CHEMISTRY

ULTIMATE QUESTIONS

GUIDE

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Contents

Particle Theory:

The theory states that in all substances the particles are _____.

There are three states of matter, solids, _____ and _____.

In solids the particles are_____about a fixed point. The forces between particles are_____. A solid can not be _____ easily because the particles are _____ _____. They have a fixed shape and_____.

In a liquid the particles are free to_____over each other. The forces between particles are_____. A liquid can not be _____ easily because the particles are _____ _____. They have a fixed _____ but their _____ changes depending upon the base of the container.
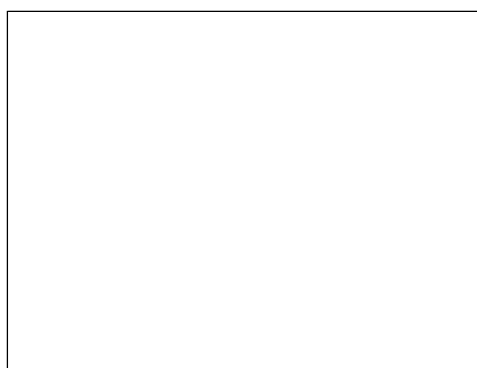
In a gas the particles are moving very_____and in _____ directions. The forces between particles are very_____. A gas can be squashed because there are large _____ between the particles. Both their _____ and shape vary depending upon the container.

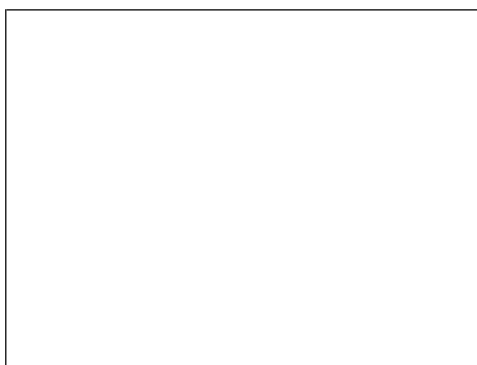Draw the structures of a solid, liquid and gas in the boxes provided.

Solid

Liquid

Gas

Other Properties:

1. Density

        Solids and _____ have high densities because their particles are _____ packed. However, _____ have very low densities because their particles are_____out.

2. Pressure

        Pressure is caused by gases, because their particles _____ with the side of the container. If the **volume** is **decreased** then the **pressure** will **increase** because the particles will collide_____. If the **temperature** is **increased** then the **pressure** will **increase** because the particles will collide more often and_____with the container.

3. Diffusion

        Diffusion is the movement of particles from a _____ concentration to a _____ concentration. _____ diffuse faster especially if they are_____. If the temperature is increased then diffusion will increase because the particles have more _____ Energy and are travelling faster.

Changes of State (1):

Match the following changes.

Solid to Liquid   Freezing

Liquid to Gas   Subliming

Gas to Liquid   Melting

Liquid to Solid   Boiling

Solid to Gas   Condensing

Changes of State (2):

1. Melting

When a solid is heated the particles gain more_____.
This makes the particles_____faster. At a certain temperature
(_____ Point) the particles are _____ fast enough to
overcome the very _____ forces between the particles and are
free to_____.

2. Boiling

When a liquid is heated the particles gain_____. If
they are travelling fast enough towards the_____then they can
escape or knock a surface particle into the_. If this happens
normally then it is known as_____. However, at a certain
temperature (_____Point) there is a mass_____of particles.

For the reverse processes particles_____down as they lose
_____ and will reform the strong_____between the particles.

Cooling Curve:
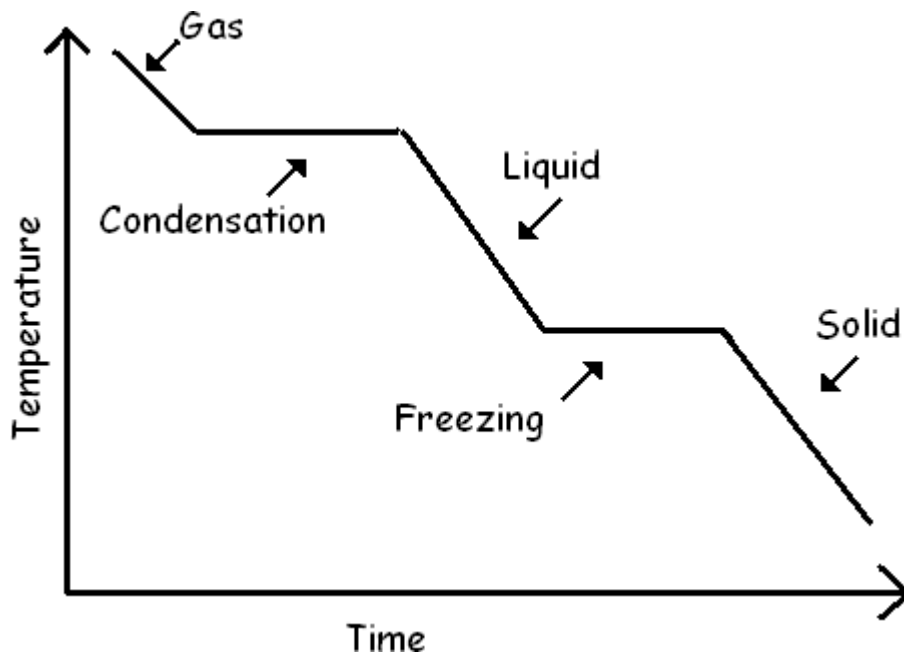
When a gas _____ or a liquid _____ the temperature remains_____ because energy is released as the _____ come together.

When a solid _____ or a liquid _____ then the temperature remains _____ because all the _____ energy is required to _____ the bonds between the particles.

Exothermic:- when energy is_____to the surroundings.
Endothermic:-   when energy is_____from the surroundings.

Mixtures:

Mixtures are two or more substances that are not _____ _____.

When two liquids dissolve they are said to be_____, however, if they form__ layers and do not dissolve then they are called_____.

An example of two liquids that do not mix are_____and water. If they were shaken together then you would see_____of _____ suspended in the water (_____). After a while they would separate out to form two_____.

If detergent was added to the mixture before it was shaken then the droplets would remain suspended for longer. In this case the detergent is acting as an_____.

Separating Mixtures:

1) Chromatography:

Used to separate mixtures of things with different _____.

i) Draw a line on the chromatography paper in _____.

ii) _____ the dyes on the line.

iii) Pour water or another suitable _____ (e.g. ethanol) into a beaker ensuring the level is below the line.

iv) Place the chromatography paper into the water.

v) Allow to develop for five minutes or until the s____ has nearly reached the top.

vi) Remove the paper and allow to d____ before comparing the distance travelled by the dyes.

A chromatogram can be used to identify different substances because under the same conditions the same dyes will travel the same d_____.

2) Distillation:

Distillation is used to separate a mixture that contains two or more substances that have different_____.

E.g. ethanol and_____.

Fractional distillation can be used to separate complex mixtures such as c_____o_____.

3) Filtration and Evaporation (Crystallisation):

Some mixtures contain a soluble substance and an insoluble substance (e.g salt and sand). These mixtures can be separated by:

i)   Add the mixture to a suitable_____.

ii)   Stir the _____ until one substance has completely _____.

iii)   _____ the mixture and leave the filter paper to dry (Sand).

iv)   Pour the_____into an evaporating basin and allow the solvent to_____(Salt).

Atoms:

Atoms have a small central_____, which is made up of _____ and_____and around which there are_____.

Name of Particle	Relative Mass	Relative Charge

The atom is made up of three types of particle. P_____and N_____(which are found in the_____) and E_____which _____ the central n_____.

The Atomic (Proton Number) tells us the number of p_____ in an atom which also happens to be the number of e_____.

The Mass Number tells us the total number of p_____ and n_____. Therefore to calculate the number of n_____:

No. of Neutrons = Mass Number – Atomic Number

e.g. For Sodium:

Mass No. = 23

Atomic No. = 11

Therefore No. of Neutrons   =   23 -11

=   **12**

Using your Periodic Table complete the following table.

Element	Atomic No.	Mass No.	Protons	Electrons	Neutrons
C	6				6
F			9		
Mg				12	
Cl		35			
Ca					20
U		238			

Isotopes are atoms of the same_____which have the same number

of_____but different number of_____. The Relative _____

Mass must be calculated from the _____ and Relative Isotopic

Mass of every isotope.

RAM = <u>Sum of (Isotopic Mass x % Abundance)</u>

$$100$$

Qu 1) For Boron there are two isotopes with their abundances in the

brackets. Calculate the Relative Atomic Mass.

