



O-Level Sc (Chemistry) v1.6 X-tra

Short Summarized Exam Notes

You should read through this booklet before entering the exam hall!

Some of the notes might be the direct answer to your upcoming O-Level paper!

Use this booklet as a quick revision tool before you enter the exam hall.

Remember to draw this out in Chemistry exams!
 (Solubility tables from your textbooks are harder to memorise)

	Soluble	Insoluble
Nitrate	All	-
Sulfate	Rest	Ba, Ca, Pb
Chloride	Rest	Ag, Pb
Carbonate	Group 1	Rest

Remember via:
 "Baked Chicken Pasta
 At Pastamania"

Secret Table contributed by Ms Aida (BVSS, MOE Singapore)

This table helps you know whether a salt is soluble or not.

Below: Preview of the Modified Periodic Table.

No. of valence electrons
Groups
 ↓ ↓
 No. of shells of electrons
Periods
 →

DATA SHEET
The Periodic Table of the Elements

1 valence		2 valence		Group																3 valence		4 valence		5 valence		6 valence		7 valence		Noble Gases																																																																			
I		II												III	IV	V	VI	VII	0																																																																														
Alkali Metals		Alkaline Metals		METALS Elements lose electrons to form positive charged ions										H Hydrogen	NON-METALS Elements gain electrons to form negative charged ions										He Helium																																																																								
1. Form 1+ Charged ions		2. Soft, Silvery Solids		3. Low Density		4. Low Melting Point		5. React with cold water		- Produces Alkaline solution of Metal Hydroxide + Hydrogen Gas												1. Metals	2. High Density	3. High m.p (1500 degrees)	4. Good Catalysts	5. Form Coloured Compounds	6. Variable Valencies	1. Form 1- Charged Ions	2. Non-metals with low mp/Bp	3. Diatomic Molecules (Each Molecule contains 2 atoms)	4. Gas -> Solid down the group	5. Form Acidic Solutions	1. Unreactive: Does not form ions																																																																
7 Li Lithium		9 Be Beryllium												11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	17 F Fluorine	18 Ne Neon	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon	19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon	55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 Lv Livermorium	103 Ts Tennessine	104 Og Oganesson
19		20												31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104										
Lower Mp/Bp		More Reactive												Higher Mp/Bp	Darker	Less Reactive											Fill Balloons (Low Density)	Making Light Tubes	Light Bulbs (Unreactive)																																																																				

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)

Key

a	a = relative atomic mass
X	X = atomic symbol
b	b = proton (atomic) number

Reactivity Series

- Potassium
- Sodium
- Calcium
- Magnesium
- Aluminium
- Zinc
- Iron
- Lead
- Hydrogen
- Copper
- Silver
- Gold

Extraction Method:

- Electrolysis (Decomposing Metal Compound with electricity)
- Heating Metal Oxide with coke
- Heating Metal Compound in air

Testing for CATIONS:

With this table, you don't need to memorise the colours of different salts!

Just draw out this table during your O-Levels

CATION	NaOH		NH ₃	
	Colour	Soluble or Insoluble	Colour	Soluble or Insoluble
Cu²⁺	B	I	B	S
Fe²⁺	G	I	G	I
Fe³⁺	R	I	R	I
Ca²⁺	W	I	-	-
NH⁴⁺	N	-	-	-
Zn²⁺	W	S	W	S
Al³⁺	W	S	W	I
Pb²⁺	W	S	W	I

Colour of Observation

Soluble or Insoluble in excess Alkali

The CATIONS table shows the colour changes observed when the salt is added to Sodium Hydroxide, NaOH, or Aqueous Ammonia, NH₃.

