Suva Sangam College
Year: 11
Chemistry

Strand 3: Reactions
Sub-strand 3.2: Type of Reactions

Week 1: Monday (05/07/21)- Friday (09/07/21)
Achievement Indicators:

- Distinguish and describe different types of reactions based on chemical statements and balanced chemical equations

Reference: Chemistry for year 11 page 53-59

Chemical Reactions
-are processes that will cause change in the properties of the substances involved.
-Most reactions are chemical changes and are *irreversible* and some are *reversible*.
Example: photosynthesis, respiration and digestion

There are 7 types of chemical reactions are:

TYPES OF REACTION	**DESCRIPTION**	**EQUATIONS SHOWING TYPE OF REACTIONS**
1.COMBUSTION	1. Metals react with oxygen to form basic metal oxides. 2. Non-metals react with oxygen to form acidic non-metal oxides. 3.Fuels react with oxygen to form carbon dioxide with water.	E.g. 1. Magnesium + Oxygen → Magnesium oxide $2Mg_{(s)} + O2_{(g)} \rightarrow 2MgO_{(s)}$ E.g.2. Carbon + Oxygen → Carbon dioxide $C_{(s)} + O2_{(g)} \rightarrow CO2_{(g)}$ E.g.3. Glucose + Oxygen →Carbon dioxide + Water $C_6H_{12}O_{6(s)} + 3O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(g)}$
2. SYNTHESIS	1. Naturally occurring elements combine chemically to form a compound. 2.All combustion of elements is synthesis reaction.	1. $C_{(s)} + S_{(s)} \rightarrow CS_{2(l)}$ Carbon disulphide 2. $Fe_{(s)} + S_{(s)} \rightarrow FeS_{(s)}$ Iron sulphide
3. DECOMPOSITION	Some carbonates and nitrates are decomposed by heat. Carbonates are decomposed to form carbon dioxide and the oxide of the metal.	1.Calcium carbonates →Calcium oxide + Carbon dioxide $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$ 2. Copper nitrate → Copper oxide + Nitrogen dioxide + Oxygen $2Cu(NO_3)_{2(s)} \rightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

4. NEUTRALIZATION	Involves the reaction between an acid and a base	Sodium hydroxide + Dilute hydrochloric acid → Sodium chloride + Water $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_20_{(l)}$
5. DOUBLE DISPLACEMENT	When two different salt solutions react forming a clear solution. The resultant salts formed are both soluble in water. It is termed double displacement as the anions are exchanged between the two cations.	Barium chloride + Sodium Nitrate → Barium nitrate + Sodium sulphate $BaCl_{2\ (aq)} + NaNO_{3\ (aq)} \rightarrow Ba(NO_3)_{2(aq)} + NaCl_{(aq)}$
6. PRECIPITATION	It is the formation of an insoluble salt from the mixture of two different clear solutions. The insoluble salt formed is the precipitate (ppt).	1. $CuSO_{4\ (aq)} + 2NaOH_{(aq)} \rightarrow Cu(OH)_{2}(ppt) + Na_2SO_{4\ (aq)}$ 2. $Mg(NO_3)_{2(aq)} + Na_2CO_{3\ (aq)} \rightarrow MgCO_{3(s)} + 2NaNO_{3\ (aq)}$
7. REDOX	Involves both oxidation and reduction reactions occurring simultaneously -**Oxidation** is gain of oxygen/ loss of hydrogen/loss of electrons -**Reduction** is gain of hydrogen/loss of oxygen/ gain of electrons Occurs in electrolysis set up	1. $C_{(s)} + 2CuO_{(s)} \rightarrow 2Cu_{(s)} + CO_{2\ (g)}$ 2. $Fe2O_{3(s)}) + 3CO_{(g)} \rightarrow 2Fe_{(l)} + 3CO_{2\ (g)}$

Exercise

Balance these equations (even if the value is one put it in the blank) and identify the type of reaction. (Synthesis, Decomposition, Single Replacement, Double Replacement or Combustion)

