

OCR (B) Chemistry GCSE

C6 - Making Useful Chemicals

Flashcards

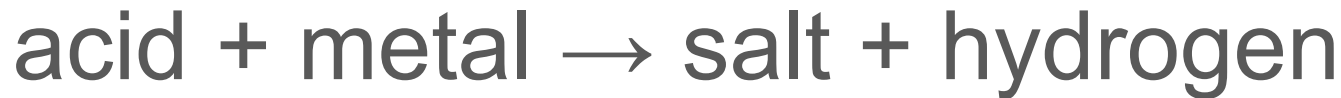


What are the products when an acid reacts with a metal?



What are the products when an acid reacts with a metal?

Salt and hydrogen



What are the products when an acid reacts with a metal carbonate?



What are the products when an acid reacts with a metal carbonate?

Salt, water and carbon dioxide

acid+metal carbonate → salt+water+carbon dioxide



What products are formed when magnesium reacts with hydrochloric acid?



What products are formed when magnesium reacts with hydrochloric acid?

Magnesium chloride (MgCl_2)

Hydrogen (H_2)



What products are formed when sodium carbonate reacts with nitric acid?



What products are formed when sodium carbonate reacts with nitric acid?

Sodium nitrate (NaNO_3)

Carbon dioxide (CO_2)

Water (H_2O)



How can a salt be prepared?



How can a salt be prepared?

Add acid to an excess of one of the following: metal, metal carbonate or metal hydroxide.

The salt will form in the solution.



State which process can be used to separate an insoluble salt from a solution. How does it work?



State which process can be used to separate an insoluble salt from a solution. How does it work?

Filtration:

- Put filter paper into a funnel then place over an empty conical flask.
- Pour the mixture through the funnel. Use distilled water to wash any of the salt left in the beaker through the funnel.
- Remove the filter paper and evaporate the water from the residue (the solid salt on the filter paper).



What process can be used to separate a soluble salt from a solution? How does it work?



What process can be used to separate a soluble salt from a solution? How does it work?

Crystallisation:

- Gently heat the solution in an evaporating basin to increase the concentration of the solution.
- Remove from the heat and allow the solution to cool.
- Salt crystals will form slowly as the rest of the water evaporates.



After a salt is produced, how can it be dried?



After a salt is produced, how can it be dried?

Leaving in an evaporating basin for a few days or using a drying oven.



Write the formulae of the following compounds: calcium hydroxide, potassium carbonate, iron(II) nitrate, copper(II) sulfate



Write the formulae of the following compounds:
calcium hydroxide, potassium carbonate, iron(II)
nitrate, copper(II) sulfate

Calcium hydroxide - $\text{Ca}(\text{OH})_2$

Potassium carbonate - K_2CO_3

Iron(II) nitrate - $\text{Fe}(\text{NO}_3)_2$

Copper(II) sulfate - CuSO_4



What does pH measure?



What does pH measure?

Relative acidity and alkalinity.



What are two ways of measuring pH?



What are two ways of measuring pH?

Universal indicator

pH meter



What is meant by the terms dilute and concentrated?
(Higher only)



What is meant by the terms dilute and concentrated?
(Higher only)

Dilute - small amount of solute dissolved in a given volume of solution.

Concentrated - large amount of solute dissolved in a given volume of solution.



In terms of acids, what is meant by the terms strong and weak?
(Higher only)



In terms of acids, what is meant by the terms strong and weak? (Higher only)

Strong - complete dissociation of an acid where almost all the hydrogen ions are released.

Weak - partial dissociation of an acid where fewer hydrogen ions are released.



For acids of the same concentration, do strong or weak acids have a higher pH?
(Higher only)



For acids of the same concentration, do strong or weak acids have a higher pH? (Higher only)

Weak acids have a higher pH.



In terms of ions, what does pH measure?
(Higher only)



In terms of ions, what does pH measure?

(Higher only)

Concentration of hydrogen ions.



If pH increases by 1 unit, what happens to the concentration of hydrogen ions?
(Higher only)



If pH increases by 1 unit, what happens to the concentration of hydrogen ions? (Higher only)

Decreases by a scale factor of 10.



Put the following in order of concentration of hydrogen ions from lowest to highest: acid, alkali and neutral
(Higher only)



Put the following in order of concentration of hydrogen ions from lowest to highest: acid, alkali and neutral (**Higher only**)

Alkali < neutral < acid



What pH do acids, alkalis and neutral solutions have?