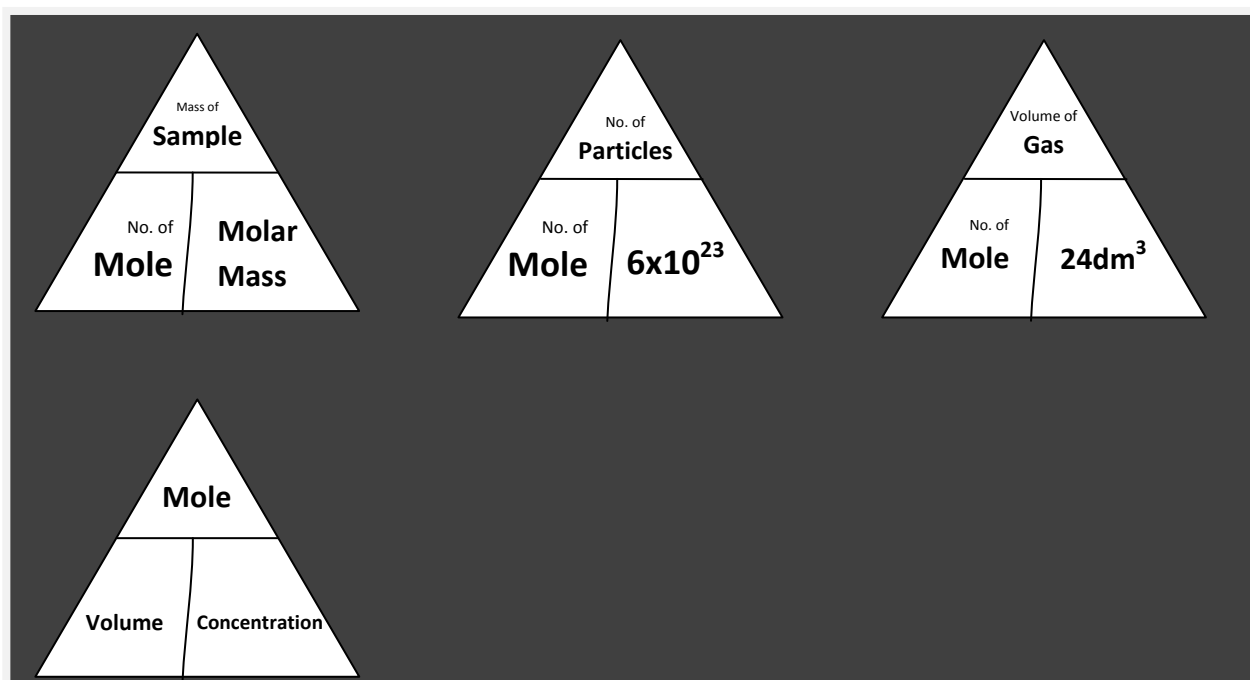
Testing for ANIONS:

ANION	Tested with	Observations	
Chlorine	AgNO ₃	AgCl	White
Carbonate	Acid	CO ₂	Carbon Dioxide (Turn Limewater chalky)
Sulphate	Ba(NO ₃) ₂	BaSO ₄	White
Nitrate	Al, NaOH	NH ₃	Ammonia (Turn red litmus blue)
Iodide	Pb(NO ₃) ₂	PbI ₂	Yellow

Test for GASES:

- **Ammonia** → Use damp litmus Paper → Turns from red to blue
 - **Carbon Dioxide** → Use Limewater → White ppt formed (Turns Chalky)
 - **Chlorine** → Use Damp blue litmus paper → Bleaches Litmus paper (Litmus Turns colourless)
 - **Hydrogen** → Use Burning Splint → 'Pop' Sound Heard
 - **Oxygen** → Use Glowing Splint → Glows Brighter or Burst into flames
 - **Sulphur Dioxide** → Place a drop of Potassium Dichromate(VI) on Filter paper
- Orange Dichromate turns green.
-

Mole Concept - Memorise this 4 IMPORTANT Formulas:



Random Notes

Some Properties of All acidic solutions

1. All acids change blue litmus red
2. Acids react with metals which are above hydrogen in the reactivity series.
3. Acid reacts with bases to form salt and water.