10.0 (18.7%)   11.0 (81.3%)

Electron Configuration:

The electrons orbit the nucleus. The electrons are arranged in shells that represent orbit of similar energy.

1st Shell: Max 2 electrons

2nd Shell: Max 8 electrons

3rd Shell: Max 8 electrons

4th Shell: The remainder if any

e.g. Sodium- 11 Electrons

Therefore: 1st Shell: 2

                 2nd Shell: 8

                 3rd Shell: 1

Overall: 2, 8, 1

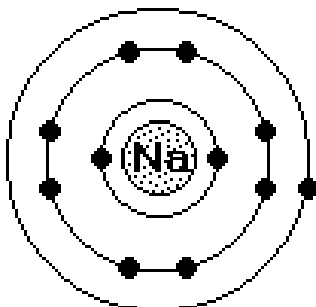Workout the electron configurations for the following elements:

i)   Carbon

ii)   Magnesium

iii)   Potassium

Electron Configurations can also be drawn:

e.g. Sodium

Draw electron configurations for the following:

i)   Oxygen

ii)   Chlorine

iii)   Calcium

a) What is the relationship between the **group** number and the number of
outer electrons.

Atomic Mass: Complete the following definitions.

Relative Atomic Mass (A_r): the_____mass of 1_____of

atoms relative to 1/12 the mass of 1 mole carbon-12_____.

Relative Isotopic Mass: the mass of 1 _____ of an _____

relative to 1/12 the mass of 1 mole carbon-12 atom.

Relative Molecular Mass (M_r): the_____mass of 1 mole of

compound relative to 1/12 the mass of 1 mole of_____-12 atoms.

It is the sum of all the Relative _____ Masses of its constituent

_____.

The term **Relative Formula Mass (M_r)** is used for Ionic Compounds.

Molar Mass: is the_____of one mole of the substance ($gmol^{-1}$)

The Mole:

This is the number of particles in 12g of Carbon-12. (**Avogadro's number**)

The number of particles is _____ and is called _____ Number.

The number of particles in any given substance can be calculated by:

No of Particles = No. of Moles x_____Number

Calculate the number of particles in the following:

1) 0.5 moles of magnesium

2) 0.1 moles of sulphur

3) 0.125 moles of oxygen

Molar Gases

One mole of any gas at room temperature and pressure occupies

_____ cm^3.

a) What volume would 0.1 moles of H_2 occupy?

b) What volume would 10g of O_2 occupy?

c) How many moles are there in 250cm^3 of I_2?

Empirical and Molecular Formulae:

The Empirical Formula is the _____ ratio of elements in a compound:

The Molecular Formula is the _____ ratio of elements in a compound:

e.g. Benzene:

Molecular Formulae: C_6H_6
Empirical Formulae: CH

To calculate the Empirical Formula you either need the _____ reacted or the_____masses.

Follow the same steps every time to calculate the empirical formula.
1 Write down the mass of each element.
2 Divide the mass by the relative atomic mass of the element.
3 Divide numbers by the smallest number to get the ratio of elements.
4 These numbers give the empirical formula.

A compound has 24 g of carbon and 64 g of oxygen. What is its empirical formula?

Element Symbol	C	O
Mass of element	24	64
Mass ÷ Relative Atomic Mass	÷ 12 2	÷ 16 4
Divide by the smaller number Ratio	÷ 2 1	÷ 2 2
The empirical formula of this compound is CO_2.		

1. A compound is made from 72 g of carbon and 12 g of hydrogen. Work out its empirical formula.

2. A common salt is analysed and is found to have 52.9 g of sodium and 81.7 g of chlorine. What is its empirical formula?

3. Aluminium ore may consist of 156 g of aluminium and 278 g of oxygen. Is its empirical formula AlO_2 or AlO_3?

4. A commercial paint thinner has the following composition: carbon 25.2 g; hydrogen 8.5 g; oxygen 33.7 g. What is its empirical formula?

Molecular Formulae:

Once you have found the Empirical Forumla e.g CH_2 then you can find the Molecular Formula using the M_r of the compound.

E_r is like M_r but for the Empirical Formula

M_r / E_r – this should be a whole number

Molecular Formula = M_r / E_r x Empirical Formula

e.g. 42/14 x CH_2 = C_3H_6

1. a) Calculate the empirical formula of the compound found to contain 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

b)   Find its molecular formula given that its M_r is 180.

2. a) Work out the molecular formula of the following compounds given the information below?

   i) empirical formula = P_2O_5 M_r = 284

   ii) empirical formula = CH_2 M_r = 56

Writing equations:

It is important when writing equations to do it methodically:

1.   Write a word equation
2.   Write the formulas for each of the species.
3.   Balance the equation.

State symbols are used to show the state of matter of the reactants of products.

(s):-   s_____

(l):-   l_____

(g):-   g_____

(aq):-   a_____

Write balanced equations for the following reactions:

a)   sodium + oxygen → sodium oxide

b)   aluminium + chlorine → aluminium chloride

c)   Potassium reacting with water?

Concentration, Volume and Moles:

In solutions the number of moles is often quoted as the concentration either in mol/dm^3 or M.

> **Number of moles = Concentration x Volume**
>
> **n = c x v**

NB Volume is often quoted in cm^3 and must first be changed into dm^3 by dividing by 1000.

Calculate the following:

a)   Number of moles in 2 dm^3 of 0.05 mol dm^{-3} HCl

b)   Concentration in 0.400 moles of HCl in 2.00 litres of solution

c)   Volume of 0.00500 moles of NaOH from 0.100 mol dm-3 solution.

Reacting Masses Calculations:

In order to calculate the mass of a reactant needed or product formed, volumes of products or perhaps a titration calculation you might need more than one step.

The MRA approach:

1. **M**oles:

    Calculate the initial number of moles of one of the species using either:

    n=m/Mr (solids)

    n=c x v (solutions)

    Pv = nRT (gases)

2. **R**atio:

    Calculate the number of moles of the other species using the ratio from the equation:

3. **A**nswer:

    Calculate your answer now that you have the number of moles of the species required.

The reaction below is known as the Thermitt reaction, which is used to form molten iron to mould train tracks together. What mass of aluminium powder is needed to react with 8.00 g of iron (III) oxide?

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$
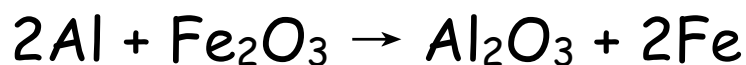
25.0 cm^3 of 0.0400 mol dm^{-3} sodium hydroxide solution reacted with 20.75 cm^3 of sulphuric acid in a titration. Find the concentration of the sulphuric acid.

Percentage Yield:

> % yield = $\dfrac{\text{mass of product obtained}}{\text{maximum theoretical mass of product}}$ x 100

The theoretical maximum mass of product must first be calculated using the reacting masses method:

Titanium can be extracted from titanium chloride by the following reaction. $TiCl_4 + 2\ Mg \rightarrow Ti + 2\ MgCl_2$

a)   Calculate the maximum theoretical mass of titanium that can be extracted from 100 g of titanium chloride .
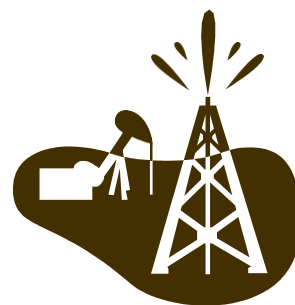
b) In the reaction, only 20 g of titanium was made. Calculate the percentage yield.

Ionic Compounds:

Ions are formed when atoms either g_____or l_____e_____.

O_____is the l_____of e_____.

R_____is the g_____of e_____.

