Edexcel IGCSE Flashcards

Section 1: Principles of Chemistry

Name the processes responsible for the following phase changes: solid ⇄ gas

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Sublimation (s to g)

Deposition (g to s)

What is diffusion?

What is diffusion?

It is the overall movement of particles from an area of high concentration to an area of low concentration.

E.g. a gas will diffuse through all the space it can find.

E.g. if you spray some perfume in one corner of the room, soon you will be able to feel the smell at the other end of the room.

What is a solubility curve?

What is a solubility curve?

It is a curve that shows how the solubility of a substance (in grams per 100 g of water) changes with temperature.

Outline the main assumptions of the kinetic theory of matter.

Outline the main assumptions of the kinetic theory of matter.

a) Matter is made up of atoms, molecules and ions of different sizes.
b) At the same temperature, small particles move faster than large particles
c) As temperature rises, the particles have more kinetic energy and move faster
d) Solids are made up of ordered arrangement of closely packed particles
e) Liquids do not have particles arranged regularly. Particles can move around.
f) In gases, the particles are far apart. They move fast. Their motion is random.

Explain what is meant by centrifuging

Explain what is meant by centrifuging

It is a method for separating out particles of different densities in a substance.

It can be used to separate suspended solids (very small particles of solid) from the liquid they are suspended in.

It is used when the particles are so small that they can't be separated *via* filtration.

In a centrifuge, the sample is spun at high rates. This forces the solid particles to settle down at the bottom of the tube. The liquid can be decanted.

What is an atom?

What is an atom?

An atom is the smallest particle of a chemical element that can exist.

What is an element?

What is an element?

An element is a substance made up of only one type of atom.

How are the elements listed and approximately how many are there?

How are the element listed and approximately how many are there?

They are listed in the periodic table; there are approximately 100.

Elements can be classified into two groups based on their properties; what are these groups?

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Metals and non-metals

Elements may combine through chemical reactions to form new products; what are these new substances called?

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Compounds

What is a compound?

What is a compound?

Two or more elements combined chemically in fixed proportions which can be represented by formulae

Do compounds have the same properties as their constituent elements?

Do compounds have the same properties as their constituent elements?

No, they have different properties.

What is a mixture? Does it have the same chemical properties as its constituent materials?

What is a mixture? Does it have the same chemical properties as its constituent materials?

A mixture consists of two or more elements or compounds not chemically combined together; the constituent materials keep their own chemical properties, but the mixture may have different chemical properties (e.g. melting point) as a whole.

What are the methods through which mixtures can be separated (there are five)? Do these involve chemical reactions?

What are the methods through which mixtures can be separated (there are five)? Do these involve chemical reactions?

Filtration, evaporation/crystallisation, simple distillation, fractional distillation and chromatography; they do not involve chemical reactions

Describe and explain simple distillation.

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Simple distillation is used to separate liquid from a solution – the liquid boils off and condenses in the condenser. The thermometer will read the boiling point of the pure liquid. Contrary to evaporation, we get to keep the liquid (it drips and is collected into a separate beaker).

Describe and explain evaporation/crystallisation.

Describe and explain crystallisation/evaporation

Evaporation is a technique for separation of a solid dissolved in a solvent from a solvent (e.g. salt from H_2O).
The solution is heated until all the solvent evaporates; the solids stays in the vessel.

Crystallisation is similar, but we only remove some of the solvent by evaporation to form a saturated solution (the one where no more solid can be dissolved). Then, we cool down the solution. As we do it, the solid starts to crystallise, as it becomes less soluble at lower temperatures. The crystals can be collected and separated from the solvent *via* filtration.

Describe and explain fractional distillation

Describe and explain fractional distillation

Fractional distillation is a technique for separation of a mixture of liquids.

It works when liquids have different boiling points.

The apparatus is similar to the one of simple distillation apparatus, with the additional fractionating column placed on top of the heated flask.

The fractionating column contains glass beads. It helps to separate the compounds. In industry, mixtures are repeatedly condensed and vapourised. The column is hot at the bottom and cold at the top. The liquids will condense at different heights of the column.