What pH do acids, alkalis and neutral solutions have?

Acid - less than pH 7

Neutral - pH 7

Alkali - greater than pH 7



What does the term 'activation energy' mean?



What does the term 'activation energy' mean?

The minimum amount of energy that two particles need to collide with for a reaction to occur.



What conditions can be changed to increase the rate of a reaction?



What conditions can be changed to increase the rate of a reaction?

- Increase temperature
- Increase pressure
- Increase surface area
- Increase concentration



Explain how temperature affects the rate of reaction



Explain how temperature affects the rate of reaction

Increasing temperature increases the rate of reaction.

The reactants have more energy so more particles have energy that exceeds the activation energy (more collisions are successful). Collisions occur more frequently because the particles have more kinetic energy. Rate is increased because there are more frequent successful collisions.



Explain how surface area affects the rate of reaction



Explain how surface area affects the rate of reaction

Increasing surface area increases the rate of reaction because there are more exposed reactant particles so more frequent successful collisions.



Explain how concentration affects the
rate of reaction



Explain how concentration affects the rate of reaction

Increasing concentration increases the rate of reaction because there are more reacting particles in the same volume so there are more frequent successful collisions.



Explain how pressure affects the rate of a gaseous reaction



Explain how pressure affects the rate of a gaseous reaction

Increasing pressure increases the rate of reaction because there are more reacting particles in the same volume of gas (or the same number of particles in a smaller volume). This means there are more frequent successful collisions between particles.



Marble chips react with hydrochloric acid. How could the rate of this reaction be increased?



Marble chips react with hydrochloric acid. How could the rate of this reaction be increased?

- Turn the marble chips into a powder to increase surface area.
- Increase concentration of acid.
- Increase temperature of the reactants and environment.



What can be added to a reaction to speed up the rate of reaction?



What can be added to a reaction to speed up the rate of reaction?

Catalyst



What is a catalyst?



What is a catalyst?

A substance that speeds up the rate of reaction without being chemically changed at the end.



Explain how a catalyst affects the rate of reaction



Explain how a catalyst affects the rate of reaction

A catalyst will increase the rate of reaction because it provides an alternate reaction pathway with a lower activation energy. More of the particles will have sufficient energy to react so there are more frequent successful collisions.



How can a catalyst be identified in a reaction?



How can a catalyst be identified in a reaction?

They are chemically unchanged so can be distinguished from the product. They are not involved in the equation as they do not get used up.



How can the rate of reaction be measured if a gas is produced during the reaction?



How can the rate of reaction be measured if a gas is produced during the reaction?

Using a gas syringe or upside down measuring cylinder:

- Reactants are placed in conical flask with a bung and delivery tube connected to a gas syringe or upside down measuring cylinder in a water trough.
- Start timer.
- Measure the volume of gas collected in 30 seconds.
- Calculate rate of reaction.



How can the rate of reaction be measured using a digital mass balance?



How can the rate of reaction be measured using a digital mass balance?

If a gas is produced during a reaction, the mass of the reaction mixture will decrease so a mass balance can be used to measure rate.

- Record initial mass of reactants.
- Start timer when the reactants are combined.
- Record the mass every 15 seconds for 2 minutes.
- Calculate the rate of reaction.



What is a precipitate? (Higher only)



What is a precipitate? (Higher only)

An insoluble solid suspended in a liquid



How can the rate of reaction be measured if a precipitate is produced?
(Higher only)



How can the rate of reaction be measured if a precipitate is produced? (Higher only)

- Place a conical flask over a black cross.
- Combine the reactants in the conical flask and start the timer.
- Time how long it takes for the black cross to disappear.



Why is the disappearing cross experiment an inaccurate way to measure rate of reaction?
(Higher only)



Why is the disappearing cross experiment an inaccurate way to measure rate of reaction?

(Higher only)

People might disagree over the exact point when the black cross disappears.



