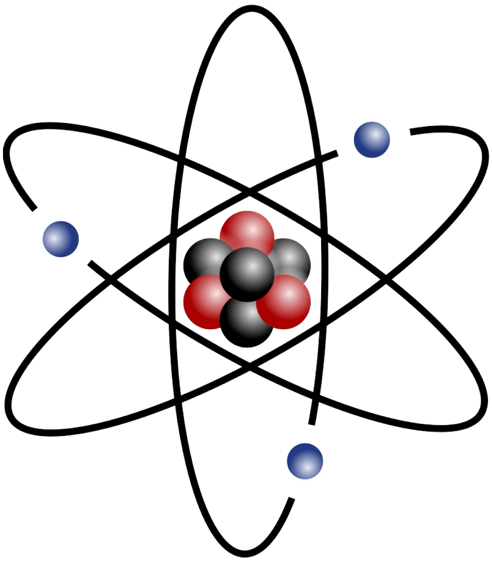
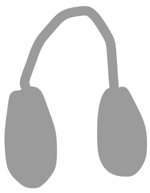
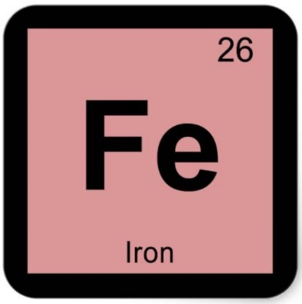


CHEMISTRY NOTES

by dhamira :)

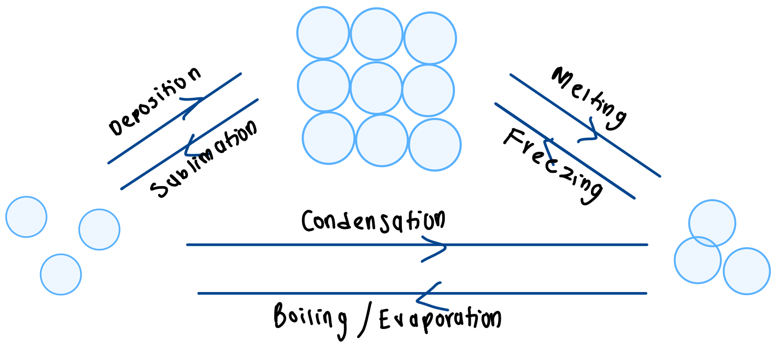




2.1) Basic concepts of matter

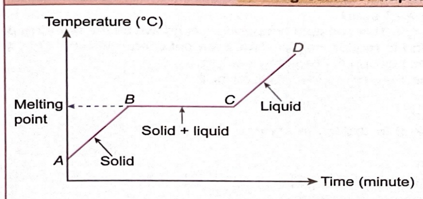
Matter	-something occupies space&has mass

Particle Theory of matter



State of matter	Solid	Liquid	Gas
Arrangement of particles	Closely packed and in orderly manner	Closely packed but not in orderly manner	Far apart and in random manner
Movement of particles	Vibrate and rotate in fixed position	Vibrate, rotate and move freely	Vibrate, rotate and move freely and randomly
Kinetic energy of particles	Very low	High	Very high
Force of attraction between particles	Very strong	Stronger than gas but weaker than solid	Very weak

Heating curve of naphthalene



At point *A*,
- Naphthalene exists as a **solid**.
- The particles are **closely packed** and **vibrate** in their fixed positions.

At point *A – B*,
- Naphthalene exists as a solid.
- The particles absorb heat energy and vibrate **faster**.
- The temperature and kinetic energy increase.

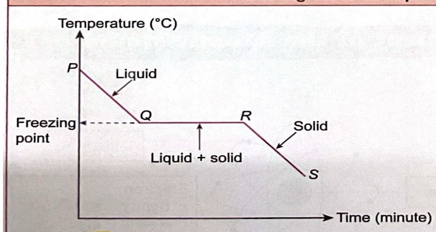
At point *B*,
- Naphthalene **still** exists as a solid.
- Heat energy absorbed is enough to overcome the force of attraction between particles.
- Solid naphthalene **starts to melt**.

At point *B – C*,
- Naphthalene exists as **solid and liquid**.
- The temperature does not change. This constant temperature is known as the **melting point**.
- Heat energy absorbed is **used** to overcome the force of attraction between particles **completely**.

At point *C*,
- Naphthalene exists as a **liquid**.
- Melting process ends.

At point *C – D*,
- Naphthalene exists as a liquid.
- The particles absorb heat energy and move **faster**.
- The temperature and kinetic energy increase.

Cooling curve of naphthalene



At point *P*,
- Naphthalene exists as a **liquid**.
- Naphthalene **gas condenses** to form a liquid.

At point *P – Q*,
- Naphthalene exists as a liquid.
- The particles release heat energy and **move slower**.
- The temperature and kinetic energy decrease.

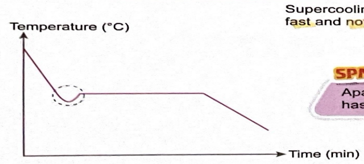
At point *Q*,
- Naphthalene **still** exists as a liquid.
- The particles **move closer** to each other and form **stronger** attraction force between particles.
- Liquid naphthalene **starts to freeze to form a solid**.

At point *Q – R*,
- Naphthalene exists as **liquid and solid**.
- The temperature does not change. This constant temperature is known as the **freezing point**.
- Heat energy released during the formation of attraction force between particles is the **same as** the heat energy lost to the surroundings during cooling.
- The **strongest** attraction force between particles is formed.

At point *R*,
- Naphthalene exists as a **solid**.
- The particles are closely packed in **orderly manner**.

At point *R – S*,
- Naphthalene exists as a solid.
- The particles continue to release heat energy.
- The temperature and kinetic energy decrease.
- Freezing continues until the process is completed.

Supercooling curve of naphthalene



Supercooling occurs when a solution is cooled too fast and not stirred evenly during the cooling process.

SPM TIP
Apart from naphthalene, acetamide has similar heating and cooling curves.

Melting point	-constant temperature that changes a solid to liquid at a specific pressure
Freezing point	-constant temperature that changes a liquid to solid at a specific pressure

2.3) Atomic structure

Proton number	number of proton in the nucleus of an atom
Nucleon number	sum of protons & neutrons in the nucleus of an atom nucleon number -> A X proton number -> Z

2.4) Isotopes&its uses

What is isotopes	atoms of the same element w same proton numbers but different nucleon number
Its uses	(see table below)

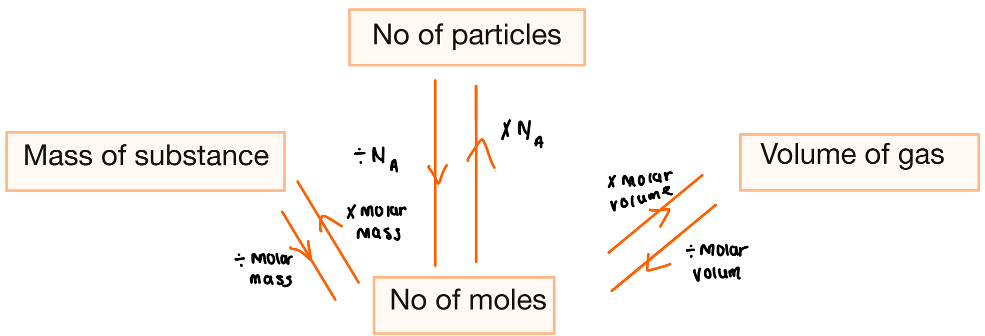
Field	Isotope	Uses
Medicine	Cobalt-60	• Used in radiotherapy for cancer treatment • To sterilise surgical tools
	Iodine-131	To treat thyroid diseases
Agriculture	Phosphorus-32	To study plant metabolism
	Carbon-14	To study the steps involved in the photosynthesis of plants
Nuclear	Uranium-235	Used in nuclear power generators to generate electricity
Archaeology	Carbon-14	To determine the age of artefacts and fossils
	Lead-210	To estimate the age of sand and soil layers
Industry	Hidrogen-3	To detect sewage and liquid wastes
Engineering	Sodium-24	To detect leakage in underground pipes