Uses of Ammonia

- 1) Manufacture of nitric acid
- 2) Used to produce fertilisers

Note:

- Hydrogen can be used as a fuel!
- Ethene (Alkene) is used to make plastic

Potassium Dichromate (VI)

- Acts as an oxidising agent.
- If something is oxidised, it will turn from orange to green!
- Used to test for Sulphur Dioxide – Place a drop on filter paper, colour changes from orange to green.

*Note: Potassium Dichromate turns from Orange to green when Alcohol is present!

- Because P.D, which is an oxidising agent, can oxidise “alcohol into organic acid”.

And P.D turns green whenever something is oxidised.

Potassium Iodide

- Acts as an reducing agent.
- If something is reduced, it will turn from colourless to brown!
(* or if an Oxidising agent is present)

Uses of Ethanol

- 1) Solvent for organic compounds.
- 2) To make alcoholic drinks.

Note: Something that contains more carbon content is stronger!

Some Reaction requirements:

- 1) Fermentation
 - 37°C
 - Enzymes
 - No Oxygen present

- 2) Alkene addition of steam, to become alcohol
 - Phosphoric acid (Catalyst)
 - 300°C
 - High temperature/pressure!

- 3) Alkene addition of Hydrogen, to become Alkane
 - Nickel Catalyst

Fractional Distillation of Petroleum

Important Process (Better Answer):

- 1) The crude oil is separated into different fractions by fractional distillation
- 2) The crude oil is boiled. Each fraction boils at a different temperature.
- 3) The smaller, lighter molecules separate at low boiling points.
The heavier parts have higher boiling points.
- 4) The fractions are run off from the fractionating column at different boiling points.

General Links

Electical Conductivity – Moving Ions

Heat Conductivity – Free Moving electrons

Boiling point – Strong electrostatic attraction

Why Ionic got high B.P?

- 1) Ionic compounds consist entirely of ions.
- 2) The opposite charged ions are held close to one another by very strong electrostatic attraction, known as ionic bonds.
- 3) Hence large amount of energy is needed to break ionic bonds; Therefore high boiling point.

Why Covalent Low BP?

- 1) Covalent compounds consist entirely of molecules as they are formed by sharing of electrons.
- 2) Forces between molecules are very weak.
- 3) Hence only small amount of energy is needed to break bonds.

Why Ionic compounds conduct in Molten/Aqueous state?

- The ions become free to move about and can convey charges.

Why cannot conduct in Solid state?

- The ions are fixed rigidly by strong electrostatic attraction hence cannot conduct electricity.

Why attaching Magnesium to underground pipe increase working life?

(About Sacrificial Protection – Prevention of rusting)

- Magnesium is above iron in the reactivity series.
- Water will react with Magnesium instead of iron, and Magnesium gets worn out.
- Iron rusting is much reduced.
- This is known as Sacrificial Protection

#Why cannot use copper instead of Magnesium??

- Copper is below iron in the reactivity series.
- Hence Iron rusts faster when copper is attached to iron.

Why Hydrogen More reactive (than Helium)?

- Hydrogen has 1 valence electron. It can gain one more to become stable.
- Helium has 2 valence electrons, making it very stable.

Physical Properties of Metals

1. Good conductors of heat and electricity - *used to make wires*
2. High Bp/Mp - *used to make cooling utensils*
3. Malleable and Ductile. – *used to make jewellery*

Why is Copper recycled?

