layer is collected on it. This is the corrosion of iron.

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Question 6:

Identify from the following reaction the reactants that undergo oxidation and reduction.

a. $Fe + S \rightarrow FeS$

b. $2Ag_2O \rightarrow 4\,Ag + O_2\uparrow$

c. $2Mg + O_2 \rightarrow 2MgO$

d. $NiO + H_2 \rightarrow Ni + H_2O$

ANSWER:

a. $Fe + S \rightarrow FeS$
In a reaction, Fe is changing to FeS. That means, iron loses electrons to form FeS. Loss of electron from a substance is called oxidation, so iron undergoes oxidation.

b. $2Ag_2O \rightarrow 4\,Ag + O_2 \uparrow$
In a reaction, silver oxide is changing to silver. That is, oxygen is being removed from silver oxide. Removal of oxygen from substance is called reduction, so silver oxide undergoes reduction.

c. $2Mg + O_2 \rightarrow 2MgO$
In a reaction, magnesium is changing to magnesium oxide. That means, oxygen is being added to magnesium. Addition of oxygen to a substance is called oxidation, so magnesium undergoes oxidation.

d. $NiO + H_2 \rightarrow Ni + H_2O$
In a reaction, Nickle oxide is changing to nickle. That is, oxygen is being removed from nickle oxide. Removal of oxygen from substance is called reduction, so nickle oxide undergoes reduction.In a reaction, hydrogen is changing to H_2O. That is,oxygen is being added to hydrogen. Addition of oxygen to a substance is called oxidation, so hydrogen undergoes oxidation.

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Question 7:

Balance the following equation stepwise.
a. $H_2S_2O_7(l) + H_2O(l) \rightarrow H_2SO_4(l)$
b. $SO_2(g) + H_2S(aq) \rightarrow S(s) + H_2O(l)$
c. $Ag(s) + HCl(aq) \rightarrow AgCl \downarrow + H_2 \uparrow$
d. $NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + H_2O(l)$

ANSWER:

a. $H_2S_2O_7(l) + H_2O(l) \rightarrow H_2SO_4(l)$
Step1. Count the number of each atom in reactant side:
H= 4
S=2
O=8
Step2. Count the number of each atom in product side:
H= 2
S=1
O=4
Step3.Then balance the number of each atom in an equation by multiplying reactant and product side with numeral value:
If we multiply product side by 2, then number of atoms in product and reactant side gets balance.
$H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$

b. $SO_2(g) + H_2S(aq) \rightarrow S(s) + H_2O(l)$
Step1. Count the number of each atom in reactant side:
H= 2
S=2
O=2
Step2. Count the number of each atom in product side:
H= 2
S=1
O=2
Step3.Then balance the number of each atom in an equation by multiplying reactant and product side with numeral value:
If we multiply H_2S by 2 in the reactant side and S by 3 and H_2O by 2 in the product side, then number of atoms in product and reactant side gets balance.
$SO_2(g) + 2H_2S(aq) \rightarrow 3S(s) + 2H_2O(l)$

c. $Ag(s) + HCl(aq) \rightarrow AgCl \downarrow + H_2 \uparrow$
Step1. Count the number of each atom in reactant side:
H= 1
Ag=1
Cl=1
Step2. Count the number of each atom in product side:
H= 2
Ag=1
Cl=1
Step3.Then balance the number of each atom in an equation by multiplying reactant and product side with numeral value:
If we multiply Ag by 2 and HCl by 2 in the reactant side and AgCl by 2 in the product side, then number of atoms in product and reactant side gets balance.
$2Ag(s) + 2HCl(aq) \rightarrow 2AgCl \downarrow + H_2 \uparrow$

d. $NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + H_2O(l)$
Step1. Count the number of each atom in reactant side:
Na= 1
H=3
O=5
S=1
Step2. Count the number of each atom in product side:
Na= 2
H=2
O=5
S=1
Step3.Then balance the number of each atom in an equation by multiplying reactant and product side with numeral value:
If we multiply NaOH by 2 in the reactant side and H_2O by 2 in the product side, then number of atoms in product and reactant side gets balance.
$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

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Question 8:

Identify the endothermic and exothermic reaction.
a. $HCl + NaOH \rightarrow NaCl + H_2O + heat$
b. $2KClO_3\,(s) \xrightarrow{\Delta} 2KCl\,(s) + 3O_2 \uparrow$
c. $CaO + H_2O \rightarrow Ca(OH)_2 + heat$
d. $Ca\,CO_3\,(s) \xrightarrow{\Delta} CaO\,(s) + CO_2 \uparrow$

ANSWER:

Identify the endothermic and exothermic reaction.
a. $HCl + NaOH \rightarrow NaCl + H_2O + heat$
Heat is released in the product side, as it mentioned in the above reaction. So, It is an exothermic reaction because heat is evolved in exothermic reaction.

b. $2KClO_3\,(s) \xrightarrow{\Delta} 2KCl\,(s) + 3O_2 \uparrow$
Heat is given in the product side to break the compound into simpler substances, as it mentioned in the above reaction. So, It is an endothermic reaction because heat is supplied in exothermic reaction.

c. $CaO + H_2O \rightarrow Ca(OH)_2 + heat$
Heat is released in the product side, as it mentioned in the above reaction. So, It is an exothermic reaction because heat is evolved in exothermic reaction.

d. $Ca\,CO_3\,(s) \xrightarrow{\Delta} CaO\,(s) + CO_2 \uparrow$
Heat is provided in the product side to break the compound into simpler substances, as it mentioned in the above reaction. So, It is an endothermic reaction because heat is supplied in exothermic reaction.

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Question 9:

Reactants	Products	Type of chemical reaction
$BaCl_2(aq) + ZnSO_4(aq)$	$H_2CO_3(aq)$	Displacement
$2AgCl(s)$	$FeSO_4(aq) + Cu(s)$	Combination
$CuSO_4(aq) + Fe(s)$	$BaSO_4\downarrow + ZnCl_2(aq)$	Decomposition
$H_2O(l) + CO_2(g)$	$2Ag(s) + Cl_2(g)$	Double displacement

ANSWER:

Reactants	Products	Type of chemical reaction
$BaCl_2(aq) + ZnSO_4(aq)$	$BaSO_4\downarrow + ZnCl_2(aq)$	Double displacement
$2AgCl(s)$	$2Ag(s) + Cl_2(g)$	Decomposition
$CuSO_4(aq) + Fe(s)$	$FeSO_4(aq) + Cu(s)$	Displacement
$H_2O(l) + CO_2(g)$	$H_2CO_3(aq)$	Combination