CHAPTER 3,F4: MOLE CONCEPT,FORMULA&EQUATION

3.1) RAM & RMM

Role of Carbon 12	-used as a standard atom • can be handled easily • solid at room temp • can be found in almost all substances
Relative atomic mass (RAM) / Relative molecular mass (RMM)	$\frac{\text{Average mass of one atom/molecule of the element}}{\text{1/12 x mass of 1 c-12 atom}}$ (*this eq =1 *kira atas je tkyah bahagi dgn bawah)
Relative formula mass (RFM)	total mass of all atoms in an ionic substances

3.2) MOLE CONCEPT

Mole (mol)	amount of particles contained in a substance
Avogadro constant	-fixed number of particles in 1 mole of substance -NA= 6.02 x 10^23
Calculate no of particles	no of mol x NA
Molar mass (g mol^-1]	-mass of 1 mol of substance -molar mass = relative mass
Molar volume	-volume occupied by 1 mol of gas -room conditions: 24.0 dm^3 -STP: 22.4 dm^3
Coversion	

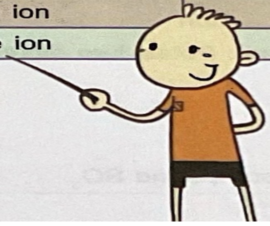
3.3) CHEMICAL FORMULA

Empirical formula	-chemical formula that shows the simplest ratio of the number of atoms of each element in a compound
Molecular formula	-chemical formula than shows the actual number of atoms of each element in a compound
Cation&anion	Cation= positively charged ion Anion= negatively charged ion

3.4) CHEMICAL EQUATION

needs to be balanced

Cation	Formula of cation	Anion	Formula of anion
Sodium ion	Na^{+}	Fluoride ion	F^{-}
Potassium ion	K^{+}	Chloride ion	Cl^{-}
Lithium ion	Li^{+}	Bromide ion	Br^{-}
Silver ion	Ag^{+}	Iodide ion	I^{-}
Hydrogen ion	H^{+}	Hydroxide ion	OH^{-}
Ammonium ion	NH_4^{+}	Nitrate ion	NO_3^{-}
Mercury ion	Hg^{+}	Nitrite ion	NO_2^{-}
Nickel(I) ion	Ni^{+}	Nitride ion	N^{-}
Nickel(II) ion	Ni^{2+}	Bicarbonate ion	HCO_3^{-}
Magnesium ion	Mg^{2+}	Manganate(VII) ion	MnO_4^{-}
Tin(II) ion	Sn^{2+}	Oxide ion	O^{2-}
Calcium ion	Ca^{2+}	Sulphate ion	SO_4^{2-}
Barium ion	Ba^{2+}	Sulphite ion	SO_3^{2-}
Zinc ion	Zn^{2+}	Carbonate ion	CO_3^{2-}
Iron(II) ion	Fe^{2+}	Thiosulphate ion	$S_2O_3^{2-}$
Iron(III) ion	Fe^{3+}	Chromate(VI) ion	CrO_4^{2-}
Manganese(II) ion	Mn^{2+}	Dichromate(VI) ion	$Cr_2O_7^{2-}$
Manganese(III) ion	Mn^{3+}	Phosphide ion	P^{3-}
Manganese(IV) ion	Mn^{4+}	Phosphate ion	PO_4^{3-}
Copper(I) ion	Cu^{+}		
Copper(II) ion	Cu^{2+}		
Lead(II) ion	Pb^{2+}		
Aluminium ion	Al^{3+}		
Chromium(III) ion	Cr^{3+}		



CHAPTER 4,F4: PERIODIC TABLE OF ELEMENTS

4.2) The arrangement in the periodic table of elements

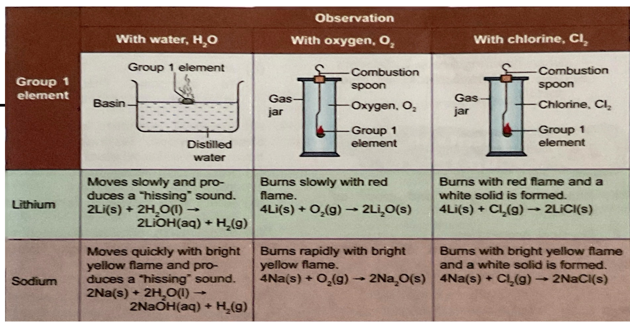
GROUP	-the vertical column -from 1 to 18 -is determined by the no of valence electrons
PERIOD	-the horizontal column -from 1 to 7 -is determined by the number of shells

4.3) Elements in group 18

What are the elements in group 18?	-known as noble gas/inert gas -exist as monoatomic gas -chemically inert -atoms hv already achieved an octet/duplet e.a -atoms x receive,donate,share electrons w other elements
Physical properties	-colourless gass at room cond -low melting & boiling point -low density -insoluble in water -cannot conduct electricity in any state -poor conducter of heat
Going down the group,	-boiling points increases -atomic size increases -attraction force becomes stronger -more heat energy is required to break the force
Examples& its uses	Helium -fill oxygen tanks & water balloon -cool metals in superconductor Neon -advertising board lights & TV Argon -provide inert atmosphere for welding at high temp Krypton -fill flashlight in cameras Xenon -in nuclear reactors -for anesthesia Radon -used in cancer treatment

4.4) Elements in group 1 (alkali metals)

Physical properties	-soft metal -low density -low melting & boiling point -silver & shiny surface -good conductor of heat&electrical
Going down the group,	-melting & boiling point decrease -atomic size increase -metallic bond becomes weaker -less heat energy is required to break the force -reactivity & electropositivity increases -v.e becomes further away from each other -attraction force between nucleus & v.e becomes weaker -ability of atom to donate electrons become easier
Safety precautions	-stored in dark bottles filled with paraffin oil -avoid holding w bare hands -wear safety googles & gloves -use only small pieces of them



Group 1 element	Observation: With water, H_2O	Observation: With oxygen, O_2	Observation: With chlorine, Cl_2
Lithium	Moves slowly and produces a "hissing" sound. $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$	Burns slowly with red flame. $4Li(s) + O_2(g) \rightarrow 2Li_2O(s)$	Burns with red flame and a white solid is formed. $4Li(s) + Cl_2(g) \rightarrow 2LiCl(s)$
Sodium	Moves quickly with bright yellow flame and produces a "hissing" sound. $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$	Burns rapidly with bright yellow flame. $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$	Burns with bright yellow flame and a white solid is formed. $4Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$

CHAPTER 4,F4: PERIODIC TABLE OF ELEMENTS

4.5) Elements in group 17 (halogens)

Physical properties	-low melting &boiling point -x conduct electricity in any state -pungent smell&poisonous -low density
Physical states in room cond	-Flourine: pale yellow gas -chlorine: greenish yellow gas -bromine: reddish brown liquid -iodine: purplish black solid
Going down the group,	-melting & boiling point increases -molecular size increases -attraction force stronger -more heat energy is required to break the force -electronegativity decreases -v.e becomes further from nucleus -ability of atoms to receive electrons is harder
all elements hv same chemical properties because	• 7 v.e • react w water to form acidic solution • react with metals to form metal halide • react with alkaline solution to form metal halide, metal halate & water
Safety precautions	-carry out experiments in fume chamber -x inhale the gas -wear goggles, mask&gloves