Describe and explain filtration

Describe and explain filtration

Filtration is used to separate an insoluble solid suspended in a liquid. The insoluble solid (called a residue) gets caught in the filter paper, because the particles are too big to fit through the holes in the paper.
The filtrate is the substance (liquid) that comes through the filter paper.
Apparatus: filter paper + funnel.

Describe and explain chromatography

Describe and explain chromatography

Chromatography is used to separate a mixture of substances dissolved in a solvent.

In paper chromatography, we place a piece of paper with a spot containing a mixture in a beaker with some solvent. The bottom of the paper has to be in contact with the solvent. The solvent level will slowly start to rise, thus separating the spot (mixture) into few spots (components).

Describe the paper chromatography experiment

Describe a paper chromatography experiment

a) A start line is drawn near the bottom of the paper. The mixture is spotted on the line.
b) A beaker is filled with small amount of solvent (it cannot touch or go above the start line when paper is placed in a beaker)
c) Paper is hung on a rod and placed in a beaker.
d) Solvent travels up the paper, thus separating the components.
e) Before solvent level reaches the end, the paper is taken out and the finish line is marked. The paper is dried.
f) The procedure works when the components dissolve differently in the solvent. More soluble components travel further up the paper. Less soluble components have a stronger attraction for the paper and travel less slowly with the solvent, therefore less further up the paper.
g) Paper is called the stationary phase - it doesn't move. Solvent is the mobile phase.

How is R_f calculated?

How is R_f calculated?

Distance moved by the spot (solute component) / distance moved by solvent

In a paper chromatography experiment, a compound A was f to have an R_f value of 0.85 - what does it tell you about the oundcompound?

In a paper chromatography experiment, a compound A was found to have an R_f value of 0.85 - what does it tell you about the compound?

It has a higher affinity for the solvent than for the paper.

What is a separating funnel?

What is a separating funnel?

A separatory funnel is an apparatus for separating immiscible liquids. Two immiscible liquids of different densities will form two distinct layers in the separatory funnel.

We can run off the bottom layer (the liquid with greater density) to a separate vessel.

Describe the plum-pudding model

Describe the plum-pudding model

The atom is a ball of positive charge with negative electrons embedded in it.

Describe the Bohr/nuclear model and how it came about

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The nuclear model suggests that electrons orbit the nucleus in energy levels (at specific distances from nucleus) – it came about from the alpha scattering experiments conducted by Ernest Rutherford and two students.

Later experiments led to the discovery of smaller, positive particles in the nucleus; what are these particles called?

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Protons

What did the work of James Chadwick provide evidence for?

What did the work of James Chadwick provide evidence for?

The existence of neutrons in the nucleus.

Describe the structure of an atom

Describe the structure of an atom

The atom has a small central nucleus (made up of protons and neutrons) around which there are electrons.

State the relative masses and relative charges of the proton, neutron and electron

State the relative masses and relative charges of the proton, neutron and electron

Masses: 1, 1, very small (respectively)

Charges: 1, 0 , -1 (respectively)

Explain why atoms are electrically neutral.

Explain why atoms are electrically neutral.

They have the same number of electrons and protons

What is the radius of an atom?

What is the radius of an atom?

0.1 nm

What is the radius of a nucleus and what is it compared to that of the atom?

What is the radius of a nucleus and what is it compared to that of the atom?

1×10^{-14} m and less than 1/10000 of the radius of the atom.

What name is given to the number of protons in the nucleus?

What name is given to the number of protons in the nucleus?

Atomic number

Atoms of the same element have the same number of which particle in the nucleus?

Atoms of the same element have the same number of which particle in the nucleus?

Protons

Where is the majority of mass of an atom?

Where is the majority of mass of an atom?

The nucleus

What is the mass number?

What is the mass number?

The total number of protons and neutrons in the nucleus.

How does one calculate the number of neutrons using mass number and atomic number?

How does one calculate the number of neutrons using mass number and atomic number?