Using the following table of common elements and their charges to complete the following formulae:

Element	Charge	Element	Charge
Sodium (Na)	+1	Chloride (Cl)	-1
Potassium (K)	+1	Bromide (Br)	-1
Magnesium (Mg)	+2	Oxide (O)	-2
Calcium (Ca)	+2	Sulphide (S)	-2
Aluminium (Al)	+3	Nitride (N)	-3
Iron (II) (Fe)	+2	Nitrate (NO_3)	-1
Iron (III) (Fe)	+3	Hydroxide (OH)	-1
Copper (II) (Cu)	+2	Carbonate (CO_3)	-2
Zinc (Zn)	+2	Sulphate (SO_4)	-2

a) Sodium Bromide

b) Aluminium Oxide

c) Iron (III) Chloride

d) Magnesium Nitride

e) Copper (II) Sulphate

f) Zinc Hydroxide

The electronic structure of the ions in sodium chloride can be represented by the following.

sodium ion,
Na$^+$ [2,8]$^+$
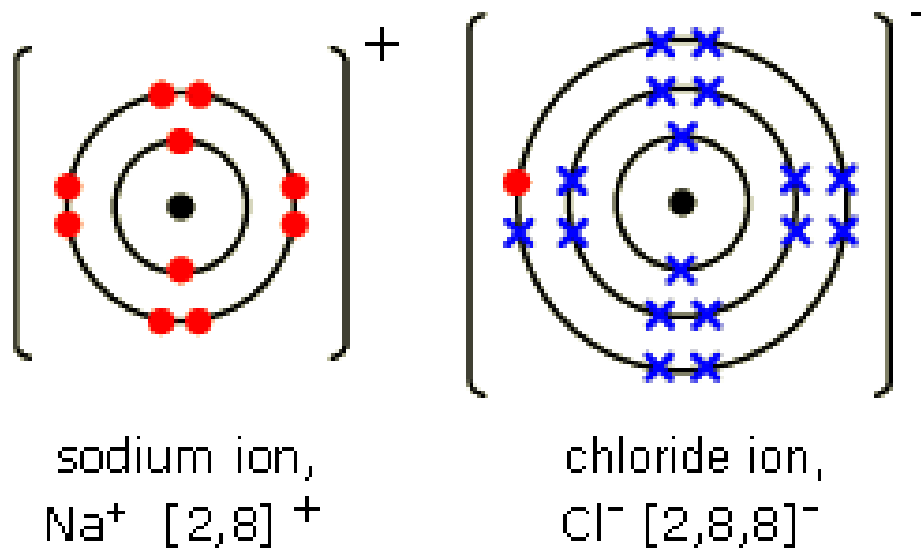
chloride ion,
Cl$^-$ [2,8,8]$^-$

a)   Draw a similar diagram to represent the ions in Calcium Chloride.

An **ionic compound** is a giant 3-d structure of ions (L_____).

Ionic compounds are held together by strong e_____ forces of

a_____between oppositely charged ions.

Ionic compounds have regular structures (giant ionic l_____)

in which there are strong e_____ forces in all directions

between oppositely charged ions.

a) Draw a diagram to show the arrangement of ions in sodium
chloride.

These compounds have high m_____points and high b_____

points because of the large amounts of e_____needed to break

the many s_____ bonds. The greater the c_____ on the ions the

higher the m_____and b_____point.

When m_____ or d_____ in water, ionic compounds conduct

e_____ because the i_____ are free to move and carry the

current.

b) Why do ionic compounds not conduct when solid?

Covalent Compounds:

When atoms share pairs of electrons, they form c_____ bonds. These bonds between atoms are s_____. Some covalently bonded substances consist of simple molecules such as H_2, Cl_2, O_2, HCl, H_2O, NH_3, CH_4, N_2, C_2H_6 and C_2H_4.

Substances that consist of simple molecules are gases, liquids or solids that have relatively low m_____ points and b_____ points.

Substances that consist of simple molecules have only w_____forces between the molecules (i_____ forces). It is these i_____forces that are overcome, **not** the c_____bonds, when the substance melts or boils.

a) Why does solid iodine sublime?

Substances that consist of simple molecules do not conduct e_____ because the molecules do not have an overall electric c_____.

Molecules that contain covalent bonds can be represented using dot-cross diagrams as shown here in ammonia.
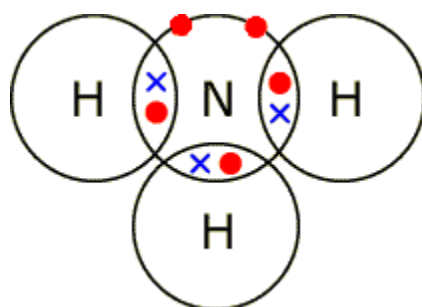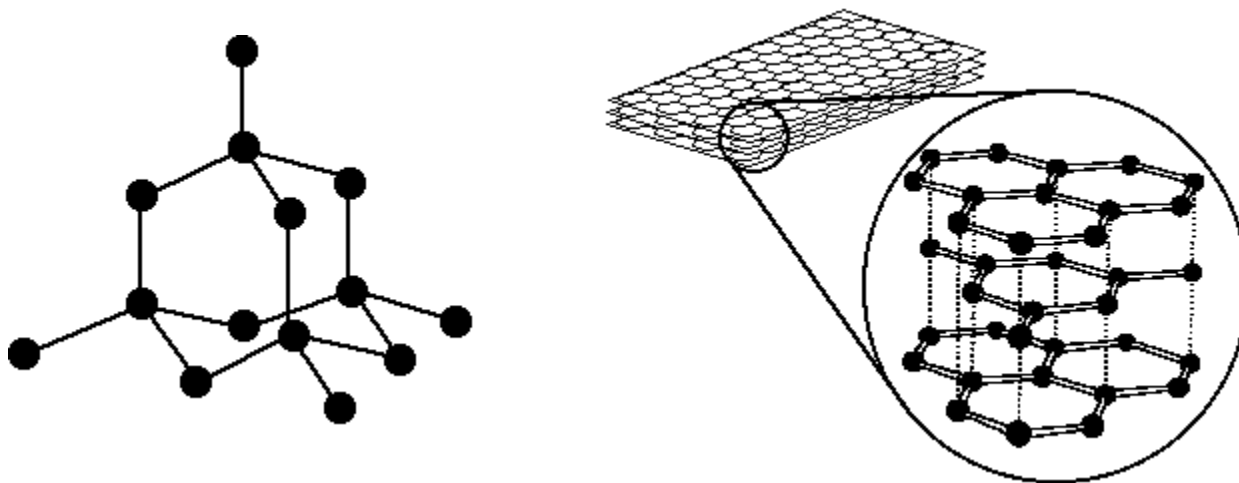

a) Draw a dot-cross diagram for water?

b) Draw a dot-cross diagram for hydrogen chloride?

c) Draw a dot-cross diagram for oxygen?

d) Draw a dot-cross diagram for ethane?

e) Draw a dot-cross diagram for ethene?

Others have **<u>giant covalent</u>** structures (m_____), such as

diamond and silicon dioxide.

a)   Why do diamond and graphite have very high boiling points?

In diamond, each carbon atom forms f covalent bonds with other

carbon atoms in a giant covalent structure, so diamond is very

h_____. This is why it is used in c_____tools.

In graphite, each carbon atom bonds to t_____others, forming

l_____. The l_____are free to slide over each other because

there are no covalent bonds between the layers and so graphite is

s_____and slippery. This is why it is used as a l_____.

In graphite, one e_____from each carbon atom is d_____.

These delocalised e_____ allow graphite to conduct h____ and
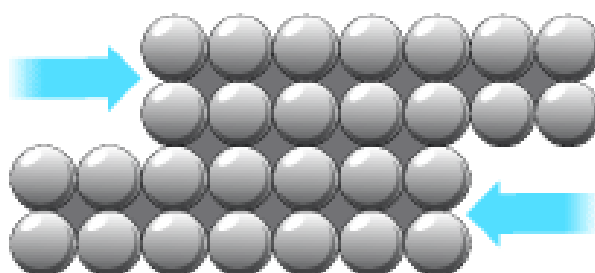
e_____.

Metals:

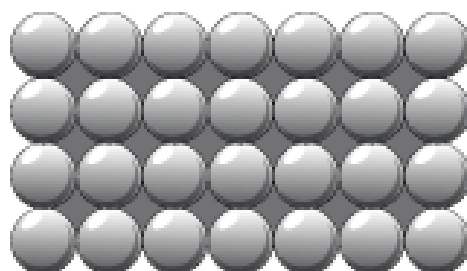The bonding in metals can be represented by:

delocalised electrons
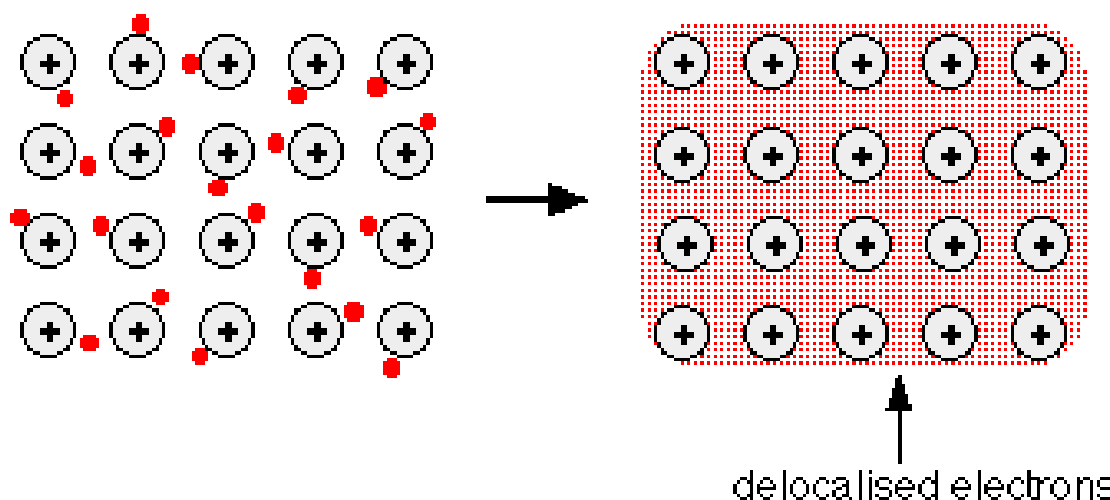
These diagrams show a r_____ arrangement of p_____ metal ions in a sea of d_____e_____.