Type of reaction

1. $\_\_HgO \rightarrow \_\_Hg + \_\_O_2$ _____
2. $\_\_ NaCl + \_\_ AgNO_3 \rightarrow \_\_NaNO_3 + \_\_AgCl$ _____
3. $\_\_ Cl_2 + \_\_ Ca \rightarrow \_\_ CaCl_2$ _____
4. $\_\_ C_2H_6 + \_\_ O_2 \rightarrow \_\_CO_2 + \_\_H_2O$ _____
5. $\_\_ H_2O + \_\_ Fe \rightarrow \_\_ Fe_2O_3 + \_\_ H_2$ _____
6. $\_\_ N_2 + \_\_ H_2 \rightarrow \_\_ NH_3$ _____

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Week 2: Monday (12/07/21)- Friday (16/07/21)

Achievement Indicators:

- Show that electrolysis of molten and aqueous salt experimental set-up involves oxidation and reduction

Reference: Chemistry for year 11 page 60-62

ELECTROLYSIS:

- Redox is commercially used in a process called electrolysis.
-involves the following:

i. electrolyte – conducting liquid
ii. electrodes – negative and positive terminal
iii. connecting wires
iv. power supply

Diagram page 60 of the text book

Electrolysis of a Molten Solution	**Electrolysis of a Salt Solution**	**Electrolysis of Cu using Carbon electrodes**	**Electrolysis of Cu using Copper electrodes**
Diagram pg. 61	Diagram pg. 61	Diagram pg. 62	Diagram pg. 62
OBSERVATIONS/INFERENCES			
ANODE: -greenish yellow gas is released [Cl_2] -bubbles form **CATHODE:** -shiny and silverish deposits form [Na metal]	**ANODE:** -bubbles of oxygen gas is evolved due to oxidation of water. **CATHODE:** Water is reduced at the cathode instead of sodium ions as it is easier to reduce; hence bubbles of hydrogen gas would be produced.	**ANODE:** -bubbles of carbon dioxide gas form **CATHODE:** -shiny and reddish brown deposits occur	**ANODE:** -bubbles form -decreases in size -becomes dull **CATHODE:** -shiny and reddish brown deposits of copper form increases in size but will only be significant if a lot of copper deposits form on it
What happens to the solution? Do they change colour?			
Solution colour remains the same when the Na^+ and Cl^- ions which are colourless leave the solution and become attracted to the	Solution remains colourless since all the components of the electrolyte are colourless.	Solution colour changes from light blue colour (of copper sulphate) to colourless because the ions responsible for the light	Solution colour remains light blue because oxidation of copper metal at the anode to form

cathode and anode respectively, water remains behind which is colourless.		blue colour which is Cu^{2+} ions leave the solution as they are reduced to copper metal and are deposited on the cathode.	copper ions occurs at the same time as reduction of copper ions at the cathode to form copper deposits.
NOTE:			
The anode is separated from the cathode by a **diaphragm**. It prevents the greenish yellow chlorine gas produced at the anode from reacting with the liquid sodium metal formed at the cathode; the reaction is explosive.	The separator represents the diaphragm that separates the electrodes to prevent the chlorine formed at the anode from reacting with the sodium hydroxide. When it is removed, sodium hypochlorite, NaClO, a bleaching agent is formed.	The carbon anode oxidises easily to form carbon dioxide.	The sludge that collects at the bottom of anode may contain impurities such as gold or silver. They will not be coated on the cathode because more electromotive force/voltage is required to oxidise them to gold and silver ions so that they can be reduced at the cathode.
COMPONENTS OF THE ELECTROLYTE			
The electrolyte sodium chloride solution contains: -sodium ions, -chloride ions and water.	The electrolyte salt solution would contain: -sodium ions, -chloride ions and water.	The electrolyte copper sulphate solution contains: -copper ions, -sulphate ions and water.	The electrolyte copper sulphate solution contains: -copper ions, -sulphate ions and water.
EQUATIONS SHOWING REACTIONS THAT OCCUR AT THE ANODE AND THE CATHODE:			
Anode $2Cl^-_{(aq)} \rightarrow Cl_{2\,(g)} + 2e^-$	**Anode** $2Cl^- \rightarrow Cl_{2(g)} + 2e^-$ Greenish Yellow gas	**Anode** $H_2O_{(l)} \rightarrow 2H^+_{(aq)} + O_{2(g)} + 2e^-$	**Anode** $Cu \rightarrow Cu^{2+} + 2e^-$
Cathode $Na^+_{(aq)} + e^- \rightarrow Na_{(s)}$	**Cathode** $2H_2O + 2e^- \rightarrow H_{2(g)} + 2OH^-$	**Cathode** $Cu^{2+}{}_{(aq)} + 2e^- \rightarrow Cu(s)$	**Cathode** $Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