How can a colour change be observed to
determine rate of reaction?
(Higher only)

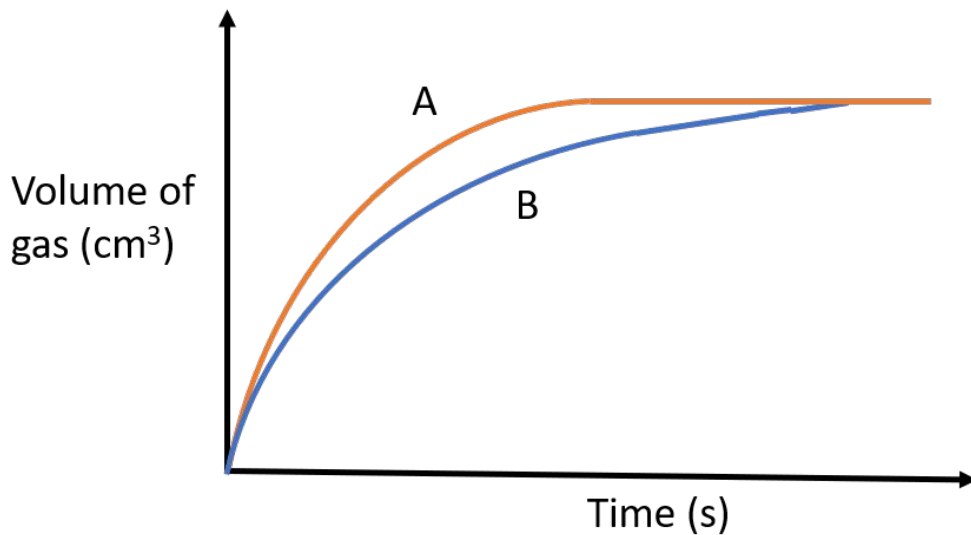


How can a colour change be observed to determine rate of reaction? (Higher only)

When the solution of reactants is a different colour to the products, time how long it takes for the reactant solution to fully change colour.

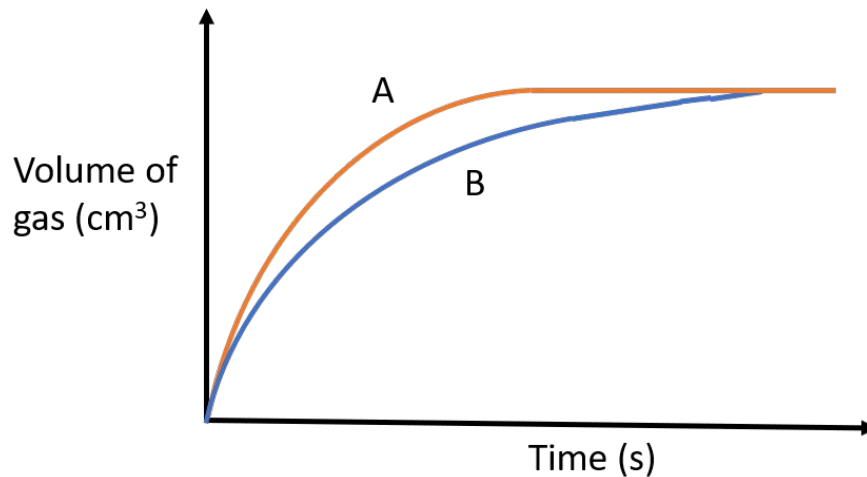


Which reaction has a faster rate of reaction?



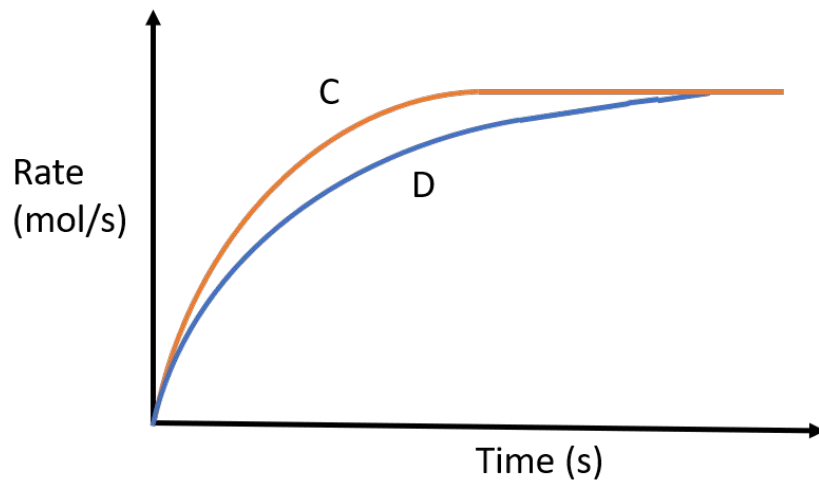
Which reaction has a faster rate of reaction?