Subtract the atomic number from the mass number.

What is an isotope? Do isotopes of a certain element have the same chemical properties?

What is an isotope? Do isotopes of a certain element have the same chemical properties?

Atoms of the same element (same proton number) that have a different number of neutrons.

They have the same chemical properties as they have the same electronic structure.

What is the relative atomic mass?

What is the relative atomic mass?

The average mass value of one atom (taking into account the abundance of isotopes), compared to 1/12 of the mass of one carbon-12 atom.

Give the electronic configurations of He (2), Be (4), F (9), Na (11), and Ca (20) to demonstrate how shells are occupied by electrons.

He, Be, F, Na, Ca configurations (respectively):

2

2,2

2,7

2,8,1

2,8,8,2

Describe the properties of noble gases. Discuss the trend in boiling point down the group.

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Non-metals, colourless gases at room temperature, low boiling points, unreactive (full outer shell; they don't easily accept or lose electrons).

The boiling point increases down the group, as the atoms get heavier.

Explain the following: solute, solvent, solution, miscible, immiscible, soluble, insoluble.

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A solute is a substance that is dissolved in a solvent. Together they form a solution.

Miscible refers to the substances (particularly liquids) that mix together in all proportions, e.g. water and alcohol. Water and oil are immiscible, i.e. they do not mix.

Soluble refers to the substance that can be dissolved in a solvent, e.g. salt in water. An insoluble substance won't dissolve in a particular solvent.

The columns of the periodic table are called…?

The columns of the periodic table are called?

Groups

The rows of the periodic table are called…?

The rows of the periodic table are called…?

Periods

Are elements in the same group similar or different?

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They may have similar chemical properties, as they have the same number of outer shell electrons.

In terms of energy levels, what are the differences between elements of the same period?

In terms of energy levels, what are the differences between elements of the same period?

They have the same number of energy levels

Electrons occupy particular energy levels, with each electron in an atom at a particular energy level; which available energy level do electrons occupy?

Electrons occupy particular energy levels, with each electron in an atom at a particular energy level; which available energy level do electrons occupy?

The lowest available energy level

The elements of Group 0 are more commonly known as…?

The elements of Group 0 are more commonly known as…?

The noble gases

What makes the periodic table periodic?

What makes the periodic table periodic?

Similar properties of elements occur at regular intervals

Elements in the same group have the same number of electrons in their outer shell; what does this tell us about their chemical properties?

Elements in the same group have the same number of electrons in their outer shell; what does this tell us about their chemical properties?

They have similar chemical properties

In terms of shells, what is the difference between elements in the same period?

In terms of shells, what is the difference between elements in the same period?

They have the same number of shells

What change in shell number is seen as one moves down a group?

What change in shell number is seen as one moves down a group?

The number of shells increases

Early periodic tables were incomplete and elements were placed in inappropriate groups if what was to be followed?

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The strict order of atomic weights

Knowledge of what made it possible to explain why the order based on atomic weights was not always correct?

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Isotopes

Mendeleev overcame some problems with the table by doing what? He also changed the order of some elements based on what?

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Leaving gaps; atomic weights

The majority of elements are…?

The majority of elements are…?

Metals

Elements that react to form positive ions are…?

Elements that react to form positive ions are…?

Metals

Elements that do not form positive ions are…?

Elements that do not form positive ions are…?

Non-metals

Elements in Group 1 are known as…?

Elements in Group 1 are known as…?

The alkali metals

Elements in Group 7 are known as…?

Elements in Group 7 are known as…?

The halogens

What is ionic bonding?

What is ionic bonding?

Ionic bonding is the transfer of electron(s) from a metal atom to a non-metal atom to form positive and negative ions.

There is a relatively strong electrostatic attraction between the positive and negative ions which is called an ionic bond.

How are ionic compounds held together?

How are ionic compounds held together?

They are held together in a giant lattice.

It's a regular structure that extends in all directions in a substance.

Electrostatic attraction between positive and negative ions holds the structure together.

