Cambridge GCSE Notes
5070 Chemistry

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Introduction

What follows is my compilation of notes I used to get through my Ordinary Level GCSE exams, in the May-June session of 2025. I release all these notes to the public so as to help combat the tragic "coaching culture" surrounding GCSE exams. This set of notes is written to be used in accordance to the coursebooks published by Cambridge, and is of little use by itself.

My despiction of coaching culture arises from the fact that it ruins student life and to a large extent the academic potential of students. A typical student has school in the day and in the evening they are made to sprint to and from coaching centres, often multiple teachers for the same subject all as a result of peer pressure and they come back home at 9 or 10 at night. If they have been given homework, they must sacrifice their sleep to complete these assignments. Students cannot, as a result, study by themselves – ruining their potential.

There exist accessible resources which are more than enough for a candidate to ace their exams, without any aid from the financially-minded coaching sharks. One of the services provided by these teachers are "compiled notes", exchanged for money, further inflating the price of education. So, in retaliation I release these notes as open-source and free to distribute.

Yet coachings are not entirely evil, students who struggle in certain subjects may ask for the aid of teachers of those subjects but it is meaningless to go to a different teacher for each and every subject.

These notes are condensed, written in sequence of the Cambridge specifications.

Suggestions for readers

These notes are not at all stand-alone resources that will magically help you to get through your exams. I suggest purchasing and utilising the Cambridge coursebooks, and read the chapters from there before referring to these notes, especially if the topic in question is absolutely novel to you.

YouTube has excellent resources, lectures galore at your discretion, simply type in "GCSE" alongside whatever topic you need to watch the lectures on.

Lastly, for practice of questions, past papers both topically and yearly compiled are available for purchase at bookstores and for free online (topicals can be found on physicsandmathstutor.com).

Contents

1 States of matter

1.1 Solids, liquids and gases

Matter is anything that occupies space and has mass. There are three states matter can be in: solid, liquid and gas. The latter two, liquid and gas are called **fluid** because they can flow and as a result they can be poured or pumped. Matter is composed of particles.

Solids

Solids have a fixed volume, with highest density of the three states, they have a definite fixed shape and are not fluid. The arrangement of particles in solids is regular, every particle is very close to another and their movement is limited to vibrations about fixed points. This is a result of the particles in solids having the least kinetic energy of the three states.

Liquids

Liquids have a fixed volume and their density is moderate to high, they lack any definite shape and take the shape of the container in which they are kept. They are fluid and they flow easily. The particles are still close together, less than that in solids but are in an irregular arrangement. The particles in liquids are able to move around and past each other as they have more kinetic energy than in solids.

Gases

Gases have no fixed volume they expand to fill any container they are put into, they have the loweest density and take the shape of the container they are put into. They too are fluid. The particles in gases are very far apart, and have no arrangement. They move randomly as a result of their high kinetic energy.

Changes of state

The below shows the names of the changes of state from solid to liquid to gas.

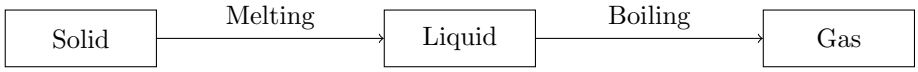

Figure 1: Endothermic changes of state

These changes of state are endothermic because heat is applied to cause these changes.

The resulting state of these changes all have a higher kinetic energy than the previous state. The resulting states have lower density and higher volumes.

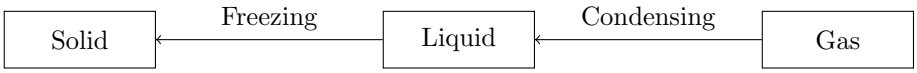

Figure 2: Exothermic changes of state

These changes of state are exothermic because because heat is absorbed (cold is applied) to cause these changes.

The resulting state of these changes have a lower kinetic energy, higher density and lower volume than the previous state.

Kinetic particle theory

The kinetic particle theory states that all matter is composed of particles, which have some kinetic energy and hence can move around. When energy is applied to these particles, they move around more and vice versa.

Heating and cooling curves

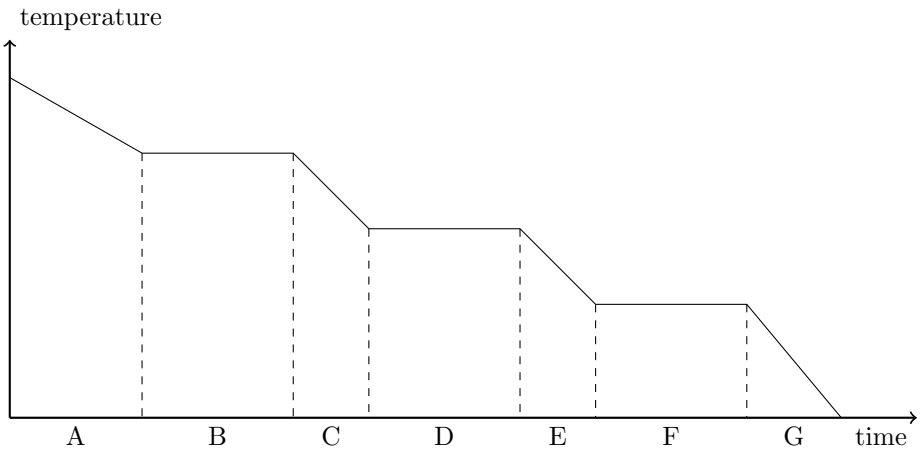

Figure 3: A typical cooling curve

Descriptions of what's happening in each region follows:

- A: The temperature of the sample is decreasing, it is still gas.
- B: The temperature of the sample is constant, the sample is a mixture of gas and liquid. Here, the sample is condensing.
- C: The sample is completely liquid, temperature continues to decrease.
- D: The temperature is once again constant, as the

2 Metals

2.1 Properties of metals

Metals are those elements which lose electrons to form ions. They are to the left of the zigzag line in the periodic table. They have the following general properties compared to non-metals:

- Metals are good conductors of heat, and cold, i.e. they are good thermal conductors.
- Metals are good conductors of electricity because their structure consists of positive ions in a sea of delocalised electrons which can move around.
- Malleability and ductility: Metals are malleable, that means they can be made into a variety of shapes. This is because metals have a layered molecular structure, layers which can slide over each other. They are ductile, meaning they can be wrought out into wires.
- Melting points and boiling points: Metals have high melting and boiling points because of the strong metallic bonding between the positive ions and delocalised sea of electrons.

Reactions

Metals react with dilute acids, water (in liquid and gaseous forms) and oxygen. They fall into the following formats:

- $\text{metal} + \text{dilute acid} \longrightarrow \text{salt} + \text{hydrogen gas}$
- $\text{metal} + \text{liquid water} \longrightarrow \text{metal hydroxide} + \text{hydrogen gas}$
- $\text{metal} + \text{steam} \longrightarrow \text{metal oxide} + \text{hydrogen gas}$
- $\text{metal} + \text{oxygen} \longrightarrow \text{metal oxide}$

These reactions are discussed at length in section 9.4.

2.2 Uses of metals

Metals are very useful as a result of their general properties. They are used in pots, pans due to their ability to conduct heat very well. Aluminium is a metal which has the following properties:

- Low density
- Low reactivity (section 9.4)
- Corrosion resistance

It can thus be used in aircraft bodies, overhead electrical cables, and food containers. Copper is used in electrical wiring.

2.3 Alloys and their properties

Alloys are mixtures of metals with other elements. Examples are brass (copper and zinc), stainless steel (iron, chromium, nickel and carbon). These alloys can be harder because the layers of particles can no longer slide over each other because of the differently sized particles of the different elements. Stainless steel is used in cutlery because of its corrosion rust resistance and hardness. Stainless steel has many such applications.

2.4 Reactivity series

Below is the reactivity series, in order of decreasing reactivity.

$$\mathrm{K, Na, Ca, Mg, Al, C, Zn, Fe, H, Cu, Au, Ag}$$

A metal is said to be more reactive than another if it displaces the other from its aqueous compound. We can classify these further, highly reactive metals (HRMs): K, Na, Ca, Mg, Al; moderately reactive metals (MRMs): Zn, Fe; and low reactive metals (LRMs): Cu, Au, Ag.

Exceptions are as follow:

1. Aluminium is a metal that is more reactive than most, but in reality it has a sample of aluminium tends to have a layer of Al_2O_3 around it (reacted with atmospheric oxygen). As a result aluminium is not particularly reactive unless the oxide layer is removed by any means.

2. Carbon is a non-metal but its is more reactive than MRMs and LRMs, but this difference only applies for oxygen displacements. That is:

   $2\,ZnO + C \longrightarrow 2\,Zn + CO_2$ but

   $ZnSO_4 + C \longrightarrow ZnSO_4 + C$ (no reaction)

3. Hydrogen is a gas. (bro just chilling)

Reactions

Metals react with water, in liquid and gaseous form; dilute acids and oxygen.

- Cold water: Na, Ca and K react with cold (room temperature and pressure) water, to give a hydroxide and hydrogen gas:

  $2\,Na\,(s) + 2\,H_2O\,(l) \longrightarrow NaOH\,(aq) + H_2\,(g)$

  $2\,K\,(s) + 2\,H_2O\,(l) \longrightarrow KOH\,(aq) + H_2\,(g)$

  $2\,Ca\,(s) + 2\,H_2O\,(l) \longrightarrow CaOH\,(aq) + H_2\,(g)$

  Observations of the above:

  - Silvery solid dissolves.
  - Bubbles of a colourless gas is seen.

  - Heat is produced (solutions becomes heated).

- Steam: All metals above H in the reactivity series react with steam, giving a metal oxide an hydrogen gas. For example:

  $\mathrm{Ca\,(s) + H_2O\,(g) \longrightarrow CaO\,(s) + H_2\,(g)}$

  Observations of the above:

  - Silvery solid turns into white solid i.e. colour becomes dull.

- Dilute acids: All metals above H react with dilute acids, giving a salt and hydrogen gas. For example:

  $\mathrm{Mg\,(s) + 2\,HCl\,(aq) \longrightarrow MgCl_2\,(aq) + H_2\,(g)}$

All of the above reactions are displacement reactions, where H is replaced by metals more reactive than it. Pb (lead) is a metal with a reactivity very close to H, as a result it sometimes displaces H and sometimes does not.