A



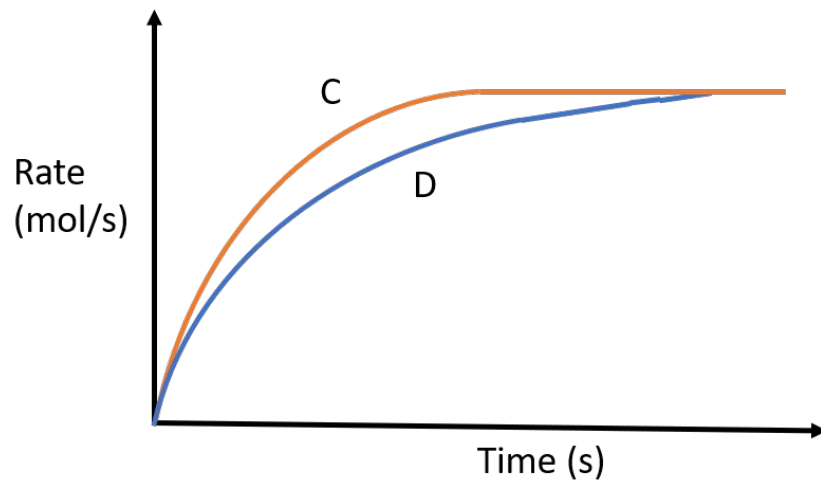
Which reaction has been conducted at a higher temperature?

(Chemistry only) (Higher only)



Which reaction has been conducted at a higher temperature? (Chemistry only) (Higher only)

C



What is the equation to calculate rate of reaction?



What is the equation to calculate rate of reaction?

Rate of reaction =

Amount of product formed or reactant used

Time (s)



What are the units of rate of reaction?



What are the units of rate of reaction?

g/s

cm³/s

mol/s (Higher only)



How can the rate of reaction be calculated at specific times in the reaction?



How can the rate of reaction be calculated at specific times in the reaction?

Plot:

X axis - time (s)

Y axis - product formed/reactant used

The rate of reaction at a specific time can be calculated by calculating the gradient of a tangent to the curve (change in y /change in x) at this time.



A graph showing time and volume of gas produced in a reaction is plotted.
Describe and explain what happens to the gradient of curve



A graph showing time and volume of gas produced in a reaction is plotted. Describe and explain what happens to the gradient of curve

Initially the gradient is very steep because the rate is fastest at the start as there are more reacting particles so more frequent collisions.

As the reactants are used up, the gradient becomes less steep.

The curve eventually levels off when the reaction is complete and there are no more reacting particles.



What is proportional to the rate of reaction and gradient of the graph?



What is proportional to the rate of reaction and gradient of the graph?

$1/t$



Marble chips react with hydrochloric acid to produce calcium chloride, water and carbon dioxide. How could you measure the rate of reaction?



Marble chips react with hydrochloric acid to produce calcium chloride, water and carbon dioxide. How could you measure the rate of reaction?

Using a digital mass balance to record mass change because gaseous carbon dioxide is released.



What is an enzyme?



What is an enzyme?

A biological catalyst made from protein.
They control reactions in living organisms.



Fill in the blanks: 'Enzymes work at their optimum within a narrow range of _____ and _____'



Fill in the blanks: 'Enzymes work at their optimum within a narrow range of _____ and _____'

Temperature and pH



What are the advantages of using enzymes in industrial processes?



What are the advantages of using enzymes in industrial processes?

- Reduce energy demand
- Lower temperature required
- Increase rate of reaction



Give an example of how enzymes can be used in industry



Give an example of how enzymes can be used in industry

Yeast is used to ferment sugar to produce alcoholic drinks.



What is a reversible reaction?



What is a reversible reaction?

A reaction in which the products can react to form the original reactants.



How can some reactions be reversed?



How can some reactions be reversed?

By altering the conditions.



What symbol is used to show that a reaction is reversible?



What symbol is used to show that a reaction is reversible?



Will a reversible reaction in a closed system reach 100% yield?