State properties of ionic substances

State properties of ionic substances

High melting and boiling point (strong electrostatic forces between oppositely charged ions).

Do not conduct electricity when solid (ions in fixed positions).

Conduct when molten or dissolved in water - ions are free to move.

Give 5 examples of positive ions and 5 examples of negative ions. What is important when working out a formula of an ionic compound?

Give 5 examples of positive ions and 5 examples of negative ions (give names of negative anions). What is important when working out a formula of an ionic compound?

E.g. Positive: Na^+, Mg^{2+}, Al^{3+}, Ca^{2+}, Rb^+,

E.g. Negative: Cl^-, Br^-, SO_4^{2-}, NO_3^-, OH^- (chloride, bromide, sulfate, nitrate, hydroxide).

Ionic compounds are electrically neutral, i.e. positive and negative charges balance each other.

How are ionic compounds formed? Explain in terms of MgO case.

How are ionic compounds formed? Explain in terms of MgO case.

Reaction of a metal with a non-metal.

Electron transfer occurs - metal gives away its outer shell electrons to non-metal.

Mg is in Group II, so has 2 available outer shell electrons.

O is in Group VI, so can accept 2 electrons to get a full outer shell configuration.

Mg becomes Mg^{2+} and O becomes O^{2-} (oxide).

What is a covalent bond?

What is a covalent bond?

Covalent bond is a shared pair of electrons between two atoms.

Describe the structure and properties of simple molecular covalent substances

Describe the structure and properties of simple molecular covalent substances

- Do not conduct electricity (no ions)
- Small molecules
- Weak intermolecular forces, therefore:
- Low melting and boiling points

How do intermolecular forces change as the mass/size of the molecule increases?

How do intermolecular forces change as the mass/size of the molecule increases?

They increase. That causes melting/boiling points to increase as well (more energy needed to overcome these forces).

What are giant covalent substances? Give examples

What are giant covalent substances? Give examples

Solids, atoms covalently bonded together in a giant lattice.
High melting/boiling points – strong covalent bonds.
Mostly don't conduct electricity (no delocalised e^-)
Diamond, graphite, silicon dioxide (silica).

Describe and explain the properties of allotropes of carbon.

Describe and explain the properties of allotropes of carbon.

Diamond

– four, strong covalent bonds for each carbon atom
– very hard (Strong bonds)
– very high melting point (strong bonds)
– does not conduct electricity (no delocalised electrons)

Graphite

– three covalent bonds for each carbon atom
– layers of hexagonal rings
– high melting point
– layers free to slide as weak intermolecular forces between layers; soft, can be used as a lubricant
– conduct thermal and electricity due to one delocalised electron per each carbon atom

Fullerenes

– hollow shaped molecules
– based on hexagonal rings but may have 5/7-carbon rings
– C_{60} has spherical shape, simple molecular structure (Buckminsterfullerene)

Nanotubes

– cylindrical fullerene with high length to diameter ratio
- High tensile strength (strong bonds)
- Conductivity (deloc. electrons)

Graphene - a single layer of graphite.

What is metallic bonding?

What is metallic bonding?

Forces of attraction between delocalised electrons and nuclei of metal ions.

Describe properties of metals

Describe properties of metals

- High melting/boiling points (strong forces of attraction)
- High density
- Good conductors of heat and electricity (delocalised electrons)
- Malleable, soft (layers of atoms can slide over each other whilst maintaining the attraction forces)

What are alloys? Why are they harder than pure metals?

What are alloys? Why are they harder than pure metals?

Alloys are mixtures of metal with other elements (usually metals).
Different sizes of atoms distorts the layers, so they can't slide over each other, therefore alloys are harder than pure metals.