Metals conduct h_____ and e_____ because of the delocalised e_____in their structures that are f_____to move.

The layers of p_____ ions in metals are able to s_____ over each other and so metals can be b_____ and s_____ easily (m_____).

b) Describe the bonding in the following chemicals and explain which is likely to have to highest melting point.

    i)   Sodium and Sodium Chloride

    ii)   Iodine and silicon dioxide

    iii)   Water and Aluminium Oxide

Electrolysis:

When an ionic substance is m_____or dissolved in w_____, the ions are free to m_____about within the liquid or solution.

Passing an electric c_____ through ionic substances that are m_____, for example lead bromide, or in solution breaks them down into elements.

This process is called e_____ and the substance that is broken down is called the e_____.

During e_____, p_____ charged ions move to the n_____ electrode, and n_____ charged ions move to the p_____electrode.

a) During electrolysis of molten copper chloride what is produced at each electrode?

b) During electrolysis of molten lead bromide what is produced at each electrode?

At the negative electrode, p_____charged ions **gain** electrons (r_____) and at the positive electrode, n_____ charged ions lose electrons (o_____).

Reactions at electrodes can be represented by half-equations for example:

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

or

$$2Cl^- - 2e^- \longrightarrow Cl_2$$
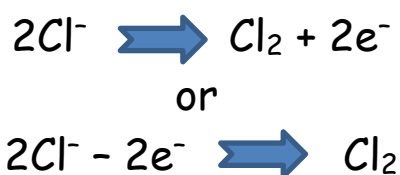
c)   Write half-equations for the reactions that took place in questions a) and b)

If there is a mixture of ions, the products formed depend on the reactivity of the elements involved.

In solutions the water provides H_____ (H+) and H_____(OH-) ions.

At the positive electrode H_____ is produced if the metal is more reactive then H_____.

At the negative electrode O_____ is produced if the non-metal ion is too complicated.

d) During electrolysis of copper sulphate solution what is produced at each electrode? What remains in the solution? Write equations for any reactions that occur.

e) During electrolysis of dilute sulphuric acid solution what is produced at each electrode? What remains in the solution? Write equations for any reactions that occur.

Calculating the mass of products from electrolysis:

The mass of product deposited on an electrode can be calculated because 1 Faraday is 1 m_____ of e_____

The first thing to do is to work out how many coulombs of electricity flowed during the electrolysis.

Number of coulombs = **current in amps x time in seconds**

Number of coulombs = 0.10 x 10 x 60 = 60

Now look at the equation for the reaction at the cathode:

$$Ag^+ + e^- \longrightarrow Ag$$

Just as with any other calculation from an equation, write down the essential bits in words:

1 mol of electrons gives 1 mol of silver, Ag.

Now put the numbers in. 1 mol of electrons is 1 faraday.

96500 coulombs give 108 g of silver.

So, if 96500 coulombs give 108 g of silver, all you have to do is to work out what mass of silver would be produced by 60 coulombs.

Mass of silver = 60/96500 x 108 g = 0.067 g

The Periodic Table:

The Periodic Table is made up of vertical g_____ and horizontal p_____.

Metals are found on the l_____and non-metals are found on the r_____. The classification of an element as either a metal or non-metal depends upon:

    i)   The e_____conductivity of the element. All metals are good c_____ because of their delocalised e_____. Non-metals are insulators because their shared e_____are not free to move. The exception to the rule is g_____.

    ii)   The acid-base nature of their oxides. Metals react with oxygen to form b_____oxides. Non-metals react with oxygen to form a_____oxides.

a) Describe the reaction of sulphur with oxygen and write a balanced equation. What does sulphur dioxide cause?

b) Describe the reaction of magnesium with oxygen and write a balanced equation.

The reactions of elements are governed primarily by the number of e_____in their outer s_____.

    i)   This means elements in the same g_____ of the periodic table will have similar c_____properties because they have the same number of e_____in their outer s_____.

    ii)   Elements in Group 0 (the N_____ gases) are all unreactive because their outer s_____ of electrons is f .

Group 1:

The alkali metals all react v_____ with water because they only have to l_____one electron.

a)   Describe the reaction of sodium with water?

b)   Write a balanced equation for this reaction?

As we go down the group the metals become more re_____ because the outer e_____is further from the n_____so there is a weaker a_____, so less e_____ is required to remove it.

Group 7 (The Halogens):

Fill in the table of their properties:

Halogen	Colour	State at room temperature
Fluorine		
Chlorine		
Bromine		
Iodine		
Astatine		

The halogens all react in a similar way because they are trying to g_____an electron into their outer s_____.

As you go down the group the outer s_____is further from the n_____and therefore the a_____is weaker. This means it is h_____to g_____an electron.
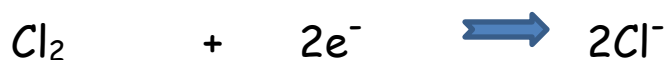
This means that a more r_____halogen will take an e_____ from the halide (n_____ ion) of a less r_____ halogen and thereby d_____it from the solution.

a)   Chlorine + Potassium Bromide ⟶

b)   Bromine + Potassium Iodide ⟶

The reactions are examples of r_____reactions. This is because the halogen is r_____and the halide ion is o_____.

e.g.   Chlorine +   Iodide $\longrightarrow$ Chloride +   Iodine

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

$2I^-$ $\longrightarrow$ I_2 + $2e^-$

Cl_2 + $2I^-$ $\longrightarrow$ $2Cl^-$ + I_2

c)   Write equations for the answers to questions a) and b)

Hydrogen Chloride is a g_____but when it dissolves in water it becomes ionised (dissociated) resulting in a solution of Hydrochloric Acid.

HCl (aq) $\longrightarrow$ H^+ (aq) and Cl^- (aq)
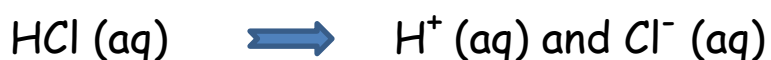
d)   Why is hydrogen chloride acidic in water but not in methylbenzene?

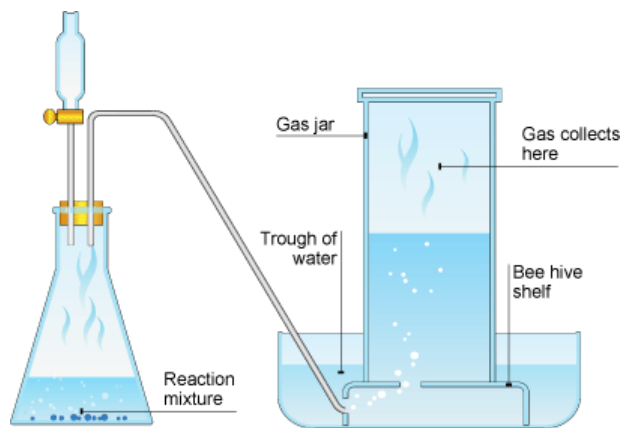# Oxygen:

Fill in the table about the composition of the air:

Name	Percentage
	78%
	21%
	1%
	0.04%

The % of oxygen in the air can be investigated by looking at the reaction of elements such as c_____, i_____and p_____.

a)   Draw a diagram of this experiment?

Oxygen can be prepared from H_____P_____ in the presence of a catalyst.

b)   Name the catalyst?

Gas jar

Gas collects here

Trough of water

Bee hive shelf

Reaction mixture

Elements can be classified according to their reactions with Oxygen. M_____ produce b_____ oxides and non-metals produce a_____oxides.

a) Describe the reactions of Magnesium, Carbon and Sulphur with oxygen? Write symbol equations for the reactions.