Will a reversible reaction in a closed system reach 100% yield?

No because some of the products will always be turning back into the reactants.



When does dynamic equilibrium occur?



When does dynamic equilibrium occur?

When the rate of the forward reaction equals the rate of the backward reaction.



How do the concentrations of reactants and products change at dynamic equilibrium?



How do the concentrations of reactants and products change at dynamic equilibrium?

The concentrations both remain constant.

The forward and backward reactions continue at the same rate so reactants are turning to products at the same rate as products are turning back into reactants.



What affects the yield and rate of a reaction?



What affects the yield and rate of a reaction?

Temperature

Pressure

Concentration



How can percentage yield be calculated?



How can percentage yield be calculated?

Percentage yield =

$(\text{actual yield} \div \text{theoretical yield}) \times 100$



What factors are considered when selecting the reaction conditions?
(Higher only)



What factors are considered when selecting the reaction conditions? (Higher only)

- High yield
- Fast rate
- Cost of maintaining conditions
- Using a catalyst
- Safety
- Waste production



What does it mean when the equilibrium position lies to the left or to the right?
(Higher only)



What does it mean when the equilibrium position lies to the left or to the right? (Higher only)

Left - concentration of reactants is higher than products.

Right - concentration of products is higher than reactants.



How can the position of equilibrium be
changed?
(Higher only)



How can the position of equilibrium be changed?
(Higher only)

- Changing concentration of reactants
- Changing concentration of products
- Changing gas pressures
- Changing temperature



How does a catalyst affect a reaction at
equilibrium?
(Higher only)



How does a catalyst affect a reaction at equilibrium?
(Higher only)

A catalyst has no effect on the position of an equilibrium, so no effect on yield.

It increases the rate at which the equilibrium is established.



How does increasing the concentration of reactants affect the position of equilibrium?
(Higher only)



How does increasing the concentration of reactants affect the position of equilibrium? (**Higher only**)

Equilibrium position shifts to the right to decrease the concentration of reactants and form more products.



How does decreasing pressure affect the position of equilibrium?
(Higher only)



How does decreasing pressure affect the position of equilibrium? (**Higher only**)

Equilibrium position shifts to the side with the fewest molecules to reduce the effect of the pressure change.



How does temperature affect the position
of equilibrium?
(Higher only)



How does temperature affect the position of equilibrium? (Higher only)

Increase - equilibrium position shifts towards the endothermic reaction to take in more energy from the surroundings.

Decrease - equilibrium position shifts towards the exothermic reaction to release more energy into the surroundings.



For the reversible reaction below, which direction is exothermic?
(Higher only)



For the reversible reaction below, which direction is exothermic? (Higher only)

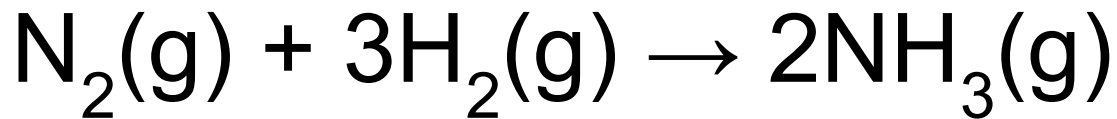


Backward reaction

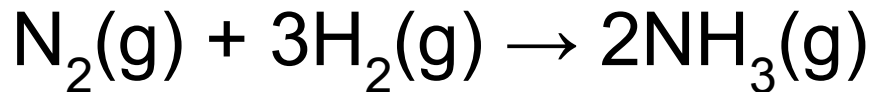


If the pressure is increased for the reaction below, what happens to the equilibrium position and the ammonia yield?

(Higher only)



If the pressure is increased for the reaction below, what happens to the equilibrium position and the ammonia yield? **(Higher only)**



Equilibrium shifts right.

Yield of ammonia increases.



What are the disadvantages of using very high temperatures and pressures?
(Higher only)



What are the disadvantages of using very high temperatures and pressures? (Higher only)

- Expensive to maintain.
- Large amount of energy required.
- Safety concerns about equipment under extreme conditions.



Which compounds are important for
agricultural production?
(Chemistry only)



Which compounds are important for agricultural production? (Chemistry only)

Compounds containing:

- Nitrogen
- Phosphorus
- Potassium



Why are fertilisers added to soil? (Chemistry only)



Why are fertilisers added to soil? (Chemistry only)

To replace nutrients lost from the soil when crops are harvested after they have used the nutrients for growth.