Complete the table:

Property	Simple Covalent	Ionic	Giant Covalent	Metallic
boiling and melting points				
conductivity when solid				
conductivity when molten				
general description				

Complete the table:

Property	Simple Covalent	Ionic	Giant Covalent	Metallic
boiling and melting points	low- because of weak **intermolecular** forces between **molecules**	high- because of **giant lattice** of ions with **strong forces between oppositely charged ions.**	high- because of **many strong covalent bonds between atoms** in giant structure	high- strong electrostatic forces between **positive ions** and **delocalised electrons**
conductivity when solid	poor: no **ions** to conduct	poor: **ions** can't move	diamond and sand: poor, because electrons can't move **graphite**: good as **free delocalised electrons between layers** can move through structure	good: **delocalised electrons** are **free to move** through structure
conductivity when molten	poor: no ions	good: **ions** are **free to move**	poor	(good)
general description	mostly gases and liquids	crystalline solids	solids	shiny metal solids

What are the limitations of the simple model?

Higher tier only

What are the limitations of the simple model?

There are no forces between spheres and atoms, molecules and ions are solid spheres – this is not true

Higher Tier Only

What does the amount of energy needed to change state from solid to liquid or liquid to gas depend on?

What does the amount of energy needed to change state from solid to liquid or liquid to gas depend on?

The strength of the forces between the particles of the substance. The nature of the particles involved depends on the type of bonding and the structure of the substance. The stronger the forces between the particles, the higher the melting point and boiling point of the substance

A pure substance will melt or boil at…? What about the mixture?

A pure substance will melt or boil at…?

A fixed temperature.

A mixture will melt over a range of temperatures.

What are the three states of matter?

What are the three states of matter?

Solid, liquid and gas

Write down the half equations for the electrolysis of the aqueous solution of KCl

Write down the half equations for the electrolysis of the aqueous solution of KCl

Cathode: $2\ H^+ + 2\ e^- \rightarrow H_2$

Anode: $2\ Cl^- \rightarrow Cl_2 + 2\ e^-$

Write down the half equations for the electrolysis of the aqueous solution of H_2SO_4

Write down the half equations for the electrolysis of the aqueous solution of H_2SO_4

Cathode: $2\ H^+ + 2\ e^- \rightarrow H_2$

Anode: $2\ H_2O \rightarrow 4H^+ + O_2 + 4\ e^-$

Describe the properties of noble gases. Discuss the trend in boiling point down the group.

Describe the properties of noble gases. Discuss the trends in properties down the group.

Non-metals, colourless gases, low boiling points, unreactive (full outer shell; they don't easily accept or lose electrons).

The boiling point increases down the group, as the atoms get heavier.

What is the law of conservation of mass?

What is the law of conservation of mass?

The law of conservation of mass states that no atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants.

Write a balanced equation of magnesium reacting with hydrochloric acid.

Write a balanced equation of magnesium reacting with hydrochloric acid.

$$Mg_{(s)} + 2\ HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$$

Define relative atomic mass and relative formula mass.

Define relative atomic mass (RAM) and relative formula mass (RFM).

RAM - average mass of an atoms in an element taking into account masses and abundance of its isotopes, relative to 1/12 of the mass of one ^{12}C atom.

RFM - sum of RAM's of all atoms in the formula.

What is the relative formula mass of:

A) CaF_2

B) $C_6H_{12}O_6$

What is the relative formula mass of:

CaF_2 - (A_r values: Ca = 40, F = 19)

40 + 19 + 19 = 78

$C_2H_{12}O_6$ - (A_r values: C = 12, H = 1, O = 16)
(12 x 6) + (1 x 12) + (16 x 6) = 180

The following reaction occurs in a test tube under a Bunsen Burner:

$$4\ MgO(s) + CH_4(g) \rightarrow 4\ Mg(s) + 2\ H_2O(g) + CO_2(g)$$

The carbon dioxide and water escape from the test tube.

Use the equation to explain why.

Use equation to explain why carbon dioxide and water escape from the test tube.

They are both gases.

The experiment was repeated three times. Calculate the mean mass of magnesium produced and suggest how you could increase the precision of the results.