Group 17 element	Observation		
	$H_2O(l)$	$Fe(s)$	$NaOH(aq)$
Chlorine	Yellowish-green gas dissolves in water to produce a pale yellow solution. $Cl_2(g) + H_2O(l) \rightarrow HCl(aq) + HOCl(aq)$	Hot iron glows very brightly and forms a brown solid. $3Cl_2(g) + 2Fe(s) \rightarrow 2FeCl_3(p)$	Yellowish-green gas dissolves very quickly to form a colourless solution. $Cl_2(g) + 2NaOH(aq) \rightarrow NaCl(aq) + NaOCl(aq) + H_2O(l)$
Bromine	Brown liquid dissolves slowly in water to form a brownish-yellow solution. $Br_2(aq) + H_2O(l) \rightarrow HBr(aq) + HOBr(aq)$	Hot iron glows brightly and forms a brown solid. $3Br_2(g) + 2Fe(s) \rightarrow 2FeBr_3(s)$	Brown liquid dissolves quickly to form a colourless solution. $Br_2(aq) + 2NaOH(aq) \rightarrow NaBr(aq) + NaOBr(aq) + H_2O(l)$
Iodine	Purplish-black crystals dissolve slightly in water to produce a pale yellow solution. $I_2(s) + H_2O(l) \rightarrow HI(aq) + HOI(aq)$	Hot iron glows dimly and forms a brown solid. $3I_2(g) + 2Fe(s) \rightarrow 2FeI_3(s)$	Purplish-black crystals dissolve slowly to form a colourless solution. $I_2(s) + 2NaOH(aq) \rightarrow NaI(aq) + NaOI(aq) + H_2O(l)$

4.6) Elements in period 3 (3 shells)

Going across from left to right	-atomic size decreases -no of protons increases,no of v.e increases -attraction force between nucleus &v.e increass -electronegativity increases
Changes of physical state	a) solid —> gas b) metal —> smei metal —> non-metal
Types of oxide formed	i) Basic metal oxides (Na&Mg) -form alkaline solution in water -react w avid to produce salt&water ii) Amphoteric (Al) -can act as acid/base -react w both to produce salt&water iii) Acidic non metal oxides -form acidic solution in water -react w base to produce salt&water
Semi metals (metalloids)	-intermediate between metal&non metal -good electrical conductors -used in microelectronics field

4.7) Transition elements (elements from group 3 -12)

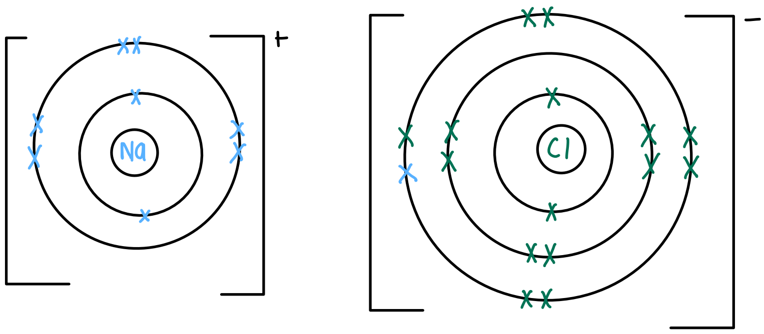
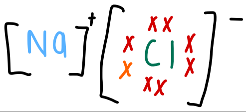
<table>
<tr><td>Physical properties</td><td>-solid at room cond
-shiny surface
-high ductility & malleability
-high melting & boiling point
-high density
-good conductor of heat & electricity</td></tr>
<tr><td>Special physical characteristics</td><td>
<table>
<tr><th>Special physical characteristic</th><th>Example</th></tr>
<tr><td>Have more than one oxidation number</td><td>Copper: +1 and +2
Iron: +2 and +3</td></tr>
<tr><td>Form coloured ions or compounds</td><td>Fe^{2+} – green
Fe^{3+} – brown</td></tr>
<tr><td>Form complex ions</td><td>$[Cu(NH_3)_4]^{2+}$ – dark blue
$[Fe(CN)_6]^{3-}$ – orange brown</td></tr>
<tr><td>Act as catalysts</td><td>Haber process – iron powder
Hydrogenation – nickel</td></tr>
</table>
</td></tr>
<tr><td>Application</td><td>
<table>
<tr><th>Transition element</th><th>Applications</th></tr>
<tr><td>Vanadium</td><td>• Added into steels to increase strength
• Vanadium(V) oxide acts as a catalyst in Contact process</td></tr>
<tr><td>Cobalt</td><td>• Added into steels to increase resistance to corrosion
• To make powerful magnets</td></tr>
<tr><td>Copper</td><td>• To make electrical wires
• Added into precious metals to make jewellery
• To produce bronze and brass (alloys)</td></tr>
<tr><td>Zinc</td><td>• To galvanise steels
• To make dry cells</td></tr>
<tr><td>Titanium</td><td>• To make the engines of rockets and jets
• To produce titanium oxide used in sunblock creams</td></tr>
</table>
</td></tr>
</table>

CHAPTER 5,F4: CHEMICAL BOND

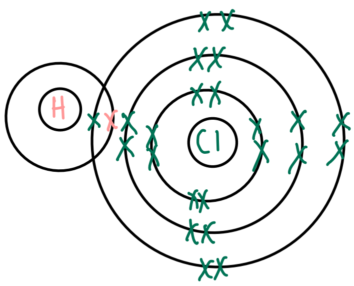
5.1) Basic of Compund formation

What is a chemical bond	-are formed when electron are transferered/shared -only involve the valence electrons -types: -Ionic bond -Covalent bond

5.2) Ionic bond

What is ionic bond?	-involves the transfer of electrons between a metal & non-metal atom -metal atom =donates electrons =form a positively charged ion(cation) -non-metal atom =receives electrons =form a negatively charged ion(anion) -strong electrostatic attraction force holds the ions together
Electron arrangement	ex: between sodium,Na & chloride,Cl 
Lewis structure	
Explain the formation of	-Electron arrangement of sodium atom is 2.8.1 -Sodium atom releases an electron to achieve a stable octet electron arrangement, forming a Na+ -Electron arrangement of chlorine atom is 2.8.7 -Chlorine atom receives an electron to achieve a stable octet electron arrangement, forming a Cl- -One mole of sodium ions, Na+ is attracted to one mole of Cl- by a strong electrostatic attraction force, forming an ionic compound with the chemical formula of NaCl.

5.3) Covalent bond

What is covalent bond?	-formed thru sharing of electrons between non metal compounds TYPES -single(1e shared),double(2e shared),triple(3e shared) covalent bond
Electron arrangement	between hydrogen & chlorine (hydrogen chloride)  Lewis structure 

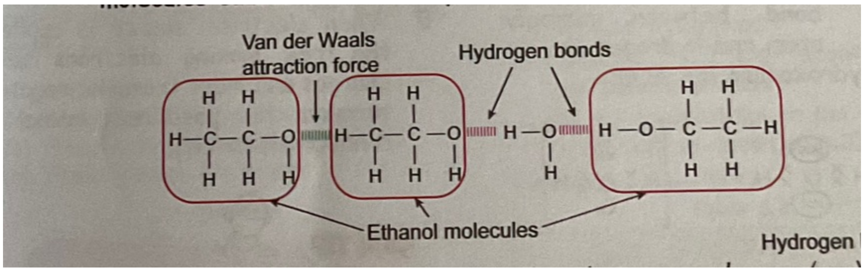
Explain the formation of	-Electron arrangement of hydrogen atom is 1. -Hydrogen atom needs an electron to achieve a stable duplet electron arrangement. -Electron arrangement of chlorine atom is 2.8.7. -Chlorine atom needs an electron to achieve a stable octet electron arrangement. -1 mole of hydrogen atoms shares 1 electron with 1 mole of chlorine atoms, forming a single covalent bond. -A covalent compound with the chemical formula of HCl is formed.

