Chemistry IGCSE

Section A: Principles of Chemistry

Chapter 1: States of Matter

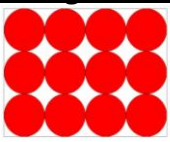
1) Name the three states of matter and each one's particles (3).

Solid (6):

-Example:

Ice.

-Diagram of particles:



-Spacing between particles:

Close together and touching one another.

-Arrangement of particles:

Regular repeating pattern.

-Movement of particles:

Vibrate about fixed positions but do not move apart.

-Forces between particles:

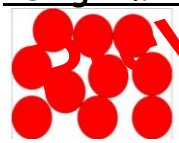
Strongest

Liquid (6):

-Example:

Water.

-Diagram of particles:



-Spacing between particles:

Close together and touching one another.

-Arrangement of particles:

Irregular.

-Movement of particles:

Move around and slide past one another.

-Forces between particles:

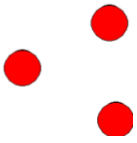
Not as strong as in the solid but stronger than in gas.

Gas (6):

-Example:

Water vapour.

-Diagram of particles:



Heat the solid until it sublimes.

b) Why does the change occur? (2)

The particles gain kinetic energy and vibrate faster and faster. Eventually the forces of attraction between the particles are completely broken and they are able to escape form the solid.

Chapter 2: Atoms

1) How do we know that matter is made up of tiny, moving particles?

Because of the dilution of coloured solutions and diffusion.

2) Dilution of coloured solutions:

a) Name an example of this:

When potassium manganate (VII) is added to water.

b) Describe what is seen.

A purple solution is formed.

c) What does this mean?

A few very tiny crystals can produce a highly intense colour.

d) What happens when the solution is diluted several times? (2)

The colour fades, but does not disappear until a lot of dilutions are made.

e) What does this experiment indicate? (2)

That there are a large number of number of particles of potassium manganate (VII) in a very small amount of solid. The particles of potassium manganate (VII) must be very tiny.

3) Answer these questions on diffusion:

a) Where can this process occur?

In both liquids and gases.

b) Name an example of this.

The diffusion of bromine from one flask to another.

c) What colour is bromine?

Orange.

d) What has happened after 5 minutes and why? (4)

The gas has diffused into the other flask. This happens because both air and bromine particles are moving randomly and there are gaps between the particles. The particles can therefore easily mix together.

e) Is diffusion faster in liquids or gases?

In liquids it is slowerbecause the particles in a liquid are closer packed together and so they move slower than in gas.

4) What are molecules made up of?

Most molecules are made up of two or more atoms covalently bonded together.

	C	H
Percentage (%)	92.31	7.69
Mass	92.31	7.69
Atomic Mass	12	1
$\frac{\text{mass}}{\text{atomic mass}}$	$\frac{92.31}{12}$	$\frac{7.69}{1}$
No. of moles	7.69	7.69

Ratio: 1 : 1.

Empirical formula: CH.

Molecular formula: 12+1 (mass of empirical formula) = 13.

Molecular formula r.f.m.= 78 ➔ $\frac{78}{13} = 6$. CH x 6 = C_6H_6.

7) If 25g of $CaCO_3$ is heated what mass of CaO will be produced?

$CaCO_3$➔no. of moles = $\frac{\text{mass}}{\text{r.f.m.}}$ ➔ $\frac{25}{40+1+(16\times 3)} = \frac{25}{100}$ = 0.25 moles.

-From Equation:

$CaCO_3$➔ $CaO+CO_2$.

1 : 1 ➔ 0.25 : 0.25.

Mass = no. of moles x r.f.m. = 0.25 x (40+16) = 0.25 x 56 = 14g.

8) Calculate the mass of carbon dioxide gas can obtain by the action of acid on 15g calcium carbonate, in the reaction:

$CaO_3 + 2HCl$ ➔ $CO_2 + CaCl_2 + H_2O$:

CaO_3➔ no. of moles= $\frac{\text{mass}}{\text{r.f.m.}}$ ➔ $\frac{15}{100}$ = 0.15 moles.