1. Copper is expensive
2. Copper is not seen as extensive as some other metals.

Naming an Ester

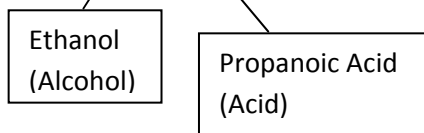
When you name or draw the structure of ester, follow this Formula:



NOL means “Name Alcohol First”

DAC means “Draw Acid First”

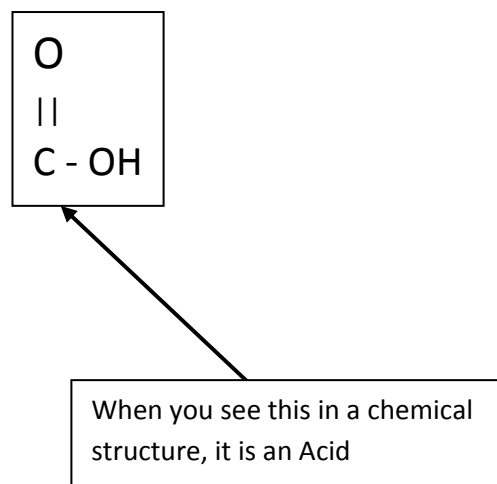
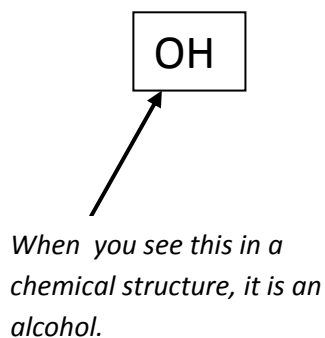
- So in Ethyl Propanoate (Ester), the one on the left is Alcohol, right is Acid.



- But when you draw the chemical structure, the Acid part must be on the left side, Alcohol on the right side.

3 Amphoteric Oxides:

1. Aluminium Oxide
2. Zinc Oxide
3. Lead Oxide



Alkane: C_nH_{2n+2}

Alkene: C_nH_{2n}

Alcohol: $C_nH_{2n+1}OH$

Acid: $C_nH_{2n+1}CO_2H$ OR $C_nH_{2n}O_2$

This new formula works the same as the original!

It is highly recommended you use this formula to avoid confusions.

Oxidation

1. Gain Oxygen
2. Loss Hydrogen
3. Loss electrons
4. Increase in oxidation state

Reduction

1. Gain hydrogen
2. Gain electron
3. Loss Oxygen
4. Decrease in oxidation state

Note: When checking if a something is oxidised or reduced, use the **oxidation state** to check! This produces 100% Correct answer. If you chose to use the lose/gain of oxygen or electrons, your answer might not be correct.

“Protein undergoes hydrolysis to form amino acids!”

Remember 4 alkalis (Soluble oxides/Hydroxides)

1. Potassium Hydroxide
 2. Sodium Hydroxide NaOH
 3. Calcium Hydroxide Ca(OH)₂
 4. Ammonia NH₃
-

Reactivity Series:

1. Potassium
2. Sodium
3. Calcium
4. Magnesium
5. Aluminium
6. Zinc
7. Iron
8. Lead
9. Hydrogen
10. Copper
11. Silver
12. Gold

*Just remember the phrase:

“Playing soccer can make all zappy, I love Hanna coz she’s gorgeous”

Mr of C₆₀: (Carbon molecule)

$$12 \times 60 = 720$$

Exothermic

- **Absorb energy → Break bonds**
- **Absorb heat → Test tube turn cold**
- **Eg. Ice melting to water** (Absorb energy to break bonds)

Endothermic

- **Give out energy → Bond Forming**
 - **Release Heat → Test tube turns hot.**
-

“Hydrogen used as a fuel”

“Ethene used to make plastics”

Solvent suitable for Chromatography: Ethanol

Chemical Reactions in Blast Furnace

1. Coke burns in air to produce carbon dioxide and lots of heat.
$$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$$
2. Carbon Dioxide reacts with more coke to produce Carbon Monoxide.
$$\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$$
3. Carbon Monoxide react with iron(III)Oxide to produce molten iron & carbon dioxide.
$$3\text{CO} + \text{Fe}_2\text{O}_3 \rightarrow 3\text{CO}_2 + 2\text{Fe}$$
4. Impurities in molten iron are removed by limestone.
$$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$$
5. Calcium Oxide formed combines with Silica present in the ore to form slag, which is tapped out.
$$\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$$

Impurity in Blast Furnace: Silica

ALKANE → STRONG HEAT → ALKENE

Process: Cracking

Cracking – A reaction in which big hydrogen molecules are broken into smaller molecules by heat.