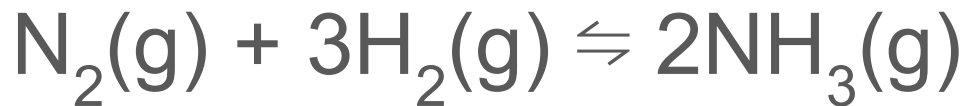
What is the Haber process? Include the word and balanced symbol equations
(Chemistry only)



What is the Haber process? Include the word and balanced symbol equations (Chemistry only)

Production of ammonia for use in synthetic fertilisers.

Nitrogen + hydrogen \rightleftharpoons ammonia



Why are synthetic fertilisers used instead
of natural fertilisers?
(Chemistry only)



Why are synthetic fertilisers used instead of natural fertilisers? (Chemistry only)

- Difficult to supply enough natural fertilisers for growth of crops.
- Difficult to transport natural fertilisers.
- Easier to keep mineral content of synthetic fertilisers constant.



What is the main problem with fertilisers?
(Chemistry only)



What is the main problem with fertilisers? (Chemistry only)

Eutrophication:

Fertilisers are washed into rivers and lakes by rainwater. Nitrate and phosphate ion concentrations increase in the water so algae grows faster. Algae prevents light reaching other plants in the water. Bacteria break down these plants, using oxygen to respire. Other species can't survive due to lack of oxygen in the water.



What are NPK fertilisers? (Chemistry only)



What are NPK fertilisers? (Chemistry only)

Fertilisers that supply nitrogen, phosphorus and potassium to plants.



Fill in the blanks: 'Fertilisers are used to
balance the _____ and _____ of food
worldwide'
(Chemistry only)



Fill in the blanks: 'Fertilisers are used to balance the _____ and _____ of food worldwide'
(Chemistry only)

Supply (and) demand



What are the sources of raw materials
for the Haber process?
(Chemistry only) (Higher only)



What are the sources of raw materials for the Haber process? (Chemistry only) (Higher only)

Nitrogen - air

Hydrogen - natural gas and steam



What is the problem with the source of hydrogen used for the Haber process?
(Chemistry only) (Higher only)



What is the problem with the source of hydrogen used for the Haber process?

(Chemistry only) (Higher only)

Hydrogen is extracted from natural gas which is finite.



The Haber process is a reversible reaction. What happens to the unreacted hydrogen and nitrogen?
(Chemistry only) (Higher only)



The Haber process is a reversible reaction. What happens to the unreacted hydrogen and nitrogen?
(Chemistry only) (Higher only)

They are recycled and pumped back into the reaction vessel.



What are the advantages of recycling the unreacted nitrogen and hydrogen in the Haber process?

(Chemistry only) (Higher only)



What are the advantages of recycling the unreacted nitrogen and hydrogen in the Haber process?

(Chemistry only) (Higher only)

- Reduces the amount of raw materials needed.
- Reduces cost.



How is ammonia separated from the reaction mixture during the Haber process?

(Chemistry only) (Higher only)



How is ammonia separated from the reaction mixture during the Haber process?

(Chemistry only) (Higher only)

The reaction mixture is cooled so that ammonia becomes a liquid. Nitrogen and hydrogen remain as gases. The liquid ammonia is collected.



What are the ideal conditions for the
Haber process?
(Chemistry only) (Higher only)



What are the ideal conditions for the Haber process?
(Chemistry only) (Higher only)

- 450°C temperature
- 200 atm pressure
- Iron catalyst



Why are the conditions of the Haber process considered to be a compromise?

(Chemistry only) (Higher only)



Why are the conditions of the Haber process considered to be a compromise?

(Chemistry only) (Higher only)

Both temperature and pressure are a compromise:

- A low temperature is used to favour the forward reaction since the forward reaction is exothermic however the temperature can not be too low as this will lead to a slow rate of reaction.
- A high pressure is used to favour the forward reaction and increase the yield, however the pressure can not be too high as this is very expensive and can be dangerous.