Carbon:

burning spoon

gas jar

carbon

oxygen
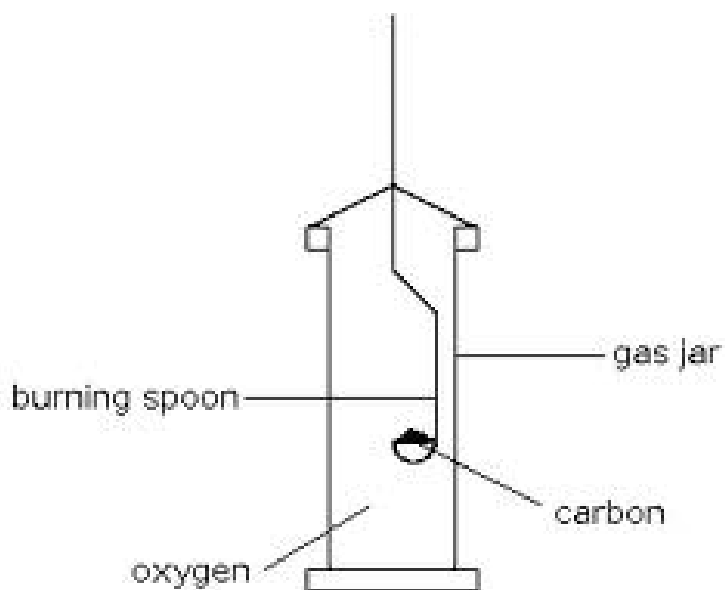
Magnesium:

Sulphur:

Carbon Dioxide:

Carbon Dioxide can be prepared from the reaction between
C_____C_____and H_____acid.

a)   Write a balanced symbol equation for this reaction?

Carbon Dioxide is also formed when metal c_____ are
heated, this type of reaction is known as T_____
D_____.

b)   Write a balanced equation for the reaction of Copper (II)
     Carbonate in this way.

Carbon dioxide is a relatively d_____gas and for this reason it is
used in f_____e_____. Carbon dioxide is also soluble in
water and therefore is used to manufacture c_____d_____.

Carbon dioxide is also a g_____ gas and contributes to
g_____ w_____. Increasing levels of Carbon
dioxide in the air may well lead to c_____change.

Hydrogen:

Metals react with Hydrochloric and Sulphuric Acids to produce H_____. The more reactive the metal, the more vigorous the b_____.

a)   Write an equation for the reaction between Magnesium and dilute Sulphuric acid?

b)   Describe the combustion of Hydrogen and write an equation for the reaction?

Water:

A_____ C_____ S_____ is used as a chemical test for water.

c)   What is the colour change in this chemical test?

d)   What is the physical test used to show whether or not the water is PURE?

Reactivity Series:

Metals can be arranged into a reactivity series based upon the following reactions:

i) Reaction with other metal compounds (D_____).

ii) Reaction with water.

iii) Reaction with dilute acids.

Small pieces of four different metals were placed in identical amounts of hydrochloric acid. The results
are shown below.

Metal A   Metal B   Metal C   Metal D
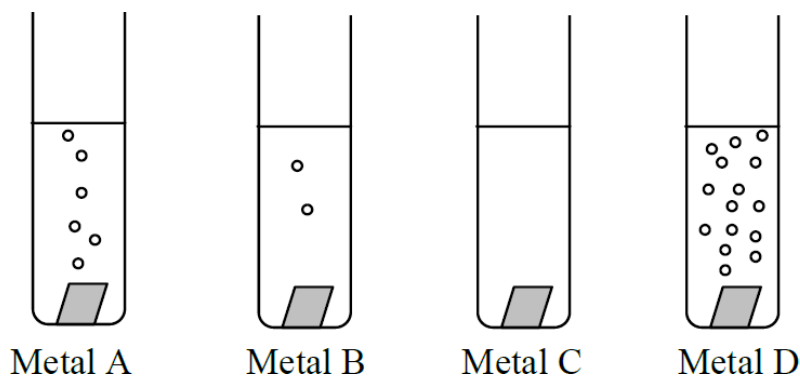
(a) Place the metals in order of reactivity, starting with the most reactive.

[2]

(b) The four metals used in the experiment were calcium, magnesium, iron and platinum.

 Use your knowledge of these four metals to identify the metals A, B, C & D. [3]

Metal A _____

Metal B _____

Metal C _____

Metal D _____

Redox reactions are reactions that involve r_____ and o_____.

> R_____ is the g_____ of electrons or the l_____ of o_____.

> Oxidation is the l_____ of electrons or the g_____ of oxygen.

> An o_____ agent is therefore a species that is itself r_____ and so takes the e_____ away from another species.

> A r_____ agent is therefore a species that is itself o_____ and so gives e_____ to another species.

Carbon + Iron ➡ Carbon + Iron
Monoxide Oxide Dioxide

a) In reaction above identify the following:

- Species Reduced:
- Species Oxidised:
- Oxidising Agent:
- Reducing Agent:

Rusting is an example of a redox reaction:

a)   Under what conditions does iron rust?

b)   How does grease, oil, paint and plastic protect the iron?

c)   Why is galvanising such a good way of protecting the iron?

d)   What is sacrificial protection?

Test for Cations (positive ions):

Flame Tests:

A p_____ wire is first heated and then dipped in concentrated h_____acid. This is then dipped into the sample to be tested and placed in a b_____flame.

Positive Ion	Flame Colour
Li^+	
Na^+	
K^+	
Ca^{2+}	

Tests with Sodium Hydroxide:

Positive Ion	Observation
NH_4^+	
Cu^{2+}	
Fe^{2+}	
Fe^{3+}	

Test for Anions (negative ions):

Test	Anion	Observations
Dilute n_____acid and s_____ n_____solution	Cl^-	
	Br^-	
	I^-	
Dilute H_____ acid and B_____ C_____ solution	SO_4^{2-}	
Dilute H_____ acid	CO_3^{2-}	

Test for Gases:

Gas	Test
Hydrogen	L_____splint goes out with a s_____p_____
Oxygen	R_____a g_____splint
Carbon Dioxide	Turns l_____, m_____.
Ammonia	Turns d_____r____l_____paper b_____.
Chlorine	Turns damp b_____l_____paper red then w_____.

Organic Chemistry:

Homologous Series: A series of organic compounds that have similar c_____ properties, g_____ change in their physical properties, the same f_____ group and the same g_____ formula.

Hydrocarbon: Molecules containing only H_____ and C_____.

Saturated: Molecules, to which no other molecules can be added, they do not contain a C_____-C_____d_____bond.

Unsaturated: Molecules that contain a C_____-C_____d_____bond.

General Formula: The formula of a homologous series e.g. C_nH_{2n+2} (a_____) and C_nH_{2n} (a_____)

Isomerism: Molecules that have the same number of each type of atom but a different s_____.

Alkanes:

S_____ hydrocarbons with the general formula C_nH_{2n+2}

Name	Formula	Displayed Formula
Methane		
	C_2H_6	
Propane		
	C_4H_{10}	
Pentane		

a)   Draw the displayed formula of the isomers of Pentane:

Combustion:

The products of combustion of a hydrocarbon are dependent upon the supply of O_____.

Plentiful supply of o_____ leads to C_____ combustion. The products of this reaction are C_____ D_____and W_____.

In a limited supply of o_____the products are more varied and this reaction is called I_____combustion. C_____ d_____and w_____are produced as usual. In addition there will be C_____ M_____ and P_____ produced. Sulphur is the main impurity in fossil fuels and so S_____D_____might also be produced.

Substitution:

Methane will react with b_____ in the presence of ____ light.

The product of this reaction is bromomethane.

b)   Draw the structure of bromomethane?

Alkenes:

U_____hydrocarbons with the general formula C_nH_{2n}

They contain a C_____-C_____d_____bond.

Name	Formula	Displayed Formula
	C_2H_4	
Propene		
	C_4H_8	

a)   Draw the displayed formulas of isomers of C_4H_8

Addition Reactions:

Because of the C_____-C_____ d_____ bond, alkenes undergo addition reactions. This is where the d_____ bond breaks and the other molecule is added.

b)   Draw the displayed formula of the product when ethene reacts with bromine.

Bromine water can be used as a test for alkenes or unsaturation because when it reacts it goes from y_____-o_____to c_____.

Ethanol:

Ethanol can be manufactured by two different processes:

Name	Fermentation	Hydration of Ethene
Raw Materials	S_____	Ethene Steam
Reaction Conditions	Y_____ Temp: _____	Catalyst: _____ ____ Temp:_____ Pressure:_____
Pros		
Cons		

Dehydration of Ethanol:

Ethanol can be dehydrated back to ethene by passing the ethene over a a_____o_____catalyst.

a)   Write an equation for the dehydration of ethanol?