Group 7 - Halogens

- Fluorine: Pale yellow gas
- Chlorine: Yellowish Green gas
- Bromine: Reddish Brown liquid
- Iodine: Black Solid
- Astatine: Black Solid

Note: when Bromine is added to Iodide, Got reaction! → Displacement reaction
(Bromine more reactive than Iodide)

- For group 7 elements, the more reactive elements will displace the less reactive elements in reactions.

Why plastic cause pollution?

- It is non-biodegradable
-

Describe a test for Chlorine

- It turns the blue litmus paper red first then white.
(Chlorine bleaches litmus paper)

How to distinguish which is Acid, which is alcohol

- Test: Put some **Sodium Carbonate**

Result for Alcohol: No reaction

Because Alcohol does not react with carbonate!

Result for Acid: A gas is released

Because Acid can react with carbonate

"ACID + CARBONATE → SALT + WATER + CARBON DIOXIDE GAS"

Uses of Noble Gases:

1. Helium: Fill Balloons (Low Density)
 2. Neon: Light Tubes
 3. Argon: Light Bulbs (unreactive)
-

**Common questions:*

Does metal liberate hydrogen from Dilute Hydrochloric Acid?

- Yes – More reactive
- No – Less reactive

Is the metal reduced by heating with carbon?

- Yes – Less Reactive
- No – More Reactive

How does calcium ion show that Calcium is a metal?

- Metals form positive ions. Calcium has 3 valence electrons thus it is a metal.
-

#Methods of preparing salts

1) 'Titration method' (For making all group 1 salts) use:

Soluble + Soluble

2) For making soluble salts not from group 1, use:

Soluble + Soluble

Soluble + Insoluble

3) 'Precipitation Method' For making Insoluble salts, use:

Soluble + Soluble

Important: Memorise the **steps of preparing salts:**

Titration Method (Soluble Base + Acid)

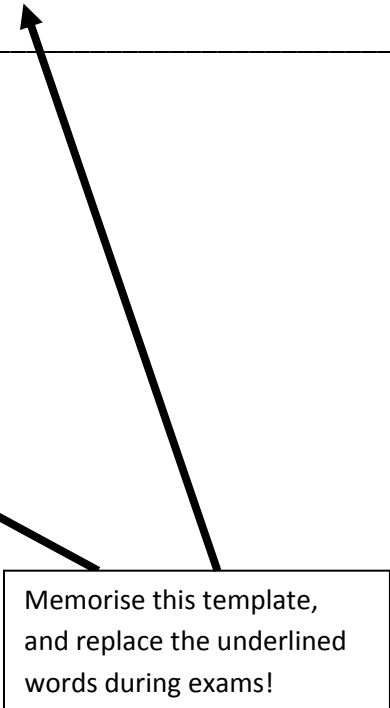
- **To prepare any salt that is from Group 1.** (Eg. Preparing Sodium Sulfate)
 - 1) Add 25cm of acid to a conical flask
 - 2) Add a few drops of indicator. (eg. Phenol-Phthalein)
 - 3) Add Sodium Hydroxide using a burette until indicator changes colour.
 - 4) Repeat experiment with 25cm³ of Sulfuric Acid but NO indicator!
 - 5) Add same volume of Sodium Hydroxide.
 - 6) Sodium Sulfate is obtained by evaporating & crystallising the salt.

Precipitation Method (Soluble + Soluble)

- **To prepare any Insoluble salt.**
 - 1) Add 'soluble salt' with 'soluble salt'.
 - 2) Filter out the precipitate.
 - 3) Wash the residue with distilled water.
 - 4) Leave the residue to dry.