What is the effect of increasing temperature on rate, equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)



What is the effect of increasing temperature on rate, equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)

- Increases rate
- Equilibrium position shifts to the endothermic side (reactants)
- Reduces yield



What is the effect of increasing pressure on equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)



What is the effect of increasing pressure on equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)

- Equilibrium position shifts right towards the side with the fewest molecules of gas
- Yield increases



What is the effect of using a catalyst on rate, equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)



What is the effect of using a catalyst on rate, equilibrium position and yield in the Haber process?
(Chemistry only) (Higher only)

- Increases rate
- No effect on equilibrium position or yield



Define atom economy (Chemistry only)



Define atom economy (Chemistry only)

A measure of the amount of desired product made by a reaction. Atom economy close to 100% indicates that most reactants have been converted into the desired product meaning the process is quite sustainable.



How can atom economy be calculated?
(Chemistry only)



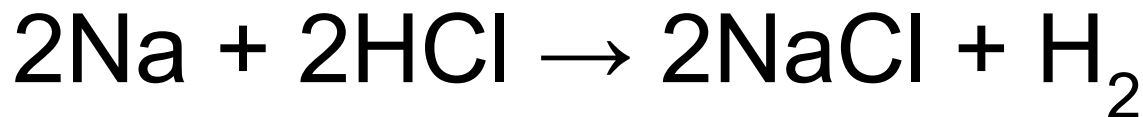
How can atom economy be calculated? (Chemistry only)

Atom economy =

$$\frac{\text{Mass of atoms in desired product} \times 100}{\text{Total mass of atoms in reactants}}$$



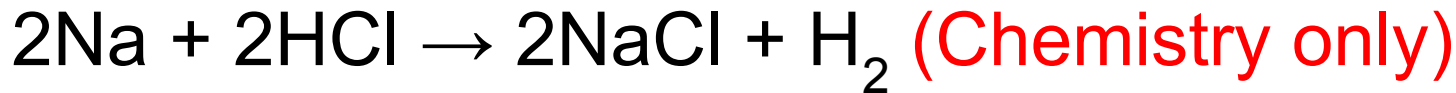
Calculate the atom economy of producing sodium chloride using the reaction below:



(Chemistry only)



Calculate the atom economy of producing sodium chloride using the reaction below:



Relative formula mass of NaCl = $23 + 35.5 = 58.5$

Relative formula mass of reactants: $23 + (1 + 35.5) = 59.5$

Atom economy = $(58.5 \div 59.5) \times 100 = 98.3\%$



Which factors affect the reaction
pathway chosen?
(Chemistry only) (Higher only)



Which factors affect the reaction pathway chosen? (Chemistry only) (Higher only)

- Percentage yield
- Rate of reaction
- Atom economy
- Position of equilibrium
- Usefulness of by-products



What factors affect the sustainability of a process?

(Chemistry only) (Higher only)



What factors affect the sustainability of a process? (Chemistry only) (Higher only)

- Renewable/non-renewable raw materials
- Impact on other uses of the raw material
- By-products (type and amount)
- Waste
- Energy use



Can fertilisers be made from by-products
or waste products of other processes?
(Chemistry only)



Can fertilisers be made from by-products or waste products of other processes? (Chemistry only)

Yes



What do process flow charts show? (Chemistry only)



What do process flow charts show? (Chemistry only)

Information about industrial processes, such as:

- Raw materials
- Production stages
- Products
- By-products and waste



Which two ammonium salts can be used as fertilisers? How are they made?
(Chemistry only)



Which two ammonium salts can be used as fertilisers? How are they made? (Chemistry only)

- Ammonium nitrate - react ammonia with nitric acid
- Ammonium sulfate - react ammonia with sulfuric acid



Fill in the blanks: 'Lab processes make ammonia in _____ while industrial processes are usually _____'
(Chemistry only)



Fill in the blanks: 'Lab processes make ammonia in _____ while industrial processes are usually _____'

(Chemistry only)

Batches

Continuous



Compare how ammonium sulfate is
made in the lab to the industrial process
(Chemistry only)



Compare how ammonium sulfate is made in the lab to the industrial process (Chemistry only)

Laboratory	Industry
Reactants are dilute ammonia and dilute sulfuric acid	Several stages are required to produce reactants (ammonia and sulfuric acid) from raw materials
Uses titration and crystallisation to obtain the salt	Titration not used
Small amount of product made	Large amount of product made
Batch process	Continuous process