$CaO_3 : CO_2$➔ 1 : 1 ➔ 0.2 : 0.2

Mass= no. of moles x r.f.m. ➔ 0.15 x 44 = 0.25 x 56 = 6.6g.

9) Calculate the mass of potassium chloride formed when a solution containing 8.00g potassium hydroxide is neutralised with hydrochloric acid:

$KOH + HCl \Rightarrow KCl + H_2O$:

KOH= 8g ➔ no. of moles= $\frac{\text{mass}}{\text{r.f.m.}} = \frac{8}{39+16+1} = \frac{8}{56}$ = 0.15 moles.

KOH : KCl ➔ 1 : 1 ➔ 0.15 : 0.15

Mass = no. of moles x r.f.m. => 0.15 x 74.5 = 10.65g.

10) What is the formula to find out Concentration?

$$\text{Concentration (mol/dm}^3) = \frac{\text{No. of moles}}{\text{Volume (dm}^3)}.$$

11) If the Volume is in cm^3 what do you do to it in order to convert it into litres (dm^3)?

c) Saturated:

An organic compound that contains only carbon-to-carbon single covalent bonds.

d) Unsaturated:

An organic compound that contains a carbon-to-carbon double covalent bond.

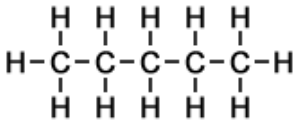
e) General formula:

A formula that states the ratio of atoms of each element in the formula of every compound in a particular homologous series.

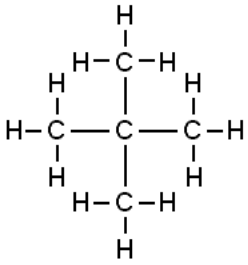
f) Isomers:

They are compounds with the same molecular formula but a different displayed formulae.

2) Draw two isomers of pentane:



Pentane



Isomer of pentane

Chapter 18: Alkanes

1) What is an alkane?

A group of saturated hydrocarbons containing only carbon-to-carbon single covalent bonds.

2) What is the general formula of an alkane?

C_nH_{2n+2}.

3) How to remember the order of the names of the compounds?

Many European People Buy Pears.

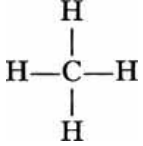
4) Give the molecular and displayed formula and if available the chain of isomers of the following alkanes:

a) Methane (2):

-Molecular formula:

CH_4.

-Displayed formula:



b) Ethane (2):

-Molecular formula:

C_2H_6.

-Add the insoluble base to the warm dilute acid and stir until the base is in excess.
-Filter the mixture into an evaporating basin to remove the excess base.
-Leave the filtrate (dilute solution of the salt) in a warm place in the laboratory so that the water evaporates and crystals form.
-Remove the crystals and dry them on a filter paper.

20) What is the method to prepare a soluble base (alkali)? (4)

-Put an aqueous solution of the alkali into a conical flask and add a suitable indicator.
-Add dilute acid from a burette until the indicator just changes colour.
-Add powdered charcoal and shake the mixture to remove the colour of the indicator.
-Filter to remove the charcoal and then obtain crystals from the filtrate in the usual manner.

Dilute acid + metal carbonate:

21) What method is used for insoluble carbonates?

Most metal carbonates are insoluble in water and hence the method for the acid + insoluble base can be followed.

22) What is a good indication of neutralisation?

Until no more bubbles are formed.

23) What method is used for soluble carbonates?

The procedure for acid + soluble base must be followed.

24) Which universal indicator should be used?

Methyl orange.

Dilute acid + metal:

25) Which are the only metals commonly used? (3)

Magnesium, iron and zinc.

26) What method is used?

The acid + insoluble base is adopted.

27) What is a good indication of neutralisation?

Until no more bubbles are formed.

28) What is a precipitate?

An insoluble solid that is made by chemical reaction that takes place in aqueous solution.

29) What is a precipitation reaction?

A reaction that produces a precipitate.

faster the rate of reaction is. Decreasing the concentration will have the opposite effect.