*****MUST-KNOW formulas:**

Amonium	NH₄⁺
Ammonia	NH₃
Hydroxide	OH⁻
Nitrate	NO₃⁻
Carbonate	CO₃²⁻
Sulfate	SO₄²⁻
Hydrochloric Acid	HCl
Sulfuric Acid	H₂SO₄
Nitric Acid	HNO₃
Oxygen	O₂
Sodium Chloride	NaCl
Carbon Dioxide	CO₂



Memorise this template,
and replace the underlined
words during exams!

Why important to recycle metals?

- 1) It can help conserve the metal ores in the ground, making it last longer.
 - 2) It saves the money needed for extraction of metals.
-

#Why people concentrate on recycling copper?

- Copper is more scarce, hence more expensive than iron.

Advantages of Recycling:

1. Metal ores in the ground can last longer.
2. Money saved in energy needed to extract new metals from ore.
3. Scrap metal is removed from the environment, prevents land & water pollution due to corrosion.

Disadvantages of Recycling:

1. Expensive to collect scrap metals from many sources
 2. Metal fumes produced in melting of scrap metals can cause pollution.
-

Members of Homologous series have:

- Different Empirical formula
- Different Physical Properties

Remember: A base is a metal oxide or hydroxide!

#Which compound forms an acidic solution with water??

Ans: Carboxylic Acid

(*Acid + Water* → *Acidic Solution*)

*Note that excess Acid or Alkali can pollute the environment!!

If a question asks for the chemical properties of acid, avoid writing "It turns blue litmus paper red" → write "acid reacts with base to form..."

How to remove Sulphur Dioxide from... .. ??

Ans: Use:

- Slaked Lime
- Calcium Hydroxide

Acidic

Important Note: Isotopes have:

- Same chemical properties (Becoz same no. of valence electrons)
- Different physical properties

Info: In chemistry, "Lime" is Alkaline! NOT same as "LEMON"!!!

"Irons reacts rapidly in steam, slowly in cold water"

Air

- 1% Other Gas (mainly argon)
- 20% Oxygen
- 79% Nitrogen
- Others: CO₂, Water Vapour

Petroleum Fractions

(Fractional Distillation of Petroleum process at Pg 7)

1. Petroleum → Cylinder gas for cooking
2. Petrol → Fuel for cars
3. Naptha → Making Chemicals
4. Kerosene (Paraffin) → Jet fuel
5. Diesel → Fuel for bus
6. Lubricating Oil → Wax, Polishes, Lubricants
7. Bitumen → Surfacing roads

Particles Theory

Must memorise the following:

Factors affecting speed of reaction

1) Concentration of solution

- The higher the concentration of solution, the faster the rate of reaction.
- Because the particles are closer together so they collide more frequently and so there were more frequent reactions.

Note: Only applies to reactions of solutions.

2) Pressure

- The higher the pressure, the higher is the rate of reaction.
- Because the particles are squeezed closer together, so they collide more frequently and so there were more frequent reactions.

Note: Only applies to reactions of gases.

3) Particle size of solid

- The smaller the particle size, the higher the rate of reaction.
- Because the total surface area of the solid increases so reacting particles of liquid and gases collide more frequently with the surface and so there are more frequent reactions.

Note: Only applies to reactions of solids.

4) Temperature

- The higher the temperature, the faster the rate of reaction.
- Because at higher temperature, the particles have greater kinetic energy, so they react more often when they collide.

*Methods of extraction

-The method used depends on how reactive is the metals!

Very Reactive Metals

Electrolysis

(Decomposing metal compound with electricity)

For:

Potassium
Sodium
Calcium
Magnesium
Aluminium

Moderately Reactive Metals

Heating metal oxide with coke

For:

Zinc
Iron
Lead

Low Reactivity Metals

Heating metal compounds in air

For:

Copper
Silver

(End of exam notes v1.6 booklet)

Found mistakes on notes? Send me an email. Corrections will be made within 2 days.