Physical Chemistry:

Acids, Alkalis and Salts:

Indicators are used to distinguish between acidic and alkaline solutions because they have different c_____in these solutions.

   a)   Name three indicators used.

Indicators can also be used to show the end point in a reaction because their colour changes are s_____.

Universal Indicator contains a number of different indicators and therefore can be used to approximate the_____of a solution. However because the changes in colour are g_____ it is not used to show the end point in a reaction.

> Acids are sources of Hydrogen Ions
>
> $H^+ (aq)$
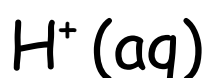
> Alkalis are sources of Hydroxide Ions
>
> $OH^- (aq)$
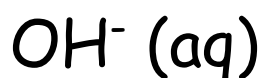
Metal oxides and hydroxides are b_____. Soluble hydroxides are called a_____.

Hydrogen ions, $H^+(aq)$, make solutions a_____ and hydroxide ions, $OH^-(aq)$, make solutions a_____.

The_____ scale is a measure of the acidity or alkalinity of a solution.

In n_____ reactions, hydrogen ions react with hydroxide ions to produce w_____. This reaction can be represented by the equation:

a) Write an equation to represent this reaction.

Another product of the reaction between acids and bases are called s_____.

Reactions of Acids:

Acid + Metal $\longrightarrow$ Salt + Hydrogen

Acid + Metal Oxide $\longrightarrow$ Salt + Water

Acid + Metal Carbonate $\longrightarrow$ Salt + Water + Carbon Dioxide

a) Write a word equation and balanced symbol equation for the following:

   i) Iron and Sulphuric Acid

   ii) Copper Oxide and Nitric Acid

   iii) Sodium Carbonate and Hydrochloric Acid

Solubility Rules

The general rules of solubility are:

i)   All   common   s_____,   p_____   and

             a_____salts are soluble.

ii)   All n_____are soluble.

iii)   Common c_____ are soluble except s_____

             c_____.

iv)   Common s_____ are soluble except those of

             b_____and c_____.

v)   Common c_____ are <mark>insoluble</mark> except those of

             s_____, p_____and a_____.

Soluble Salts:

The method to make a soluble salt depends upon the reactivity of the m_____and the a_____used.

Salts have two parts to their name, Metal and Non-Metal.

e.g. Sodium Sulphate, Copper Chloride, Iron Nitrate.

The metal comes from the base or alkali. Whereas the non-metal comes from the a_____used.

Hydrochloric Acid ⟶ _____

Nitric Acid ⟶ _____

Sulphuric Acid ⟶ _____

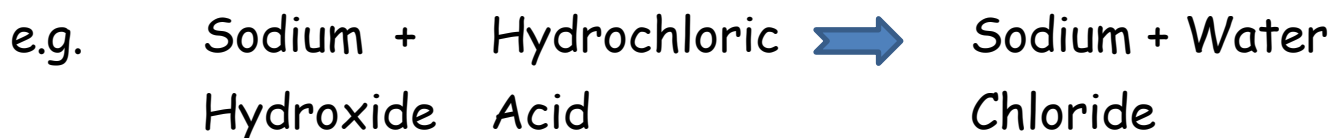The method used to make the salt depends upon the r_____of the metal.

Metals that are very r_____use the Acid + Alkali method.

Metals that are more r_____ than H_____ use the Acid + Metal method.

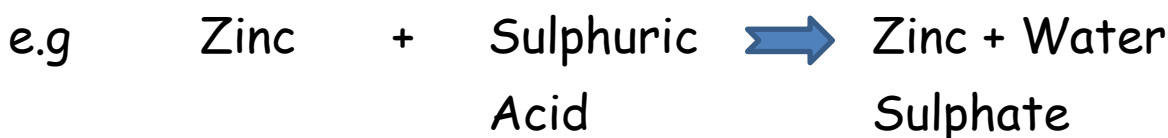Metals that are less r_____ than H_____ use the Acid + Base method.

Acid + Alkali:

1. The alkali is added to the acid.
2. An i_____ can be used to determine when the reaction is complete.
3. The alkali should be added d_____ near to the end point.
4. The salt solution can be c_____ to produce solid salts.

Acid + Alkali ⟹ Salt + Water

e.g.   Sodium + Hydrochloric ⟹ Sodium + Water
        Hydroxide Acid   Chloride

Ammonia dissolves in water to produce an a_____solution. It is used to produce a_____ salts. A_____ salts are important as f_____.

Acid + Metal:

1. The m_____ is added to the acid until there is no more f_____.

2. The excess m_____ is f_____.

3. The salt solution can be c_____ to produce solid salts.

Acid + Metal ⟹ Salt + Hydrogen

e.g   Zinc   +   Sulphuric ⟹ Zinc + Water
                     Acid   Sulphate

Acid + Base:

1. The metal o_____ is added to the acid and w_____.

2. The metal o_____ is added until no more d_____.

3. The excess metal o_____ is f_____.

4. The salt solution can be c_____ to produce solid salts.

Acid + Base ⟹ Salt + Water

e.g.   Copper +   Nitric ⟹ Copper + Water
        Oxide   Acid   Nitrate
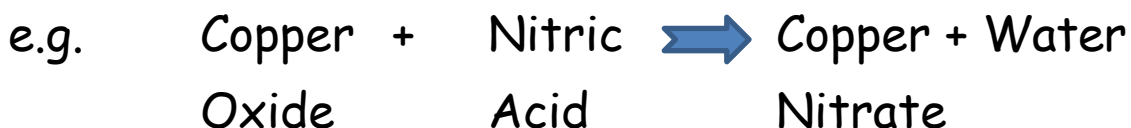
b) Give the method and write an equation to make the following salts.

i)   Copper Sulphate

ii)   Potassium Nitrate

iii) Iron Chloride

iv)   Ammonium Nitrate

Insoluble Salts:

Insoluble salts can be made by mixing appropriate solutions of ions so that a p_____is formed. This can then be f_____, w_____and d_____.

The solutions used are Metal Nitrate and Sodium Non-Metal.

e.g. Barium Sulphate can be made from Barium **Nitrate** and **Sodium Sulphate** solutions.

   c)   Write an equation to make insoluble Lead Iodide.

   d)   Write an equation to make insoluble Silver Chloride.

Precipitation can be used to remove unwanted ions from solutions, for example in treating water for d_____ or in treating e_____.

Titrations:

Titrations are used to calculate the concentration of a solution by reacting it precisely with a solution of known concentration.

i)   Measure out a <mark>precise</mark> volume of an alkali using a

       p_____.

ii)   Add a few drops of an i_____.

iii)   Fill a b_____with a_____. This will allow to add a

       varied amount of a_____.

iv)   Add the a_____ to the alkali until the i_____

       changes colour.

v)   When nearing the end point the a_____ should be added

       <mark>drop-wise</mark>.

vi)   Record the volume of a_____added.

Titration Calculations:

1. What volume of 0.100 mol/dm^3 sulphuric acid reacts with 30 cm^3 of 0.150 mol/dm^3 sodium hydroxide?

$$2\ NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2\ H_2O(l)$$
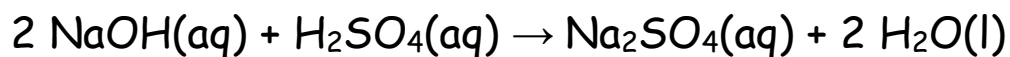
2. What volume of 0.150 mol/dm^3 rubidium hydroxide reacts with 25.0 cm^3 of 0.240 mol/dm^3 nitric acid?

$$RbOH(aq) + HNO_3(aq) \rightarrow RbNO_3(aq) + H_2O(l)$$
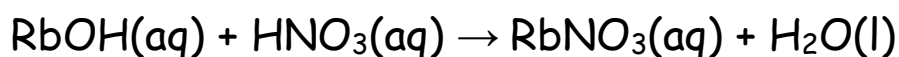
Energetics:

A reaction in which energy is transferred to the surroundings is known as an e_____ reaction. The temperature of the surroundings would i_____.

A reaction in which energy is transferred from the surroundings is known as an e_____ reaction. The temperature of the surroundings would d_____.

We can measure the energy changes in a reaction by measuring the energy change of the surroundings.

$$q = m \times c \times \Delta T$$

m = mass of the surroundings (usually water)
c = specific heat capacity
ΔT = temperature change of the surroundings.

a) In an experiment, 1.00 g of hexane (C_6H_{14}) was completely burned in air. The heat evolved raised the temperature of 200 g of water by 51.6°C. Calculate the heat evolved.

The heat evolved will be dramatically reduced due to h_____l_____.

The molar enthalpy change (ΔH) is the energy change for 1 mole of a substance.