EXERCISE:

1. Balance the following half equations:
   a) $K \longrightarrow K^+$
   b) $Al \longrightarrow Al^{3+}$
   c) $C \longrightarrow C^{4+}$
   d) $Ca \longrightarrow Ca^{2+}$

2. State whether oxidation or reduction is occurring in the reactions illustrated in the half equations above.

   (a) _____ (b) _____
   (c) _____ (d) _____

Suva Sangam College
Year: 11
Chemistry

Strand 3: Reactions
Sub-strand 3.2: Type of Reactions

Week 3: Monday (19/07/21)- Friday (23/07/21)

Achievement Indicators:

- Show that electrolysis of molten and aqueous salt experimental set-up involves oxidation and reduction

Reference: Chemistry for year 11 page 63

ELECTROPLATING

- Involves coating metals with a more or less reactive metal or more expensive metal in order:

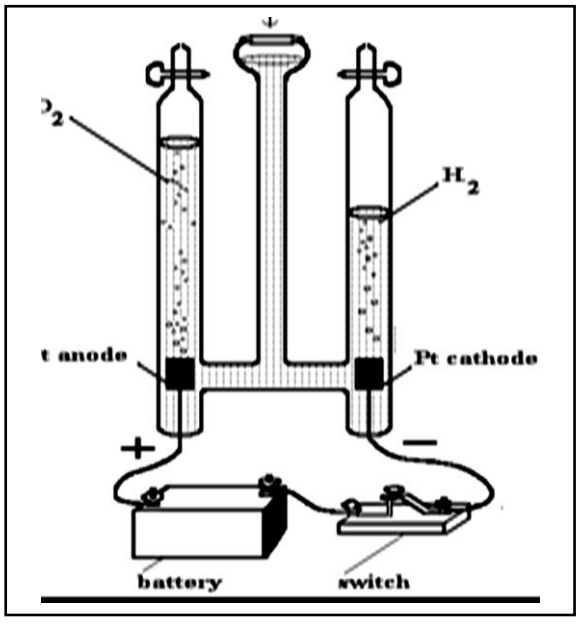
(I) To prevent rusting or corrosion or
(II) To improve appearance of metal
(III) To increase the value of a metal
(IV) To increase conductivity of metals (metals used in some electrical appliances, cell phones, computers, etc are coated with silver and gold because they are better electrical conductors)

EXAMPLES OF Electroplated METALS

Car parts Cell phones Computers Utensils / cutlery Ornaments
Electrical appliances Coins Etc.

OTHER EXAMPLES:

I. Electrolysis of Water Using Carbon Electrodes



ANODE:	bubbles of colourless oxygen gas form
CATHODE:	bubbles of colourless hydrogen gas form

Solution remains colourless since there are no dissolved salts in the electrolyte to give forth colours.	Hydrogen gas is used as rocket fuel as it burns explosively (self-combust) in oxygen releasing a lot of energy. The product formed is water. Electrolysis of water is used	Water molecules split up to form oxygen and hydrogen gas.

Anode:

$2H_2O_{(l)} \rightarrow 4H^+_{(aq)} + O_{2\,(g)} + 4e^-$

Cathode:

$2H_2O_{(l)} + 2e^- \rightarrow 2H^+_{(aq)} + 2OH^-_{(aq)}$

II. Electrolysis of molten Lead Bromide Using Carbon Electrodes

Lead bromide melts at 373°C to form molten lead bromide, $PbBr_{2\,(l)}$, which is made up of mobile lead ions and bromide ions. During electrolysis lead ions are attracted to the cathode and it is reduced to silver lead metal, and bromide ion is attracted to the anode forming bromine, a red coloured gas.

Cathode Reaction		Anode Reaction
$Pb^{2+}_{(aq)} + 2e^- \rightarrow Pb_{(l)}$		$2Br^-_{(aq)} \rightarrow Br_{2\,(g)} + 2e^-$
Silver liquid		red gas

HALF EQUATIONS:

- are used to illustrate the different reactions that occur on the different electrodes of an electrolysis set up
- can either be oxidation or reduction

EXAMPLES OF OXIDATION REACTIONS:

- metals lose electrons to form cations

$Na \rightarrow Na^+ + e^-$

$Mg \rightarrow Mg^{2+} + 2e^-$

$Al \rightarrow Al^{3+} + 3e^-$

(Electron(s) lost will appear on the right side of the equation)

EXAMPLES OF REDUCTION REACTIONS:

- Non metals gain electrons to form anions

$Cl_2 + 2e^- \rightarrow 2Cl^-$

$O_2 + 4e^- \rightarrow 2O^{2-}$

(Electron(s) gained will appear on the left side of the equation.)

EXERCISE:

1. Balance the following half equations:

i. $S \rightarrow S^{2-}$ ii. $N \rightarrow N^{3-}$ iii. $Cl \rightarrow Cl^-$

2. State whether oxidation or reduction is occurring in the reactions illustrated in the half equations above.

i. _____ ii. _____ iii. _____

3. Explain your answer to (2) above.

_____

_____

_____

Suva Sangam College
Year: 11
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Strand 3: Reactions
Sub-strand 3.3: Acids, Bases and Salts

Week 4: Monday (26/07/21)- Friday (30/07/21)

Achievement indicators:
1. Describe the difference between acids and bases.

	Acids	**Bases/Alkalis**
Definition	Acids form hydrogen ions /protons (H+) or hydronium ions (H_3O+) in solution.	Form hydroxyl ions (OH^-) in solution.
Equation	$HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$ $HCl_{(aq)} + H_2O_{(l)} \rightarrow Cl^-_{(aq)} + H_3O^+_{(aq)}$	$NaOH_{(s)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$
In general,	$HA + H_2O \rightarrow A^- + H_3O^+$	**$BOH \rightarrow B^+ + OH^-$**
Properties	➢ Have a low pH (below 7). ➢ Neutralizes bases to form water and a salt. ➢ Have a sour taste. ➢ Changes blue litmus to red. ➢ React with many metals to produce hydrogen gas.	➢ Have a high pH (above 7). ➢ Changes red litmus to blue. ➢ Neutralises acids to form water and a salt. ➢ Have a bitter taste. ➢ Feels slippery.
Examples	➢ Hydrochloric acid (HCl), sulphuric acid (H_2SO_4) and nitric acid (HNO_3). ➢ Citric acid (in orange juice or lemon juice). ➢ Acetic acid (in vinegar) ➢ Phosphoric acid (in Coke). ➢ Ascorbic acid (in vitamin C tablets). ➢ Uric acid (in urine) ➢ Stearic and lauric acid (in cosmetics)	➢ Ammonia ➢ Calcium hydroxide (caustic lime/lime water) ➢ Lithium hydroxide ➢ Potassium hydroxide (caustic potash) ➢ Sodium hydroxide (caustic soda) ➢ Many bleaches, soaps, toothpastes and cleaning agents. Window cleaners may contain ammonia

Exercise:

1. Answer the following questions

Acid Characteristics	Base Characteristics
Tastes _____	Tastes _____
Turns litmus paper _____	Feels _____
Turns phenolphthalein _____	Turns litmus paper _____
pH _____	pH _____
Examples:	Examples:
Conducts Electricity? _____	Conducts electricity? _____

2. True or false. Acids and bases are common in everyday places such as the kitchen.
3. Give an example of an acid found in something you can eat.

   _____
4. What is the environment like inside your stomach?

   _____
5. The acid have numbers _____than 7.
6. Acidic solutions have lots of _____ ions present.
7. Bases have pH numbers _____ than 7.
8. Fill in the blanks

   Acids have a _____ taste, react with metals to produce _____ gas, turn _____ different colours according to pH and are _____ because their water solutions conduct electricity. On the other hand, bases have a _____ taste, feel _____, turn _____ different colours according to pH and are _____ because their water solutions conduct electricity.

Suva Sangam College
Year: 11
Chemistry

Strand 3: Reactions
Sub-strand 3.3: Acids, Bases and Salts

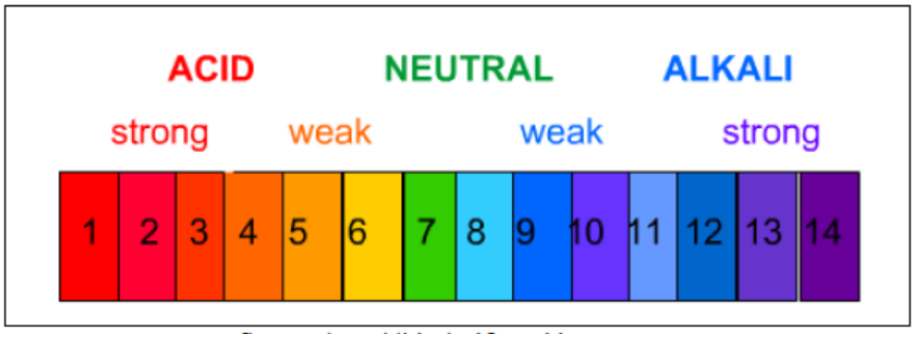
Week 5: Monday (02/08/21)- Friday (06/08/21)

Achievement indicators:

1. Illustrate the differences between weak and strong acids and alkalis using the pH scale.

The pH Scale

- pH is a measure of how acidic or how alkaline a solution is.
- it is a scale for measuring hydrogen ion concentration.
- p stands for 'potenz' in German meaning power.



Measuring the pH of a solution using the Universal Indicator

The *Universal Indicator* is in liquid form and changes colour at different pH.

Steps in measuring the pH of a solution using the Universal Indicator.

1. Take the test solution in a test tube. If there is a solid substance such as a salt then dissolve the solid by adding distilled water to it.
2. Place a drop of the Universal Indicator using a fine dropper into the solution.
3. Observe the colour produced and match it with the different colour shades of the standard colour pH chart.
4. Note down the pH of the colour chart that matches most closely with the colour produced on the pH paper.

Strengths of Acids and Bases

Acids	Bases
Strong Acids	**Strong Bases**
Are acids which completely dissociates into ions in aqueous solution. Examples include: HCl, H2SO4, and HNO3.	Are bases which completely dissociates in aqueous solution. Examples include: NaOH and KOH.
Weak Acids Are acids which only partially ionise or dissociates in aqueous solution. Examples include: Acetic acid (CH3COOH) and carbonic acid (H2CO3).	**Weak Bases** Are bases which only partially ionise or dissociates in aqueous solution. Examples include: Ammonia (NH_3) and ammonium hydroxide (NH_4OH)

Exercise

1. The pH scale goes from _____.
2. A substance with a pH of 7 is likely to be classified as a_____.
3. What is the difference between a strong acid and a weak acid?

   _____

   _____

   _____
4. What does it mean if a solution is a "weak acid"? "Strong acid"?

   _____

   _____

   _____
5. A solution with a pH of 9 is_____.
6. What is a universal indicator?
7. What are the numbers on a pH scale that could indicate a base? An acid? Neutral solution?

   _____

   _____

   _____