	Experiment		
	1	2	3
Mass of magnesium oxide used in g	4.0	4.0	4.0
Mass of magnesium produced in g	3.3	3.5	3.2

Calculate the mean of magnesium produced and suggest how you could increase the precision of the results

(3.3 + 3.5 + 3.2) / 3 = 3.3

Measure to more decimal places **or** use a more sensitive balance / apparatus

What is Avogadro's constant?

What is Avogadro's constant?

The number of atoms, molecules or ions in a mole of a given substance.

The value of the constant is 6.02×10^{23}.

What is the formula that links mass, molecular mass and moles together

What is the formula that links mass, molecular mass and moles together

Mass (g) = Mr x Moles

What is the mass of:
20 moles of calcium carbonate, $CaCO_3$

What is the mass of 20 moles of calcium carbonate, $CaCO_3$

Mass = Mr x Moles

Mr = 100

100 x 20 = 2000 g

Calculate the amount of carbon dioxide in moles in 0.32 g of carbon dioxide.

Relative atomic masses (A_r): carbon = 12, oxygen = 16

Calculate the amount of carbon dioxide in moles in 0.32 g of carbon dioxide.

Relative atomic masses (A_r): carbon = 12, oxygen = 16

Moles = Mass / Mr

0.32 / 44 = **0.007**

Nitrogen and hydrogen form ammonia shown by the following equation:

$$N_{2(g)} + 3\,H_{2(g)} \rightleftharpoons 2\,NH_{3(g)}$$

Calculate the mass of nitrogen needed to form 6.8 tonnes of ammonia.

Relative atomic masses (A_r): H = 1; N = 14

Calculate the mass of nitrogen needed to form 6.8 tonnes of ammonia

Step 1 - Work out the number of number of moles of ammonia (Mr of ammonia = 17)

6800000 / 17 = 400000 moles of ammonia

Step 2 - Use the balanced equation and number of moles of ammonia to work out the number of moles of nitrogen

The ratio of nitrogen to ammonia is 1:2

Therefore the number of moles of nitrogen is 400000/2 = 200000

Step 3 - Work out the mass of nitrogen (Mr of N_2 is 28)

200000 x 28 = 5600000 g = 5.6 tonnes.

State what we mean by a limiting reactant in a chemical reaction

State what we mean by a limiting reactant in a chemical reaction

In a chemical reaction involving two reactants, it is common to use an excess of one of the reactants to ensure that all of the other reactant is used. The reactant that is completely used up is called the limiting reactant because it limits the amount of products formed.

Hydrogen peroxide decomposes in water to form water and oxygen. How many grams of oxygen gas will be given off from 40.8 g of hydrogen peroxide?

How much oxygen will be given off from 40.8 g of hydrogen peroxide?

Step 1: Write the balanced equation $2\ H_2O_{2(l)} \rightarrow 2\ H_2O + O_{2(g)}$ Mr of H_2O_2 = 34

Step 2: Number of moles in 40.8 g : 40.8/34 = 1.2 moles

Ratio in the balanced equation of H_2O_2 : O_2 = 2:1

Step 3 :Therefore number of moles of O_2 = 0.6 moles

Step 4: Mass of oxygen = 0.6 x 32 (Mr of O_2) = **19.2**

Write down the two formulae that link concentration, mass and volume together.

Write down the two formulae that link concentration, mole/mass and volume together.

Concentration (g per dm^3) = Mass (g)/Volume (dm^3)

Concentration (mol per dm^3) = nr of moles/volume (dm^3)

31.0 cm^3 of potassium hydroxide solution neutralised 25.0 cm^3 of 2.0 $moldm^{-3}$ nitric acid.

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O$$

Calculate the concentration of the potassium hydroxide solution in $moldm^{-3}$

Calculate the concentration of the potassium hydroxide solution in $moldm^{-3}$

Step 1: Calculate the moles of HNO_3 used = Concentration x volume

2 x 0.025 dm^3 (25/1000 to convert the units) = 0.05 moles

Step 2 : Calculate the moles of KOH

Ratio is 1:1 therefore number of moles of KOH = 0.05

Step 3 : Calculate the concentration of KOH

Concentration = Moles/Volume; 0.05 / 0.031 = 1.61

What is the molar volume of a gas at room temperature and pressure?