3) How does the surface area affect rate of reaction? (4)

The smaller the pieces of solid, the larger the surface area will be. This means that there will be more particles exposed, increasing the amount of collisions. The more collisions there are in a certain amount of time, the faster the rate of reaction is. Increasing the size of pieces of solid will have an opposite effect.

4) How does the temperature at which the reaction takes place affect the rate of reaction? (4)

Increasing the temperature increases the energy the particles have (kinetic energy). This means that they move more and therefore collide more with each other. The more collisions there are in a certain amount of time, the faster the rate of reaction is. Decreasing the temperature will have the opposite effect.

5) What is a catalyst?

A substance that increases rate of reaction but stays unchanged.

6) How does adding a catalyst affect rate of reaction? (3)

The catalyst acts as a surface to which one type of the particles stick on to, so then the others have it easier to collide. The more collisions there are in a certain amount of time, the faster the rate of reaction is. It provides an alternative pathway with lower activation energy.

7) How can you recognize a catalyst? (5)

-Do the reaction.
-Weigh the catalyst.
-Do the reaction again, this time with the catalyst.
-If it speeds up the reaction filter it and then weigh it.
-If it hasn't changed colour or weight it is a catalyst.

Chapter 24: Equilibria

1)What are reversible reactions?

A reaction that can go in both a forward and a backward direction.

2) What is the symbol for an arrow that shows that the reaction is reversible?

⇆.

3) What are the observations when copper(II) sulphate is heated?

The blue crystals turn into a white powder and a clear, colourless liquid (water) collects at the top of the test tube.

4) What is the white powder?

Anhydrous copper(II) sulphate.

best yield of the product of ammonia will occur at a high pressure, but this is expensive and dangerous. A compromise is reached, so we use a moderate pressure of 200 atm, giving a good yield in a reasonable time.

17) Describe the 5 steps of the Häber Process (5):

1) Nitrogen is taken from the fractional distillation of liquid air.
2) Hydrogen is made from the reaction of steam and methane.
3) These gases react together at 450°C, with a pressure of 200 atm and using an iron catalyst.
4) Gases are cooled and ammonia turns to liquid to make liquid ammonia.
5) The unreacted gases are recycled and used again in the Häber Process.

18) Name 5 properties of ammonia (5):

-Ammonia is a gas at room temperature.
-It is a colourless gas.
-It has a pungent choking smell.
-It is soluble in water.
-When dissolved in water ammonium hydroxide is produced $NH_3(g) + H_2O \rightarrow NH_4OH(aq)$. This solution is alkaline.

19) Name 4 things that ammonia is used for:

1) To make nitric acid (HNO_3).
2) To make nylon (for example parachutes).
3) To make explosives.
4) To make fertiliser.

Section E: Chemistry in Society

Chapter 25: Extraction and Uses of Metals

1) How does the difficulty and expense to extract a metal depend on its reactivity?

The more reactive the metal the harder and more expensive it is to extract.

2) What are the three methods of extraction?

Electrolysis of the molten chloride or oxide, by being heated with a reducing agent such as carbon or carbon monoxide and some occur naturally as elements.

3) Which elements are extracted by electrolysis? (6)

Potassium, sodium, lithium, calcium, magnesium and aluminium.

4) Which elements are extracted by being heated with a reducing agent? (3)

Zinc, iron and copper.

20) Name 6 uses of aluminium and the most important propertyfor each:

Use (6):Most important property (6):

-Aeroplane bodies. –High strength-to-weight ratio.

-Overhead power cables. –Good conductor of electricity.

-Saucepans. –Good conductor of heat.

-Food cans. –Non-toxic.

-Window frames. –Resists corrosion.

-Drinking cans. –Easily moulded.

21) Name 3 uses of iron and the most important property for each:

Use (3):Most important property (3):

-Car bodies. –Strong (withstands collisions).

-Iron nails. –Strong.

-Ships, girders and bridges -Strong.

Chapter 26: Crude Oil

1) What is crude oil?

A mixture of hydrocarbons, mostly alkanes.

2) What is the first step of the refining of crude oil?

Fractional distillation.

3) What is fractional distillation?