If ΔH is negative then the reaction is e_____. (i.e. heat has been evolved)

If ΔH is positive then the reaction is e_____. (i.e. heat has been taken in)

ΔH can be calculated by:

$$\Delta H = q / n$$

Where n is the number of moles of the substance reacted or produced.

In an experiment, 1.56 g of propan-1-ol ($CH_3CH_2CH_2OH$) was completely burned in air. The heat evolved raised the temperature of 250 g of water by 47°C. Calculate ΔH (NB: the sign!)

The energy change can also be calculated by using the **bond enthalpies**, this is the energy required to break 1 mole of the bonds.

1. Calculate the energy required to break all of the bonds in the reactants.
2. Calculate the energy required to break all of the bonds in the products

3. Calculate the overall energy change = Reactants – Products.

a) Calculate the energy change in this reaction. Bond energies are: (C-C) = 348, (C-H) = 412, (O=O) = 498, (C=O) = 743, (H-O) = 463 kJ/mol.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$
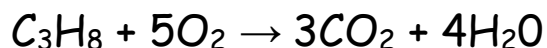
b) Calculate the energy change in this reaction. Bond energies are: (C≡C) = 837, (C-H) = 412, (H-H) = 436, (C-H) = 412, (C-C) = 348 kJ/mol.

$$H\text{-}C≡C\text{-}H + 2H_2 \rightarrow C_2H_6$$
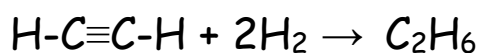
A reaction is ex_____because more energy is given out from the formation of new bonds than is required to break bonds.

A reaction is en_____because more energy is taken in to break bonds than is given out by forming new bonds.

Energy Profile Diagram:
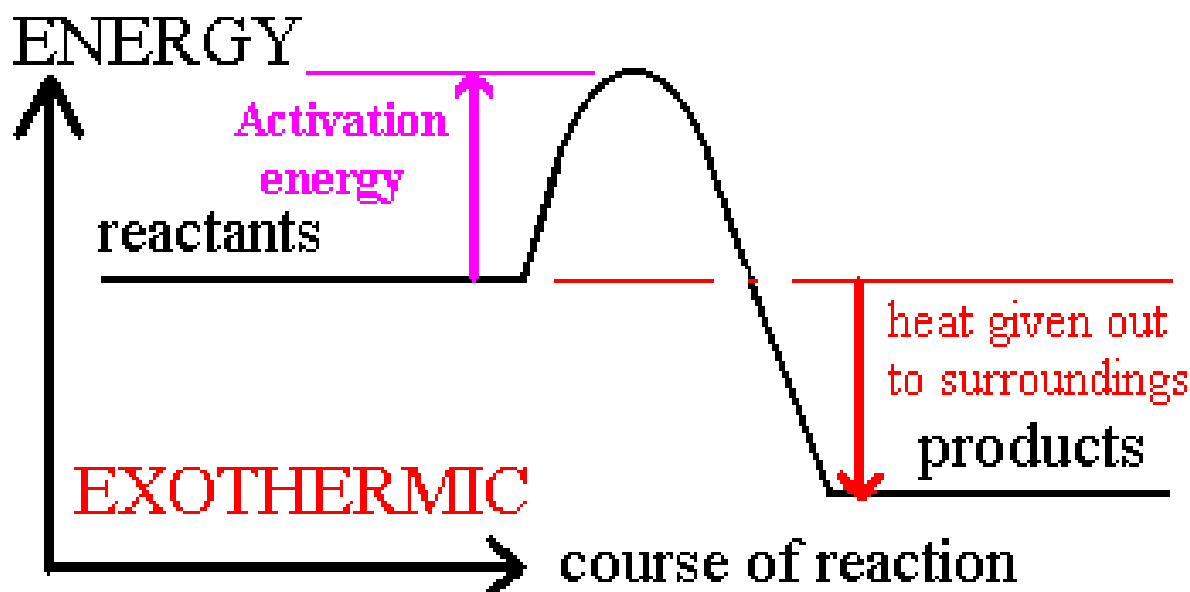
a) Draw a similar energy profile diagram for an endothermic reaction.

Rates of Reaction:

The rate of a reaction can be monitored by looking at the change in m_____ of the reaction mixture, the v_____ of a gas given off or perhaps a c_____ change.

Reactions occur because particles c_____ with sufficient e_____, the minimum energy required for a reaction to occur is known as the A_____ E_____. Most c_____ that occur do not result in a reaction. Therefore to i_____ the rate of reaction you must either i_____ the number of c_____ or i_____ the e_____ of the particles.

Surface Area: I_____ surface area means that more particles can c_____ at the surface and therefore there will be more s_____ collisions resulting in an i_____ in the rate of reaction.

Concentration: I_____ the concentration means there are more p_____ in the set volume. This means there will be more c_____ and therefore there will be more s_____ collisions resulting in an i_____ in the rate of reaction.

Pressure: I_____the pressure means there are more p_____in the set volume. This means there will be more c_____and therefore there will be more s_____collisions resulting in an i_____in the rate of reaction.

Temperature: Increasing the temperature means that the particles have more e_____and are travelling f_____. This means that not only when they c_____they will be more likely to react but also they will have more c_____. This results in an i_____in the rate of reaction.

Catalyst: A catalyst is a substance that s_____up the rate of reaction **without** itself being u_____up. It does this by providing an a_____ reaction pathway with a lower A_____ E_____. Therefore more collisions are likely to be s_____leading to an i_____in the rate of reaction.

Equilibria:

Some reactions are reversible and are shown by using a $\rightleftharpoons$.

    a)   Describe the dehydration of hydrated copper (II) sulphate.

    b)   Describe the effect of heat on ammonium chloride.

When a reaction is in dynamic equilibrium the rate of the f_____ reaction is equal to the rate of the b_____ reaction. The concentrations of the reactants and products remain u_____.

Increasing temperature always favours the en_____ reaction. If an equilibrium is ex_____then an increase in temperature will favour the b_____ reaction and the equilibrium will move to the l_____resulting in a lower y_____. Therefore in exothermic reactions a l_____temperature is needed to achieve a higher y_____ but l_____ temperatures mean the overall rate of reaction is too s_____so a compromise is often used.

Increasing pressure always favours a d_____in the number of moles of g_____. You can figure this out by adding up the total number of moles of g_____ on each side of the equation. High pressures are more e_____ and therefore a compromise is often used in industry.

Extraction of Metals:

The extraction of a metal depends upon its position in the r_____series. Those elements above C_____can be extracted by E_____ and those below can be extracted by R_____.

Aluminium:

Process: E_____
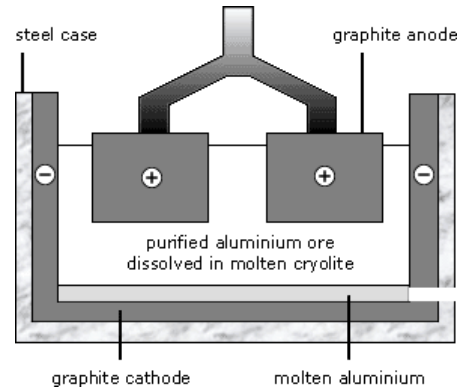
Raw Material: B_____(Aluminium O_)

Conditions: Temperature of_____°C

C_____(this is used to dissolve the aluminium oxide so that the process can take place at a lower t_____.

Equations: Cathode:

Anode:

Comments: The anodes have to be replaced regularly because they react with the o_____ to produce c_____ d_____

Uses: Aluminium is used because of its low d_____ and high s_____. (used to make a_____)

It is also a very good conductor of e_____ and h_____. (used to make p_____)

Aluminium has a thin layer of aluminium o_____on its s_____and therefore is resistant to c_____. (used to make aluminium f_____)
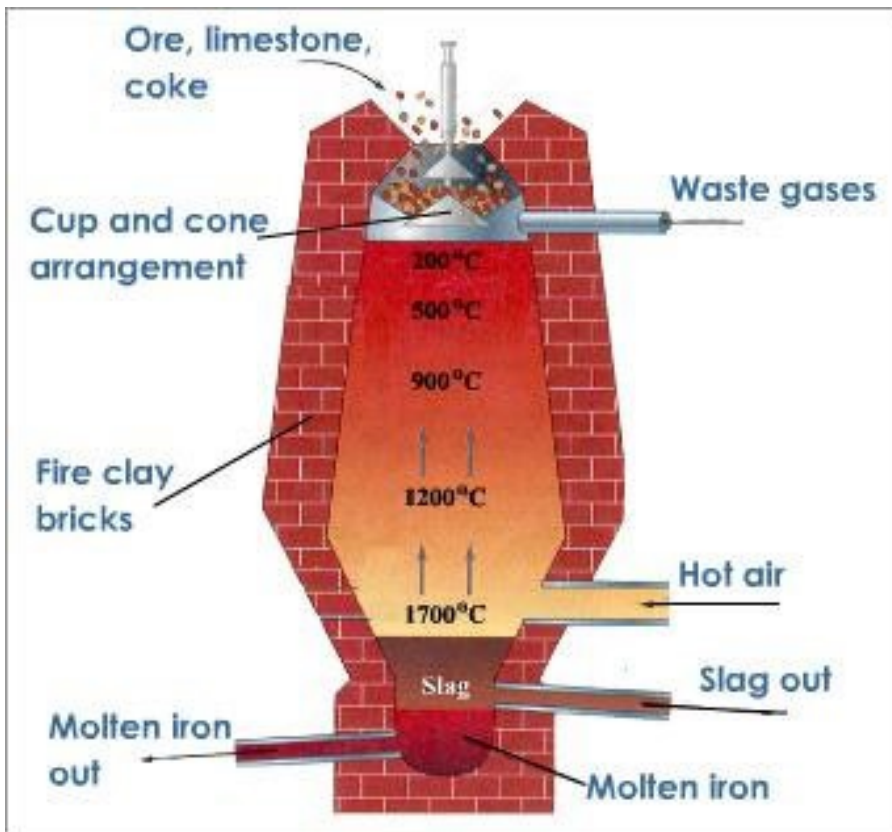
Iron:

Process: R_____(loss of o_____) with c_____.

Raw Material: H_____(Iron o_____)

                  C_____

                  L_____

Conditions: Temperature of_____°C to_____°C

Equations: 1.

               2.

               3.

               4.

Comments: The l_____ (c_____ c_____)
decomposes to form c_____o_____and this reacts with the
acidic impurities in the ore to form s_____.

---

a) Write a word equation for the reaction with the
acidic impurities.

---

b) Write a symbol equation for the reaction with the
acidic impurities.

Uses: The iron that comes out of the B_____F_____
is known as p___iron and can be converted into c_____
iron by remelting and cooling. C_____iron contains
about____% c_____. C_____iron is very f_____
when molten and therefore good for making castings.
It is also quite h_____but b_____.

To remove some of the carbon the impure iron is
reacted with o_____to make s_____. The uses of
the s_____depends upon the % carbon.

Type of Iron	Iron mixed with	Uses
Wrought Iron	p_____iron	r_____
M_____s_____	Up to_____% c_____	n_____ s_____building
H_____c_____ s_____	_____% to_____% c_____	c_____tools
C_____Iron	_____% c_____	m_____ covers g_____
S_____ s_____	c_____and n_____	c_____

Crude Oil:

Crude Oil is a mixture of hydrocarbons.

The crude oil is separated into f_____by a process known as F_____D_____. First the crude oil is v_____and then passed into a c_____. As the v_____rises the different f_____will c_____at different levels.

Name of Fraction	Use
R_____g_____	
G_____	
K_____	
D_____	
F_____O_____	
B_____	

As the number of c_____atoms in a hydrocarbon increases:

i)   The b_____p_____increases.

ii) The v_____increases.

Combustion:

Alkanes are used as f_____s. Their combustion can be c_____or i_____.

b)   What are the products when hydrocarbons are burned in excess oxygen?

c)   What are the products when a hydrocarbon is burned in a limited supply of oxygen?

d)   What other pollutant can be produced by the internal combustion engine?

e)   What pollutant is caused by the main impurity in fossil fuels?

The combustion of fossil fuels (including alkanes) results in the release of c_____d_____into the atmosphere

C_____d_____, m_____and water vapour are referred to as g_____ gases and that these gases may contribute to global_____.

Cracking:

The f_____d_____of crude oil produces more long-chain hydrocarbons than can be used directly and fewer short-chain hydrocarbons. Therefore the long-chain hydrocarbons can be b_____ d_____ to produce more useful, s_____ hydrocarbons. This process is known as c_____.

C_____involves heating the hydrocarbons to_____°C and using a_____catalyst.
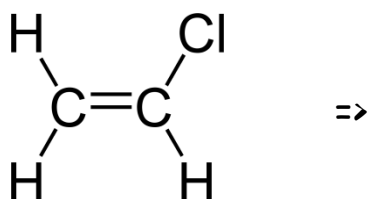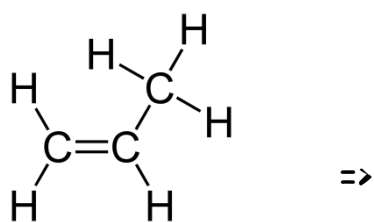
Synthetic Polymers:

Addition Polymerisation:

This is when many s_____ molecules (known as m_____) are j_____together to form a l_____chain known as a p_____.

Alkenes can be used to make p_____ such as poly(ethene) and poly(propene). In these reactions, many small molecules (m_____) **join together** to form very large molecules (p_____).

(c) doc b

n = a big number of monomers

polymer n units long (2 shown)

or in 'shorthand'
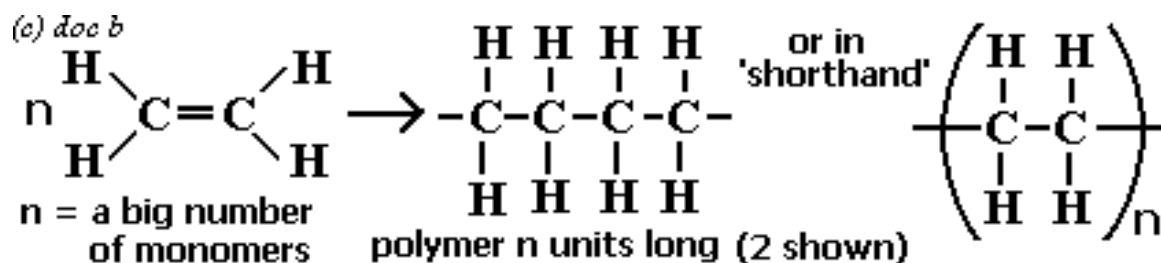
a) Draw a diagram of the polymer formed from this alkene?

=>

=>

Describe the uses of the following polymers:

Polymer	Use
Poly(ethene)	
Poly(propene)	
Poly(chloroethene)	

Addition polymers are difficult to dispose of because of their i_____

which means that they do not easily b_____.

Condensation Polymerisation:

Some polymers such as n_____are formed by a process known as

c_____polymerisation. The reaction also produces a small molecule,

such as w_____.

  a) Write an equation to show the formation of nylon.

Industrial Manufacture of Chemicals:

Haber Process:

This process is used to manufacture a_____.
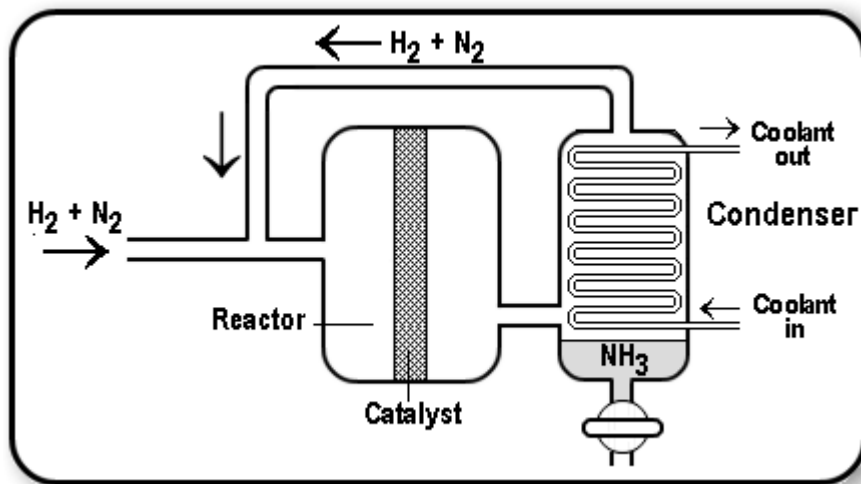
Raw Materials: Nitrogen from a_____.

Hydrogen from m_____or c_____of h_____.

Conditions: Temperature of_____°C

Pressure of_____atm

I_____catalyst

Process: The reaction mixture is passed over a bed of i_____ catalyst.
The reaction mixture is then c_____ to l_____ the
a_____. Any u_____ Nitrogen and Hydrogen is
r_____.

Uses: A_____ is used in the manufacture of N_____ acid
and f_____.

Nitrogen is important in f_____as it is required by plants
to aid g_____. A_____ and N_____ acid react
together to form A_____ N_____, a
f_____high in nitrogen.