5.4) Hydrogen bond

<table>
<tr><td>What is hydrogen bond?</td><td>-attraction forces between hydrogen atom w a high electronegativity atom : Flourine, oxygen, nitrogen
-is weaker than ionic/covalent bond
-strong than the van der waals attraction</td></tr>
<tr><td>How is it formed?</td><td>

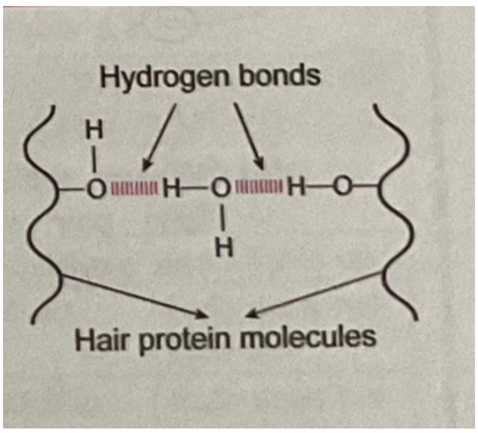
EXAMPLE 1

• In ethanol molecule, the hydrogen atom forms a single covalent bond with the oxygen atom.
• The oxygen atom from ethanol will form a hydrogen bond with the hydrogen atom from the water molecule, H_2O.
• The hydrogen atom from ethanol also can form another hydrogen bond with the oxygen atom from the water molecule.
• The formation of hydrogen bonds between ethanol molecules and water molecules causes the solubility of ethanol in water.



EXAMPLE 2

• Our hair consists of protein molecules that can form hydrogen bonds when the hair is dry.
• When the hair is wet, the protein molecules form hydrogen bonds with water molecules.
• Formation of hydrogen bonds between protein molecules and water molecules causes the hair to stick together.



</td></tr>
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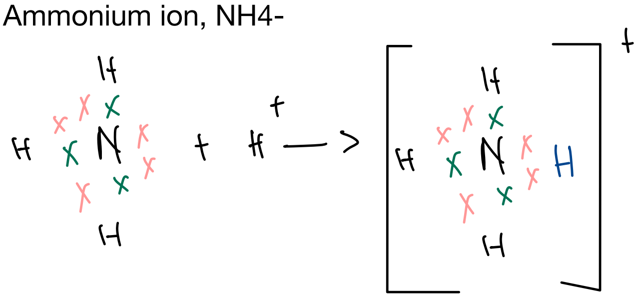
5.5) Dative bond

What is dative bond?	-type of covalent bond between 2 atoms where the electron pair is shared by one atom only -also known as coordinate bond
Examples	Ammonium ion, NH4-  NH3 + H+ —> NH4+ (i) Ammonia molecule, NH, has a lone pair of electrons at the nitrogen atom. (ii) Hydrogen ion, H has an empty orbital. (iv) Nitrogen atom shares its lone pair of electrons with hydrogen ion, H through the formation of a dative bond between nitrogen atom and hydrogen ion.

5.6) Metallic bond

What is metallic bond?	• Metal can conduct in electricity solid state due to the presence of electrons that move freely. • Although metallic atoms are arranged closely and orderly in solid state, the valence electrons of metal atoms are donated easily and can be delocalised • Valence electrons in metal atoms that move freely throughout the whole metal structure indicates that the electrons are delocalised • The delocalised electrons are known as a sea of electrons. • When electrical source is applied the free moving electrons carry charges and move from the negative terminal the positive terminal to conduct electricity.

5.7) Properties of ionic compounds & covalent compound

a)

Table 5.2

Characteristic	Ionic compound	Covalent compound
Melting point and boiling point	High	Low
Solubility in water	Normally soluble	Normally insoluble
Solubility in organic solvent	Normally insoluble	Normally soluble
Electrical conductivity	Can conduct electricity in molten state or aqueous solution	Cannot conduct electricity in all states

b) Covalent compound

Table 5.6

Covalent compound	
Simple molecule	**Giant molecule**
Small and simple structure	Very large structure
Exists as solid, liquid or gas	Exists as solid
Strong covalent bonds in the molecules and weak van der Waals attraction forces between molecules.	Strong covalent bonds in the molecules only. No van der Waals attraction force between molecules.
Less heat is required to overcome the weak van der Waals attraction force. Thus, the melting point and boiling point are low.	A lot of heat is required to break the strong covalent bonds between molecules. Thus, the melting point and boiling point are high.
Examples: Carbon dioxide, CO_2, hydrogen chloride, HCl, ammonia, NH_3	Examples: Diamond, silicon dioxide, graphite

c) Uses of ionic & covalent compounds in daily life

Sector	Ionic compound	Covalent compound
Industry	• Lithium iodide, LiI is used as an electrolyte in long-life batteries. • Calcium chloride, $CaCl_2$ is used in the dye retention in paper manufacturing.	• Ethanoic acid, CH_3COOH is used as preservatives in food industry. • Carbon dioxide gas, CO_2 is used in carbonated soft drinks.
Agriculture	• Ammonium nitrate, NH_4NO_3 and urea, $CO(NH_2)_2$ are used as chemical fertilisers. • Calcium carbonate, $CaCO_3$ (limestone) is used to reduce the acidity of soil.	• Dichlorodiphenyltrichloroethane (DDT), $C_{14}H_9C_{15}$ is used in insecticides. • Chlorobromuron, $C_9H_{10}BrClN_2O_2$ is used in herbicides.
Medicine	• Sodium bicarbonate, $NaHCO_3$ is used in antacids to relieve gastric pain. • Potassium bromide, KBr is used in medicines to treat epilepsy in animals.	• Paracetamol, $C_8H_9NO_2$ is used to treat fever and reduce mild pain. • Ethanol, C_2H_5OH is used in alcohol swab before injection is carried out.
Domestic	• Sodium chlorate(V), $NaClO_3$ is found in detergents and used for domestic cleaning. • Aluminium chlorohydrate, $Al_2Cl(OH)_5$ is used in antiperspirants or deodorants.	• Glycerol, $C_3H_5(OH)_3$ is added into skincare products to moisturise skin. • Butane gas, C_4H_{10} is used as cooking gas.

CHAPTER 6,F4: ACID BASE & SALT

6.1) Role of water in showing Acidic & alkaline properties

What is acid?	Chemical substances that ionises in water to form H+/Hydroxonium ions, H_3O^+
What is acidity of an acid?	-no of moles of H+ formed when 1 mole of acid dissolves in water **Monoprotic Acid** -acid that ionises in water to form 1mole of H+ **Diprotic Acid** -2 mole of H+ **Triprotic Acid** -3 mole of H+
Uses of acids	• Ethanoic Acid= coagulate latex • Ascorbic acid= vitamin C • Benzoic acid= preserve ketchups • Hydrochloric acid= remove rust • Nitric acid= make fertilisers • Sulphuric acid= as an electrolyte in lead acid accomulators
What is base?	Chemical substances that can react with acid to form salt and water
What is alkali?	A base that ionises in water to form OH-
Uses of bases/alkalis	• Sodium hydroxide= make soaps • Potassium hydroxide= make shampoos&lotions • Magnesium hydroxide= produce antacids • Ammonia=make fertilisers • Calcium hydroxide= used as lime to neutralise acids in soils
Litmus paper	-Acid= blue turns red -Alkali= red turns blue