The physical process by which crude oil can be separated into its substances.

4) Why does fractional distillation work?

Because the fractions are composed of molecules of different boiling points (they are different sizes).

5) How does the size of the molecules affect the boiling points?

The bigger and longer the molecule, the higher the boiling point and the smaller and shorter the molecule, the lower the boiling point.

6) Name the five steps of fractional distillation. (5)

-Crude oil is heated to convert it into a vapour. The vapour is then fed into the bottom of the fractionating column.

-The hydrocarbons with a high boiling point (fuel oil and bitumen) turn immediately into liquids and are tapped off at the bottom of the column.

-The hydrocarbons that have boiling points lower than 400°C remain as gases and rise up the column. As they rise they cool down.

-The different fraction will condense at different heights according to their different boiling points. When they condense they are tapped off as liquid.

-The fraction with the lowest boiling point (refinery gas) remains as a gas and comes out at the top of the column.

7) What is a fraction?

A part of a mixture that has been separated by fractional distillation.

8) Name the 6 different fractions and what they are used for.

Name:	Used for:
Refinery gas	Camping Fuel
Gasoline	Car Fuel
Kerosene	Fuel for aeroplanes
Diesel	Fuel for buses, lorries, trains and cars.
Fuel oil	Fuel for ships and industrial heating.
Bitumen	Covering for roads and flat roofs of buildings.

9) Does the no. of carbon atoms in molecule increase or decrease as you go down?

It increases.

10) Does the boiling point increase or decrease as you go down?

It increases.

11) Does the viscosity increase or decrease as you go down?

It increases.

12) What is the problem of fractional distillation? (2)

The amount of gasoline fraction in crude oil is far less than is needed. The amount of the higher boiling points fractions in crude oil is far greater than is needed.

13) What process is the solution to this?

Cracking.

14) What is cracking?

This chemical process is used to make the more common, but less useful long chain of alkanes into less common, but more useful short chain of alkanes and also an alkene.

15) What does it require?

Heat (600-700°C) and a catalyst (aluminium oxide).

16) What is the word and chemical formula for the cracking of decane?

-Decane (heat+Al_2O_3) ➔Octane + Ethene.

-$C_{10}H_{24}$ (heat+Al_2O_3) ➔ C_8H_{18} + C_2H_4.

17) What can the octane produced by used for?

To make petrol.

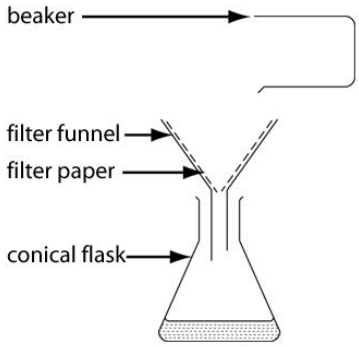
18) What can the ethene be used for?

A polymer called poly(ethene)

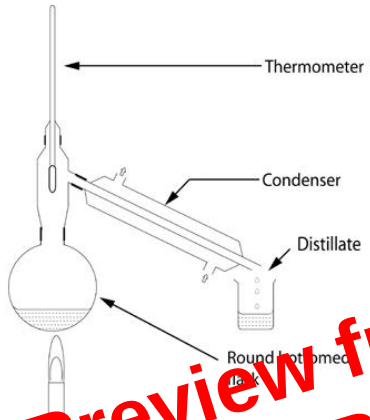
Mixtures contain more than one substance. They are just mixed together and not chemically combined. Elements have only one type of atom. Compounds are two ore more elements which are chemically combined together.

39) Draw a diagram for the following processes:

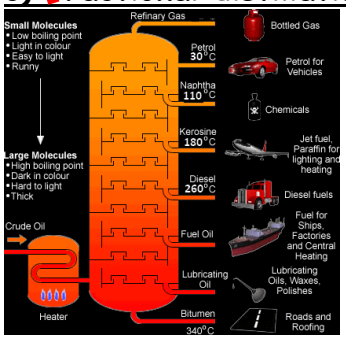
a) Filtration:



b) Simple distillation:



c) Fractional distillation:



d) Crystallisation: