Edexcel Chemistry GCSE

Topic 5 - Separate chemistry 1

(Chemistry only)

Flashcards

What are the typical properties of transition metals?

What are the typical properties of transition metals?

- High melting point.
- High density.
- Form coloured compounds
- Transition metals and their compounds can be used as catalysts.

Which transition metal is used as a catalyst in the Haber process?

Which transition metal is used as a catalyst in the Haber process?

Iron

What causes metals to corrode?

What causes metals to corrode?

Oxygen reacts with the metal to form a metal oxide

Why is corrosion of a metal a redox reaction?

Why is corrosion of a metal a redox reaction?

The metal loses electrons so is oxidised.

Oxygen gains electrons so is reduced.

What is rusting?

What is rusting?

Rusting is the name specifically given to the corrosion of iron when it reacts to oxygen and water in the air.

What two substances need to be excluded to prevent rusting?

What two substances need to be excluded to prevent rusting?

Oxygen (O_2)

Water (H_2O)

How can oxygen and water be excluded to prevent iron rusting?

How can oxygen and water be excluded to prevent iron rusting?

- Paint the metal.
- Coat the metal in oil/grease.
- Cover the metal in plastic.
- Keep the metal in a vacuum container.

What is sacrificial protection? How does it prevent corrosion?

What is sacrificial protection? How does it prevent corrosion?

Sacrificial protection is when the metal being protected from rusting is galvanized with a more reactive metal.

The outer metal will corrode first and will prevent the corrosion of the inner metal.

Which metal is used to in the sacrificial protection of iron?

Which metal is used to in the sacrificial protection of iron?

Zinc

What is electroplating?

What is electroplating?

A process in which a metal is coated with a layer of another metal.

What are two reasons for using electroplating?

What are two reasons for using electroplating?

- To make a metal more resistant to corrosion.
- To improve the appearance of a metal (e.g. silver plated cutlery).

Explain how the process of electroplating works

Explain how the process of electroplating works

Similar setup to electrolysis:

The metal being coated is the cathode. The metal that will form the exterior layer is the anode. The electrolyte solution must contain ions of the metal which will form the outer coating. A power supply is connected to both electrodes.

Why are pure metals generally very malleable?

Why are pure metals generally very malleable?

The atoms lie in uniform rows which are able to slide over one another.

What is an alloy?

What is an alloy?

An alloy is a mixture of two or more metals or a metal and another element.

A pure metal can be converted into an alloy. How does this increase the strength of the product?

A pure metal can be converted into an alloy. How does this increase the strength of the product?

Alloys contain several metals which will have different sized atoms. This distorts the regular arrangement of the atoms so the layers are unable to slide over one another very easily.

Why is iron alloyed with other metals to produce alloy steels?

Why is iron alloyed with other metals to produce alloy steels?

Iron is relatively brittle so it is combined with other elements such as carbon produces a material with more desirable qualities.

- Low carbon steel: Malleable so used for sheeting.
- High carbon steel: Hard so used for cutting tools.
- Stainless steel: Corrosion resistant so used for cutlery.

What property of copper makes it suitable to be used in electrical cables?

What property of copper makes it suitable to be used in electrical cables?

Very good electrical conductor.

What property of aluminium makes it suitable for use in aircrafts?

What property of aluminium makes it suitable for use in aircrafts?

Low density

What is a key property of gold that makes it suitable for use in jewellery?

What is a key property of gold that makes it suitable for use in jewellery?

Very unreactive so resist to corrosion.

Jewellery appearance will not be affected over time.

What is magnalium?
What is it used for?

What is magnalium? What is it used for?

Magnalium is an alloy of magnesium and aluminium.

It is lighter and stronger than aluminium and more resistant to corrosion. It is used for car and aircrafts.

What is brass?
What is it used for?

What is brass? What is it used for?

Brass is an alloy of copper and zinc.

Brass is hard and resistant to corrosion. It is used for decorative hardware such as plumbing fittings.

How do you calculate the concentration of a solution in mol dm^{-3}?

(higher only)

How do you calculate the concentration of a solution in mol dm^{-3}?

(higher only)

Concentration (mol dm^{-3}) = moles ÷ volume (dm^3)

How can you convert concentration in g dm^{-3} to mol dm^{-3}?

(higher only)

How can you convert concentration in g dm^{-3} to mol dm^{-3}? (higher only)

Concentration(mol dm^{-3}) = concentration(g dm^{-3}) ÷Mr

Mr - molecular mass

Describe how to carry out an acid-alkali titration to find the concentration of alkali (higher only)

Describe how to carry out an acid-alkali titration to find the concentration of alkali (higher only)

1. Rinse the pipette with the solution of unknown concentration (alkali). Use this pipette to add a known volume of alkali to a conical flask.
2. Add a few drops of indicator.
3. Rinse and fill the burette with acid.
4. Gradually add the acid to the conical flask.
5. Record the volume in the burette when the indicator changes colour.
6. Repeat the experiment until you have concordant results.
7. Use results to calculate a mean titre and the concentration of alkali.

If you know the volume of acid required to neutralise an alkali, how could you calculate the concentration of the acid, given the alkali concentration and volume? (Higher)

If you know the volume of acid required to neutralise an alkali, how could you calculate the concentration of the acid, given the alkali concentration and volume?
(Higher)

- Calculate the number of moles of the alkali using the known volume and concentration (moles = concentration x volume).
- Use the chemical equation to work out the ratio of acid and alkali that react and hence work out how many mole of acid have reacted.
- Divide the moles of acid by the volume used in neutralisation to find concentration.

What is meant by the term theoretical yield?

What is meant by the term theoretical yield?

The amount of product that would be collected under perfect reaction conditions.

How do you calculate percentage yield?

How do you calculate percentage yield?

Percentage yield =

(Actual yield ÷ Theoretical yield) x 100

What is the percentage yield of NH_3 if 40.5 g of NH_3 is produced from 20.0 mol H_2 and excess N_2? (higher only)

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

(higher only)

1. Equation: $N_2 + 3H_2 \rightarrow 2NH_3$
2. Moles of ammonia = 20/1.5 = 13.3 moles
3. Mass of ammonia = 13.3 x (14+1+1+1) = 227 g
4. Percentage yield = (40.5/227) x 100 = 17.8%

Why could the actual yield of product be less than expected?

Why could the actual yield of product be less than expected?

- Incomplete reaction.
- Competing, unwanted side reactions.
- Practical losses, for example some solid may get lost when being transferred between beakers.

What is the atom economy of a reaction?

What is the atom economy of a reaction?

Atom economy is a measure of the efficiency of the reaction. It looks at the amount of reactants that get turned into useful products.

How can atom economy be calculated?

How can atom economy be calculated?

Atom economy =

(Mr of desired product ÷ Mr of reactants) x 100

Mr - molecular mass

Fill in the gap: ‘The _____ the atom economy, the more sustainable and efficient the process’

Fill in the gap: ‘The _____ the atom economy, the more sustainable and efficient the process’

Higher

Why might one reaction pathway be chosen over another? (Higher only)

Why might one reaction pathway be chosen over another? (Higher only)

- Higher atom economy.
- Higher yield.
- Faster rate.
- Equilibrium position favours products more.
- By-products are more useful / less harmful.

What does Avogadro's Law state about gas volumes? (higher only)

What does Avogadro's Law state about gas volumes? (higher only)

At the same temperature and pressure, equal amounts of gas will occupy the same volume.

What is the molar volume of a gas?

(higher only)

What is the molar volume of a gas? (higher only)

The volume occupied by one mole of molecules of any gas at room temperature and pressure.

What is RTP? (higher only)

What is RTP? (higher only)

Room temperature and pressure:

- 20°C
- 1 atmosphere

How can the molar volume of a gas be calculated? What are the units? (higher only)

How can the molar volume of a gas be calculated? What are the units? (higher only)

Molar volume = volume (dm^3) ÷ moles of gas

Units: $dm^3\ mol^{-1}$

What is the Haber process?

What is the Haber process?

A reversible reaction that forms ammonia from nitrogen and hydrogen.

Describe the steps that are carried out during the Haber process

Describe the steps that are carried out during the Haber process

1. Reactants are obtained (hydrogen from natural gas, nitrogen from air).
2. The gases are compressed to 200 atm and heated to 450°C before being pumped into a tank containing layers of catalytic iron beads.
3. Ammonia forms.
4. Ammonia and unreacted hydrogen and nitrogen pass into a cooling tank where the ammonia is collected as a liquid.
5. The unreacted hydrogen and nitrogen are recycled back into the tank.

What is meant by the term dynamic equilibrium?

What is meant by the term dynamic equilibrium?

The rate of the forward reaction equals the rate of the backwards reaction. The concentration of reactants and products are constant.

What is the chemical equation for the formation of ammonia from hydrogen and nitrogen?

What is the chemical equation for the formation of ammonia from hydrogen and nitrogen?

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

What are the ideal conditions for the Haber process?

What are the ideal conditions for the Haber process?

- 450ºC temperature
- 200 atm pressure
- Iron catalyst

How is the rate of attainment of equilibrium affected by temperature? (higher only)

How is the rate of attainment of equilibrium affected by temperature? (higher only)

A higher temperature means equilibrium is reached quicker. This is because the reacting particles have more kinetic energy so there are more frequent successful collisions.

How is the rate of attainment of equilibrium affected by a catalyst? (higher only)

How is the rate of attainment of equilibrium affected by a catalyst? (higher only)

Equilibrium is reached faster when a catalyst is used because the catalyst provides an alternative reaction pathway with a lower activation energy.

How is the rate of attainment of equilibrium affected by pressure? (higher only)

How is the rate of attainment of equilibrium affected by pressure?

(higher only)

Equilibrium is reached faster with a higher pressure. This is because there are more particles in the same volume (or the same number of particles in a smaller volume) so more collisions between reacting particles.

How is the rate of attainment of equilibrium affected by concentration? (higher only)

How is the rate of attainment of equilibrium affected by concentration?

(higher only)

Equilibrium is reached faster at a higher concentration. This is because there are more particles in the same volume so more collisions between the reacting particles.

Why are the conditions used in the Haber process a compromise? (higher only)

Why are the conditions used in the Haber process a compromise? (higher only)

- A high temperature increases the rate of reaction however, it will favour the reverse reaction, decreasing the yield. A compromise of 450°C is used to obtain a sufficient rate and yield.
- A high pressure speeds up the rate and favours the forward reaction (increasing the yield). High pressures can be dangerous and require expensive machinery so a compromise of 200 atm is used.

Why is a catalyst used in the Haber process?

(higher only)

Why is a catalyst used in the Haber process? (higher only)

To increase the rate of reaction so more product is produced within the same time frame.

What factors should be considered before deciding the conditions for an industrial reaction? (higher only)

What factors should be considered before deciding the conditions for an industrial reaction? (higher only)

- Availability and cost of raw materials.
- Energy requirements.
- Optimum temperature and pressure for high yield and fast rate of reaction.
- Need for a catalyst.

What is the purpose of fertilisers?

What is the purpose of fertilisers?

To promote plant growth.

What chemical compounds might fertilisers contain?

What chemical compounds might fertilisers contain?

Nitrogen, phosphorus and potassium compounds.

What compounds are found in NPK fertilisers?

What compounds are found in NPK fertilisers?

A combination of all three fertiliser compounds: nitrogen, phosphorus and potassium compounds.

Which parts of plant growth do the compounds nitrogen, potassium and phosphorus help with?

Which parts of plant growth do the compounds nitrogen, potassium and phosphorus help with?

Nitrogen: Healthy leaves.

Phosphorus: Healthy roots.

Potassium: Growth and healthy fruit / flowers.

Which ammonium salt is most commonly used in fertilisers?

Which ammonium salt is most commonly used in fertilisers?

Ammonium nitrate

How is the salt ammonium nitrate formed? Write a chemical equation for the reaction taking place

How is the salt ammonium nitrate formed? Write a chemical equation for the reaction taking place

React ammonia with nitric acid

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

What is the chemical equation for the formation of ammonium sulfate from ammonia and sulfuric acid?

What is the chemical equation for the formation of ammonium sulfate from ammonia and sulfuric acid?

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

How can ammonium sulfate be prepared in a laboratory?

How can ammonium sulfate be prepared in a laboratory?

Titration between ammonia and sulfuric acid:

- Exact volume of NH_3 added to a conical flask using a pipette.
- Add a few drops of indicator.
- Add H_2SO_4 from the burette drop by drop. Stop when the indicator changes colour.
- Repeat, adding the exact volumes of reactants without the indicator (as it is an impurity).
- Remove the water by evaporation and crystallisation, leaving pure crystals.

How can ammonium sulfate be produced on an industrial scale?

How can ammonium sulfate be produced on an industrial scale?

Raw materials obtained from the Haber process (ammonia) and the contact process (sulfuric acid). A large reactor chamber is filled with ammonia gas. Sulfuric acid is sprayed into the chamber from above. Ammonium sulfate crystals are produced.

Compare the laboratory method of producing ammonium sulfate with the industrial process

Compare the laboratory method of producing ammonium sulfate with the industrial process

Laboratory method	Industrial process
- Faster rate of reaction. - Small reactant quantities can easily be bought. - Room temperature and pressure - Simple equipment required. - Very small yield.	- Very expensive and complex. - Continuous process so continuous yield. - Large volumes of product. - Slow rate of reaction. - High energy requirement. - Other industrial processes required to obtain the reactants.

How is a voltage produced from a chemical cell?

Describe how to set up a chemical cell. How is a voltage produced from a chemical cell?

Two metals of different reactivities are placed in an electrolyte.

The more reactive metal releases electrons, becoming positively charged. The electrons flow to the other electrode which becomes negatively charged. The difference in the ability of each electrode to release electrons causes a voltage to be produced.

When will a chemical cell stop producing a voltage?

When will a chemical cell stop producing a voltage?

When one of the reactants has been used up.

What is a fuel cell?

What is a fuel cell?

A cell that continually produces a voltage as long as it is supplied with oxygen and a fuel (like hydrogen).

What is the only product of a hydrogen-oxygen fuel cell?

What is the only product of a hydrogen-oxygen fuel cell?

Water

How does a hydrogen-oxygen fuel cell work?

How does a hydrogen-oxygen fuel cell work?

Hydrogen and oxygen are pumped through porous electrodes. The electrolyte is often an acid such as phosphoric acid.

Hydrogen and oxygen react, producing electricity and water.

Write an equation for the overall reaction that takes place in a hydrogen-oxygen fuel cell

Write an equation for the overall reaction that takes place in a hydrogen-oxygen fuel cell

$$2H_2 + O_2 \rightarrow 2H_2O$$

What are the advantages of using fuel cells?

What are the advantages of using fuel cells?

- No pollution produced.
- Produce more energy than an alternative fuel like petrol.
- Continuous process as long as fuel is supplied.

What are the disadvantages of using fuel cells?

What are the disadvantages of using fuel cells?

- Materials used to make them are expensive.
- High pressure tanks required to store oxygen and fuels like hydrogen.
- Hydrogen is expensive and hard to store.
- Efficiency is affected by temperature.