6.2) pH value

Acidic solution	-pH value <7 -concentration of H+ increases, pH value decreases -pH=-log [H+]
Alkaline solution	-pH value > 7 -concentration of OH- increases, pH value increases -pOH=-log[OH-]
pH scale	-set of numbers to indicate the acidity or alkalinity of an aqueous solution -pH+pOH = 14

6.3) Strength of acids & alkalis

Strong acid	Acid that ionises completely in water to produce a higher concentration of H+ -ex: hydrochloric acid,HCL
Weak acid	Acid that ionises partially in water to produce a low concentration of H+ ions -ex:ethanoic acid, CH_3COOH
Strong alkali	Alkali that ionises completely in water to produce a high concentration of OH- -ex: sodium hydroxide,NaOH
Weak alkali	Alkali that ionises partially in water to produce low concentration of OH- -ex: ammonia,NH_3

CHAPTER 6,F4: ACID BASE & SALT

6.4) Chemical properties of acids & alkalis

Acid & its physical properties	CHEMICAL PROPERTIES -acid+base —> salt+water -acid+reactive metal —> salt+hydrogen gas -acid+metal carbonate —> salt + water + CO2 PHYSICAL PROPERTIES -sour taste -corrosive -pH value <7 -blue litmus paper turns red
Alkalis & its physical properties	CHEMICAL PROPERTIES -alkali+acid —> salt+water -alkali+ammonium salt —> salt+water+ammonium gas -alkali+metal ion —> insoluble metal hydroxide+cation from the alkali PHYSICAL PROPERTIES -biiter taste -soapy feel -pH value >7 -red litmus paper turns red

6.5) Concentration of aqueous solution

Concentration (g dm-3)	$\frac{\text{Mass of solute (g)}}{\text{Volume of solution (dm3)}}$
Molarity (mol dm-3)	$\frac{\text{No of moles of solute (mol)}}{\text{Volume of solution (dm3)}}$
Conversion	Molarity (mol dm-3) —(x molar mass)→ Concentration (g dm-3) Concentration (g dm-3) —(divide molar mass)→ Molarity (mol dm-3)

6.6) Standard solution

What is standard solution	A solution of accurately known concentration
Ways to prepare	-from a solid substances -dilution method of an aqueous solution
What is dilution	-process used to reduce the concenof a solution from a stock solution -water is added into the stock solution to obtain a little dilute solution
Formulae	M1V1=M2V2 M= molarity before&after V= initial & final volume

CHAPTER 6,F4: ACID BASE & SALT

6.7) Neutralisation

What is neutralisation?

Chemical reaction between an acid& an alkali to produce salt & water

What is the product of neutralisation

$H^+ + OH^- \longrightarrow H_2O$

Application of neutralisation

Agriculture	Health	Industry
-pH of soil -aquaponic -nitrogenous fertiliser	-treat acid in stomach -prevent tooth decay -treat bee&wasp stings,jellyfish stings&ant bites	-soap&detergent product -treat acidic effluents -treat acidic gases

• Protease enzyme
=function well in acidic medium stomach
=break down the protein into polypeptide
=pH of stomach is maintained between 1 and 2 by the presence of hydrochloric acid

• Gastric patients
=experience excess HCl in stomach
=milk of magnesia, $Mg(OH)$, relieve pain as its alkaline properties can neutralise excess HCl

• Plants
=grow best when the pH of the soil is close to 7
=extremely acidic soil is not suitable for crops
=quicklime, (CaO)or slaked lime, [$Ca(OH)_2$] can be used to treat the acidic soil.

• Bacteria in the mouth produce lactic acid
=toothpaste is an alkaline can neutralise the acid.

•Bee sting
=acidic
=treated with alkaline calamine lotion or baking powder.

•Wasp sting
=alkaline
=can be treated with vinegar.

Titration

-method use to determine volume of acid required to neutralise alkali & vice versa quantitatively

-involves a slow addition of a solution of known concentration (in the burette) to a known volume of another solution of unknown concentration (in the conical flask) until the reaction reaches the end point indicated through colour change of the acid-base indicator

pH indicator

Indicator	in acid	in distilled water	in alkali
litmus	red	purple	blue
universal	red	light green	purple
methyl orange	red	orange	yellow
phenolphthalein	colourless	colourless	pink

Solving numerical problems

$$\frac{M_1V_1}{M_2V_2} = \frac{n(a)}{n(b)}$$

M=molarity ($mol\ dm^{-3}$)
V=volume (cm^{-3})
n=mole ratio of acid/alkali

CHAPTER 6,F4: ACID BASE & SALT

6.8) Salts,crystals & their uses in daily life

What is salt?	-ionic compound form from metal ion or ammonium ion,NH4+ that replaces H+ in the end
Salt's products	• acid+alkali —> salt+water • acid+reactive metal —> salt+hydrogen gas • acid+aqueous ammonia —> salt
Physical characteristics of salt crystal	-flat surface,straight sides&sharp corners -angles between adjacent faces are the same -has geometrical shape -high melting point -geometrical shape varkes for different crystals -geometrical shape is the same for similar crystals of different sizes
Examples&uses of salts	

-ammonium chloride/nitrate/ phosphate -potassium chloride	chemical fertilisers
-copper(II) sulphate -mercury(I) chloride -sodium chlorate(V)	pesticides to kill insects,pests,grass&legs
hydrated calcium sulphate	make plaster casts for supporting broken bones
iron(II) sulphate heptahydrate	iron supplements to treat anemia
-magenesium sulphate heptahydrate(epsom salt) -sodium sulphate decahydrate(glauber salt)	laxatives to treat constipation
sodium hydrogen carbonate	-ingredients in antacids -neutralise excess acids in stomach
barium sulphate	make intestinal organs seen clearly on x-ray
potassium manganete (IV)	-kill bacteria -used as disinfectants
sodium chloride	food additives
MSG	enhance taste of foods
sodium nitrite	preservatives for processed food
sodium benzoate	tomato &chilli sauce
sodium hypochlorite	bleaching agent&disinfectant
tin(II) flouride	water&toothpaste to prevent tooth decay
silver bromide	photographic papers&films

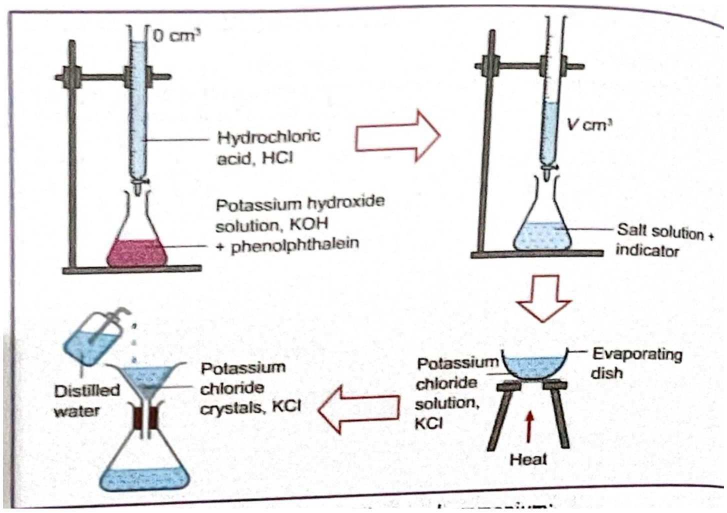
6.9) Preparation of salts

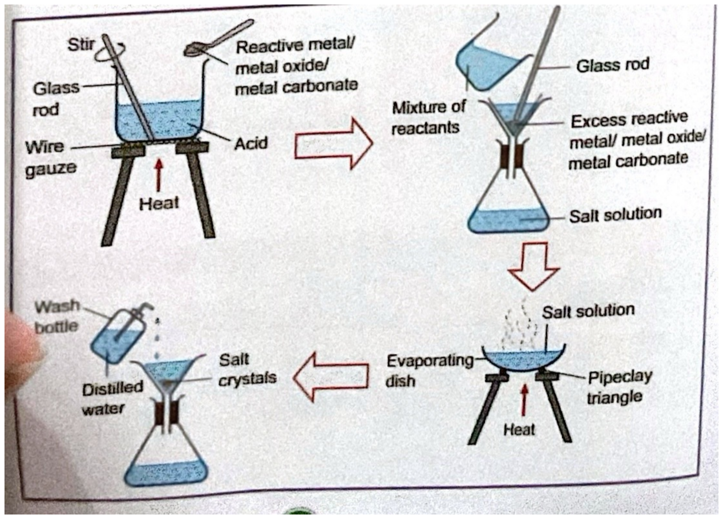
Solubility of salts	Ammonium, sodium, potassium, ethanoate, nitrate = soluble Chloride = soluble except (Ag, Hg & Pb) Sulphate = soluble except (Pb, Ca, Ba, Ag) Carbonate = insoluble except (Na, K & NH_4)

⭐ Preparation of soluble salt

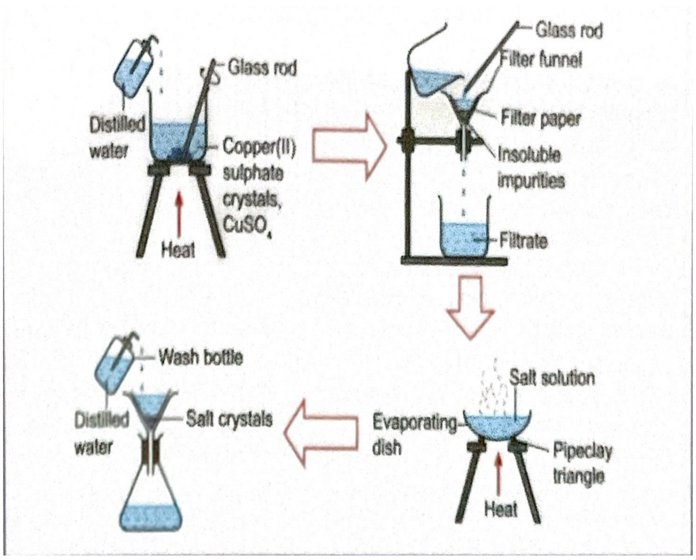
a) Sodium,potassium or ammonium salt =neutralisation reaction between acid & alkali

b) Soluble salt pther than <—
-reaction between acid&reactive metal
-reaction between acid&metal sandwich
-reaction between acid&metal carbonate



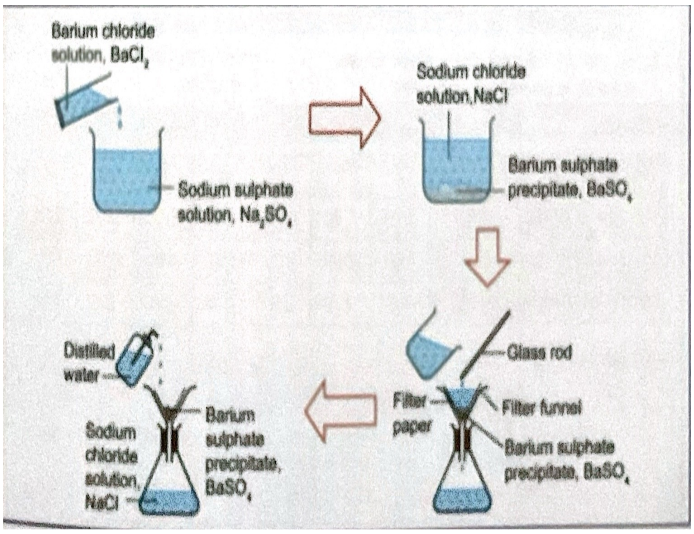


c) Purification of soluble salts by recrystallisation method



⭐ Preparation of insoluble salt

-double decomposition reaction (precipitation method)
-ionic eq can be constructed thru the continuous variation method



6.10) Effect of heat on salts

1. Gas tests

Gas	Method	Observation
Oxygen, O_2	Glowing wooden splinter is inserted into a test tube filled with colourless gas	The wooden splinter rekindles
Hydrogen, H_2	Lighted wooden splinter is inserted into a test tube filled with colourless gas	A "pop" sound is heard
Carbon dioxide, CO_2	Colourless gas is channelled to a test tube containing limewater	The limewater turns cloudy
Ammonia, NH_3	A piece of moist red litmus paper is placed in a test tube filled with colourless gas	The red litmus paper turns blue
Chlorine, Cl_2	A piece of moist blue litmus paper is placed in a test tube containing yellowish gas	The blue litmus paper turns red and then bleached
Hydrogen chloride, HCl	A glass rod is dipped into a concentrated ammonia solution and the glass rod is brought close to the mouth of the test tube filled with hydrogen chloride gas	White fume is produced
Sulphur dioxide, SO_2	Gas is channelled to a test tube containing acidified potassium dichromate(VI) solution	The orange acidified potassium dichromate(VI) solution turns green

2. The colour of residue can determine the cation present in the salt.

Initial colour of salt	Colour of residue	Metal oxide produced	Cation in the salt
White	Yellow when hot White when cold	ZnO	Zn^{2+}
Yellow	Brown when hot Yellow when cold	PbO	Pb^{2+}
	Brown	Fe_2O_3	Fe^{3+}
Green	Brown	Fe_2O_2	Fe^{2+}
	Black	CuO	Cu^{2+}

c) Effect of heat on carbonate salts

Carbonate salt	Colour of salt before heating	Colour of the residue		Effect on limewater
		Hot	Cold	
Sodium carbonate	White	–	–	Remains colourless
Calcium carbonate	White	White	White	Colourless to cloudy
Zinc carbonate	White	Yellow	White	Colourless to cloudy
Lead(II) carbonate	White	Brown	Yellow	Colourless to cloudy
Copper(II) carbonate	Green	Black	Black	Colourless to cloudy

d) Effect of heat on nitrate salt

Nitrate salt	Colour of salt before heating	Colour of residue		Gas test		
		Hot	Cool	Colour of gas	Glowing wooden splinter	Moist blue litmus paper
Sodium nitrate	White	White	White	Colourless gas	Lights up	Remains blue
Calcium nitrate	White	White	White	Brown gas and colourless gas	Lights up	Blue turns red

6.11) Qualitative analysis

a) Confirmatory test for anions

Test	Observation			
	Salt solution *A*	Salt solution *B*	Salt solution *C*	Salt solution *D*
Carbonate ion, CO_3^{2-}	• Effervescence occurs after acid is added. • Limewater turns cloudy.			
Chloride ion, Cl^-	• Effervescence occurs after acid is added. • White precipitate is formed.	• No effervescence after acid is added. • White precipitate is formed.		
Sulphate ion, SO_4^{2-}	• Effervescence occurs after acid is added • White precipitate is formed.		• No effervescence after acid is added. • White precipitate is formed.	
Nitrate ion, NO_3^-				Brown ring is formed.

* Discussion:

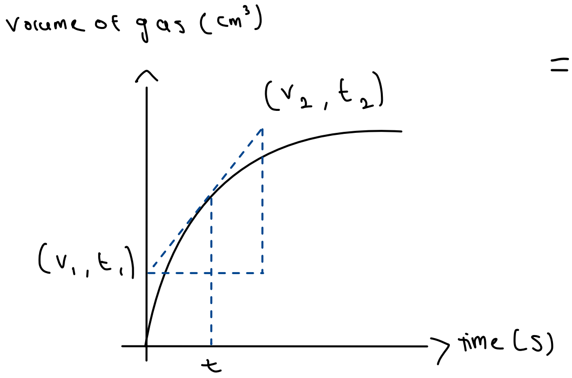
b) Cation tests are conducted by using
-NaOH solution
-NH3 solution

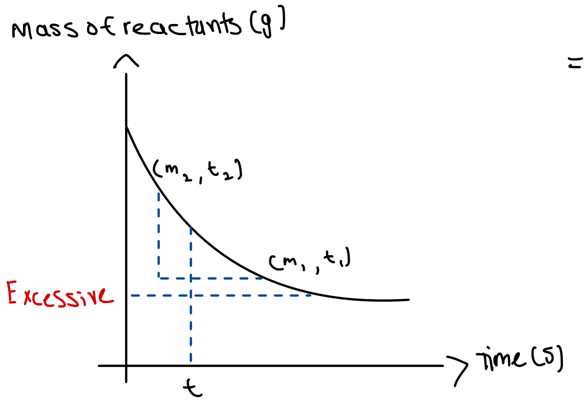
Salt solution	Cation	Observation			
		A few drops of NaOH solution	Excess amount of NaOH solution	A few drops of NH_3 solution	Excess amount of NH_3 solution
Calcium nitrate, $Ca(NO_3)_2$	Ca^{2+}	White precipitate	Insoluble white precipitate	No precipitate	No precipitate
Magnesium nitrate, $Mg(NO_3)_2$	Mg^{2+}	White precipitate	Insoluble white precipitate	White precipitate	Insoluble white precipitate
Aluminium nitrate, $Al(NO_3)_3$	Al^{3+}	White precipitate	White precipitate dissolves forming a colourless solution	White precipitate	Insoluble white precipitate
Zinc nitrate, $Zn(NO_3)_2$	Zn^{2+}	White precipitate	White precipitate dissolves forming a colourless solution	White precipitate	White precipitate dissolves forming a colourless solution
Iron(II) sulphate, $FeSO_4$	Fe^{2+}	Green precipitate	Insoluble green precipitate	Green precipitate	Insoluble green precipitate
Iron(III) chloride, $FeCl_3$	Fe^{3+}	Brown precipitate	Insoluble brown precipitate	Brown precipitate	Insoluble brown precipitate
Lead(II) nitrate, $Pb(NO_3)_2$	Pb^{2+}	White precipitate	White precipitate dissolves forming a colourless solution	White precipitate	Insoluble white precipitate
Copper(II) sulphate, $CuSO_4$	Cu^{2+}	Blue precipitate	Insoluble blue precipitate	Blue precipitate	Blue precipitate dissolves forming a dark blue solution
Ammonium nitrate, NH_4NO_3	NH_4^+	No precipitate		No precipitate	

c) Confirmary test for cations

Cation	Reagent	Observation
NH_4^+	Nessler reagent	Brown precipitate
Pb^{2+}	Sodium iodide solution	• Yellow precipitate is formed • The yellow precipitate dissolves when heated • The yellow precipitate forms again when cooled.
Fe^{2+}	Potassium hexacyanoferrate(III) solution, $K_3Fe(CN)_6$	Dark blue precipitate
	Potassium hexacyanoferrate(II) solution, $K_4Fe(CN)_6$	Light blue precipitate
Fe^{3+}	Potassium hexacyanoferrate(II) solution, $K_4Fe(CN)_6$	Dark blue precipitate
	Potassium hexacyanoferrate(III) solution, $K_3Fe(CN)_6$	Greenish brown solution
	Potassium thiocyanate solution, KSCN	Blood red solution

7.1) Determining the Rate of Reaction

<table>
<tr><td>Chemical reactions</td><td>
<table>
<tr><th>Fast reaction</th><th>Slow reaction</th></tr>
<tr><td>-Combustion of cooking gas
-Fireworks
-Ignition of matches
-Burning of papers
-Precipitation</td><td>-Rusting
-Fermentation
-Photosynthesis
-Decaying process
-Rock erosion</td></tr>
</table>
</td></tr>
<tr><td>Rate of reaction</td><td>-Meaning: Changes in the quantity of reactant or product per unit time
-Formula: Change in quantity of reactant or product/time taken for the change to occur
-During the reaction:
a) Quantity of reactants decreases per unit time
b) Quantity of products increases per unit time</td></tr>
<tr><td>Average rate of reaction</td><td>Average value for the rate of reaction that occurs in a particular time interval
$\text{Rate of reaction} = \frac{\text{Total volume of gas}}{\text{Total time}}$ $cm^3 s^{-1}$</td></tr>
<tr><td>Instantaneous rate of reaction</td><td>

$= \frac{V_2 - V_1}{t_2 - t_1}$ $cm^3 s^{-1}$</td></tr>
<tr><td></td><td>

$= \frac{m_2 - m_1}{t_2 - t_1}$ $g s^{-1}$</td></tr>
</table>

CHAPTER 7,F4: RATE OF REACTION

7.2) Factors affecting rate of reactions

Factors	SIZE OF REACTANTS -the smaller the size of reactants,the higher the rate of reaction	CONCENTRATION OF REACTANTS -the higher it is,the higher the rate of reaction	TEMPERATURE -the higher it is, the higher the rate of reaction	PRESENCE OF CATALYST -catalyst increases the rate of reaction
Characteristics of catalyst	-specific -changes the rate of reaction -only small amount of catalyst required -undergo physical changes -no changes in chemical properties -powdered catalyst is more effective -transition elements			

7.3) Application of Factors that Affect the Rate of Reaction in Daily Life

Factors	Rate of reaction in daily life
Size	-cooking -actions of medicines -barbecue *cut into smaller pieces *the smaller pieces hv larger TSA *— increases
Concentration	-rusting -corrosion in industrial area
Pressure	-haber process -pressure cooker
Temperature	-cleaning -storage of food
Catalyst	-fermentation -production of ammonia solution -production of sulphuric acid

RUSTING
- window grills made of iron near d seaside will rust faster
- bcs the water vapours near the seaside contain higher Cl^- ions
- when the concentration of water vapours increases, rusting becomes faster

CORROSION IN INDUSTRIAL AREA
- In industrial area, concentration of SO_2 is higher
- SO_2 dissolves in water & form acid rain
- Acid rain that comes in contact with metals causes corrosion

HABER PROCESS
- pressure increases, N_2 & H_2 react & produce ammonia gas
- this pressure form ammonia liquid for easier storage

PRESSURE COOKER
- high pressure increases the temperature of water faster
- Steam molecules w higher kinetic energy hv higher heat energy
- Raw materials can be cooked faster

CLEANING
- Detergent powder dissolved in hot water can remove stains easier

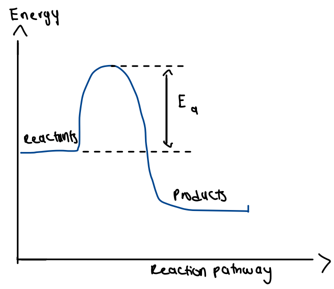
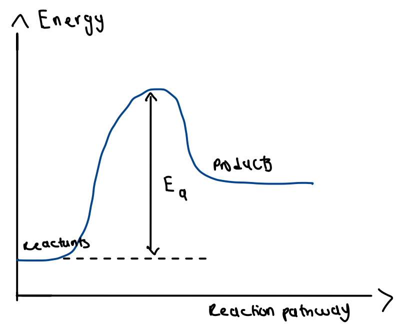
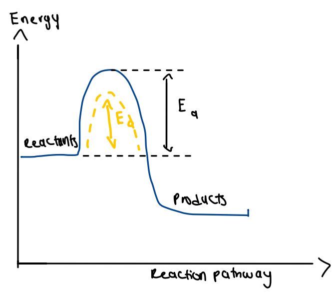
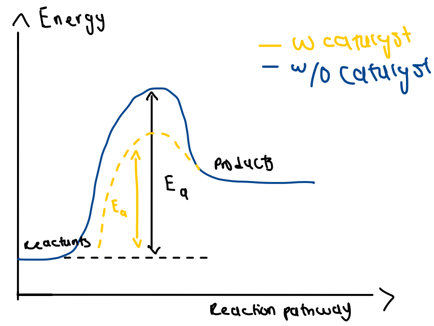
STORAGE OF FOOD
- Cooked food is stored in fridge
- Low temp of fridge slows down bacterial activity