What is the molar volume of a gas at room temperature and pressure?

1 mole of a gas at room temperature and pressure occupies 24 dm^3

What is titration?

What is titration?

A technique for finding the concentration of a solution by reacting a known volume of this solution with a solution of known concentration.

Why is it not always possible to obtain the theoretical amount of product in a chemical reaction?

Why is it not always possible to obtain the theoretical amount of product in a chemical reaction?

- The reaction may not go to completion because it is reversible.
- Some of the product may be lost when it is separated from the reaction mixture.
- Some of the reactants may react in ways different to the expected reaction (side reactions may occur).

How is the percentage yield of a product in a chemical reaction?

How is the percentage yield of a product in a chemical reaction?

$$\% \text{ Yield} = \frac{\text{Actual mass of a product}}{\text{Maximum theoretical mass of product}} \times 100$$

Calculate the percentage yield from the following data

Actual Yield (g)	Predicted Yield (g)	Percentage Yield (%)
45	100	
12	50	
8	40	

Calculate the percentage yield from the following data:

Actual Yield (g)	Predicted Yield (g)	Percentage Yield (%)
45	100	45
12	50	24
8	40	20

What is the % yield of NH_3 if 40.5 g NH_3 is produced from 20.0 mol H_2 and excess N_2?

What is the % yield of NH_3 if 40.5 g NH_3 is produced from 20.0 mol H_2 and excess N_2?

Step 1 - Write the balanced equation

$N_2 + 3\ H_2 \rightarrow 2\ NH_3$

Step 2 - Calculate the theoretical amount of NH_3. Moles NH_3 (ratio of H_2 to NH_3 is 3:2); of 20/1.5 = 13.3 moles

13.3 X 17 (Mr of NH_3) = 227

Step 3 - Calculate percentage yield of NH_3

40.5/227 x 100 = 17.8%

What is atom economy?

What is atom economy?

A measure of the amount of starting materials that end up as useful products.

It is a ratio of the relative formula mass of desired product(s) to the sum of the relative formula masses of all reactants.

Look at the equations for the two reactions that produce $CuCl_2$

Reaction I: $CuCO_{3(s)} + 2\ HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

Reaction II: $CuO_{(s)} + 2\ HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)}$

Reactive formula masses: $CuCO_3$ = 123.5, CuO = 79.5; HCl = 36.5; $CuCl_2$ = 134.5; H_2O = 18, CO_2 = 44

Which reaction has a better atom economy?

Which reaction has a better atom economy?

Reaction II (look at the reactants):

Total formula mass of reactants = 152.5

Formula mass of $CuCl_2$ = 134.5

(134.5/152.5) x 100% = **88.2%**

What is electrolysis?

What is electrolysis?

The passing of an electric current through ionic substances that are molten or in solution to break them down into elements; ions are discharged (they lose/gain electrons) at electrodes to produce these.

What is an electrolyte?

What is an electrolyte?

The liquid/solution which conducts electricity.

What is a cathode and what is an anode?

What is a cathode and what is an anode?

Cathode is the negative electrode, anode is the positive electrode.

What occurs at the cathode and what occurs at the anode during electrolysis?

What occurs at the cathode and what occurs at the anode during electrolysis?

Reduction and oxidation, respectively.

How is aluminium manufactured?

Why is it expensive?

How is aluminium manufactured? Why is it expensive?

Electrolysis of aluminium oxide and cryolite – large amounts of energy needed to produce current.

What are the half equations in the extraction of aluminium?

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$$Al^{3+} + 3\ e^- \rightarrow Al \text{ (cathode)}$$
$$2\ O^{2-} \rightarrow O_2 + 4\ e^- \text{ (anode)}$$

Oxygen reacts with the Carbon of the anode producing CO_2.

Why is cryolite used in this process?

Why is cryolite used in manufacturing of aluminium?

It lowers the melting point of aluminium oxide, reducing energy costs.