FERMENTATION
- Zymase is added to glucose to produce alcohol
- Duration for fermentation can be reduced

PRODUCTION OF AMMONIA
- Iron powder is added to mixture of N_2 & H_2 gas in haber process
- Iron as catalyst speeds up formation of ammonia

PRODUCTION OF SULPHURIC ACID
- vanadium (v) oxide added to mixture of O_2 gas & SO_2 in contact process
- Speeds up formation of SO_3 before gas is channelled to oleum form concentrated sulphuric acid

7.4) Collision theory

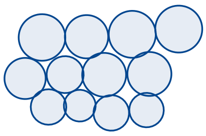
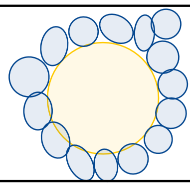
Based on collision theory	-reactant particles must collide w e/o for a reaction to occur -rate of reaction depends on the frequency of effective collisions -the higher it is, the higher the rate of reaction
To produce effective collision	-reactant particles must hv energy =/> than the activation energy (Ea) -Ea is the minimum energy required to break the chemical bonds between reactants particles & form a new chemical bonds in the products
Activation energy	-difference between reactants energy & energy at the peak of the curve in the graph  ★ Exothermic reaction  ★ Endothermic reaction
Size of reactants	-the smaller the size of reactants,the larger the TSA exposed -the frequency of collisions between reactants particles is higher -the frequency of effective collisions between reactant particles is higher -rate of reaction is higher
Temperature of solution	-the higher the temperature,the more kinetic energy of the reactant particles -the frequency of collision between reactant particles is higher -thee frequency of effective collision between reactant particles is higher -rate of reaction is higher
Concentration of reactants	-the higher the concentration of reactant particles,the higher the number of particles per unit volume -the frequency of collision between reactant particles is higher -the frequency of effective collision between reactant particles is higher -rate of reaction is higher
Gas pressure	-the higher the gas pressure, higher the number of gas particles per unit volume -the frequency of collision between reactant particles is higher -the frequency of effective collision between reactant particles is higher -rate of reaction is higher
Presence of catalyst	-catalyst lower the Ea for the collision of reactant particle -more reactant particles achieve the activation energy -the frequency of collision between reactant particles is higher -the frequency of effective collision between reactant particles is higher -rate of reaction is higher
	 ★ Exothermic reaction  ★ Endothermic reaction

CHAPTER 8,F4: MANUFACTURED SUBSTANCES IN INDUSTRY

8.1) Alloy & its Importance

Meaning of alloy	Mixture of 2 or more elements whereits main elements is metal
Strength & hardness	Alloy > Pure metal
Properties of alloy	-Shiny -More resistant to corrosion -Harder than its pure metal -Harder to be mouled

Comparison between pure metal & alloy

	Pure metal	Alloy
Diagram of the arrangement		
Size of atoms	All atoms hv the same size	Foreign atoms hv different sizes
Arrangemen t of particles	Arranged in orderly manner	Orderly arrangement is disrupted by foreign atoms
Ability of particles to slide over	When force is applied, layers of atoms easily slide over each other to fill the empty space & form a new structure	When force is applied,it is difficult for the layers of atom to slide over one another

BRONZE
-90% copper
-10% tin
-Medals,trophies,monuments

BRASS
-70% copper
-30% zinc
-Musical instruments,keys

DURALUMIN
-93% aluminium
-3% copper
-3% magnesium
-1% manganese
-body of aeroplanes,racing cars,bicycles

PEWTER
-95% tin
-3.5% antimony
1.5% copper
-trophies,souvenirs

STEEL
-98% iron
-0.2-2% carbon
-construction materials, railway tracks

STAINLESS STEEL
-73% iron
-18% chromium
-8% nickel
1% carbon
-cutlery,surgical instruments

8.2) Composition of glass & its uses

Basic properties of glass
-Transparent -Hard but brittle -Chemically inert
-Waterproof -Heat insulator -Electrical insulator

Types of glasses	FUSED SILICA GLASS -made from silica,SiO_2 w/o mix w chemical -high melting point -make telescope lens SODA LIME GLASS -made from silica,SiO_2 soda,Na_2Co_3 & limestone, $CaCo_3$ -low melting point -make glass containers BOROSILICATE GLASS -made from SiO_2,Na_2Co_3,$CaCo_3$,boron oxide,B_2O_3 & aluminium oxide, Al_2O_3 -resistant to heat -low expansion coefficient -make laboratory glasses LEAD CRYSTAL GLASS -made from SiO_2, Na_2Co_3, lead (II) oxide, PbO -Pb replaces Ca to produce denser&softer glass -high refractive index -make prisms

8.3) Composition of Ceramics & its uses

What is ceramic?	Solid made up of non-metallic compound&inorganic compounds
Basic properties of ceramics	-High termal resistant -Break easily -Chemically inert -Electrical Insulator -Heat insulator -Hard&strong
Type of ceramics	TRADITIONAL CERAMICS -made from clay (kaolin) $Al_2O_3.2SiO_2.2H_2O$ -make bricks,pottery&crockery ADVANCED CERAMICS -made from inorganic compounds (oxides&carbides) -hv higher heat resistance -resistant to abrasion -more chemically inert -hv superconductivity properties
Advanced ceramics Properties&Uses	a) SILICAN CARBIDE -hard&strong(cutting disc) -resistant to thermal shocks&high resistance to heat(brake disc) -hard&resistant to abrasion(tungsten carbide rings) b) SILICAN NITRIDE -high strength&fracture toughness at high temperature(structural component for gas turbines) c) ALUMINIUM OXIDE -chemically resitant&resistant to wear(hip joint replacement) d) SILICON (IV) OXIDE -high melting point(furnace lining) -light&high melting point(ceramic tiles for space shuttles) e) LITHIUM DISILICATE GLASS -biocompatibility!excellent aesthetic properties,good mechanical strength (used in dental treatment)

CHAPTER 8,F4: MANUFACTURED SUBSTANCES IN INDUSTRY

8.4) Composite materials & its importance

Composite material	A combination of 2 or more non-homogeneous substances
What is non-homogeneous substances?	MATRIX SUBSTANCE -substance that holds strengthening substances together to form a composite material STRENGTHENING SUBSTANCE -substance is added to the matrix substance to enhance the physical&chemical properties of the composite material formed
Example of composite materials	REINFORCED CONCRETE -combination of steel bar/wire mesh (SS) & concrete (MS) -high compression strength -resistant to corrosion -high stretching strength -uses: construction of bridges,dams&buildings FIBRE GLASS -combination between pastic (MS) & glass fibres (SS) -high stretching strength -durable -resistant to corrosion -heat&electrical insulator -uses:helmets OPTICAL FIBRE -combination between silica glass fibres (SS) &cladding/plastic jacket(MS) -flexible -high compression strength -use:transmit information in the form of light PHOTOCHROMIC GLASS -combination between glass(MS) &silver chloride w copper(I) chloride (SS) -transparent -absorb UV rays (depends on light intensity) -use as car windows& camera lenses SUPERCONDUCTORS -YBCO has superconductivity properties -0 electrical resistance -use: to make MRI&NMR