# Science 1.5 AS 90944

GZ Science Resources

Demonstrate understanding of aspects of acids and bases

# WORKBOOK

## Working to Excellence & NCEA Questions

CONTENTS



All NCEA answers can be found on S1.5 ppt

GZ Science Resources

# NCEA Questions for Electron Configuration (Part ONE)

2012: 1a: Complete the table below for ions formed by Ca, F, and Cl.

| | Atomic Number | Electron arrangement of atom | Electron arrangement of ion | Ion symbol |
|---|---|---|---|---|
| Ca | 20 | | | |
| F | 9 | | | |
| Cl | 17 | | | |

2012: 1b: Explain the charges on ALL three ions, in terms of electron arrangement and number of protons. Use their positions on the periodic table to explain why two of the atoms form ions with the same charge, AND two of the atoms form ions with the same electron arrangement.

2013: 1a: $F^-$, Ne, and $Mg^{2+}$ have the same electron arrangement. (a) Complete the table below.

| | Atomic Number | Number of protons | Number of electrons | Electron arrangement |
|---|---|---|---|---|
| $F^-$ | 9 | | | |
| Ne | 10 | | | |
| $Mg^{2+}$ | 12 | | | |

2013: 1b: Compare the atomic structure of $F^-$, Ne, and $Mg^{2+}$.
In your answer you should:
• describe the difference between an atom and an ion
• explain the charges on $F^-$, Ne, and $Mg^{2+}$ in terms of electron arrangement and number of protons
• relate the position of $F^-$, Ne, and $Mg^{2+}$ on the periodic table to the charges and electron arrangement
• explain why all three have the same electron arrangement.

2014: 1b: Complete the table below for the ions formed by magnesium, aluminium, and oxygen.

| | Atomic Number | Electron arrangement of atom | Electron arrangement of ion | Charge on ion |
|---|---|---|---|---|
| Mg | 12 | | | |
| Al | 13 | | | |
| O | 8 | | | |

# NCEA Questions for Electron Configuration (Part TWO)

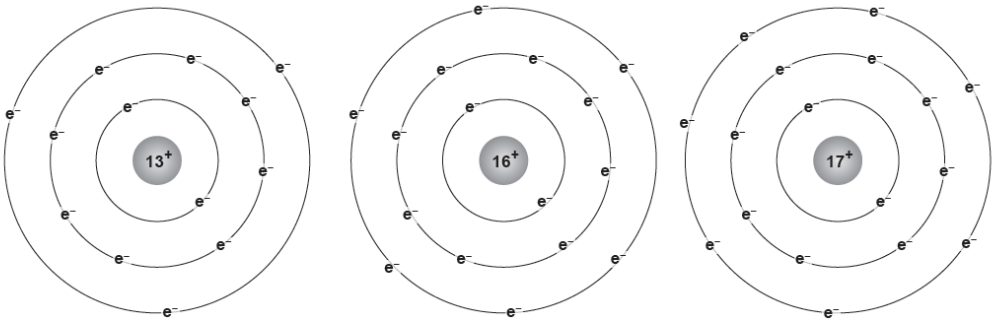
2015: 2a: Each of these atoms can form ions, as listed below.

• Explain why each of the ions has the charge it does, in terms of electron arrangement and number of protons.

• Ions are charged atoms. Explain how each of the ions below reached the charge shown.

You should discuss particles gained or lost by the atoms involved, and the reasons for this.

Aluminium ion, $Al^{3+}$: Sulfide ion, $S^{2-}$ : Chloride ion, $Cl^{-}$ :




Aluminium Sulfur Chlorine

2016: 1a: Complete the table below.

| Element | Atomic Number | Electron arrangement of atom | Electron arrangement of ion |
|---|---|---|---|
| F | 9 | | |
| S | 16 | | |
| Ca | 20 | | |

2016: 1c (i) : Sodium burns in oxygen gas, $O_2$, to form sodium oxide, $Na_2O$.

(i) Explain how the Na and O atoms form $Na^+$ and $O^{2-}$ ions, in terms of their groups in the periodic table, electron arrangement, AND number of protons.

2017: 2a: Sodium and potassium are both highly reactive metals that react with oxygen gas. However, sodium and potassium do not react with each other.

(a) Why do sodium and potassium each react with oxygen, but not with each other?

In your answer you should:

• refer to the electron arrangements of each of the three atoms and three ions involved

• explain how the electron arrangement of each of the three atoms relates to its position in the periodic table

• explain how an ionic bond forms when sodium or potassium reacts with oxygen.

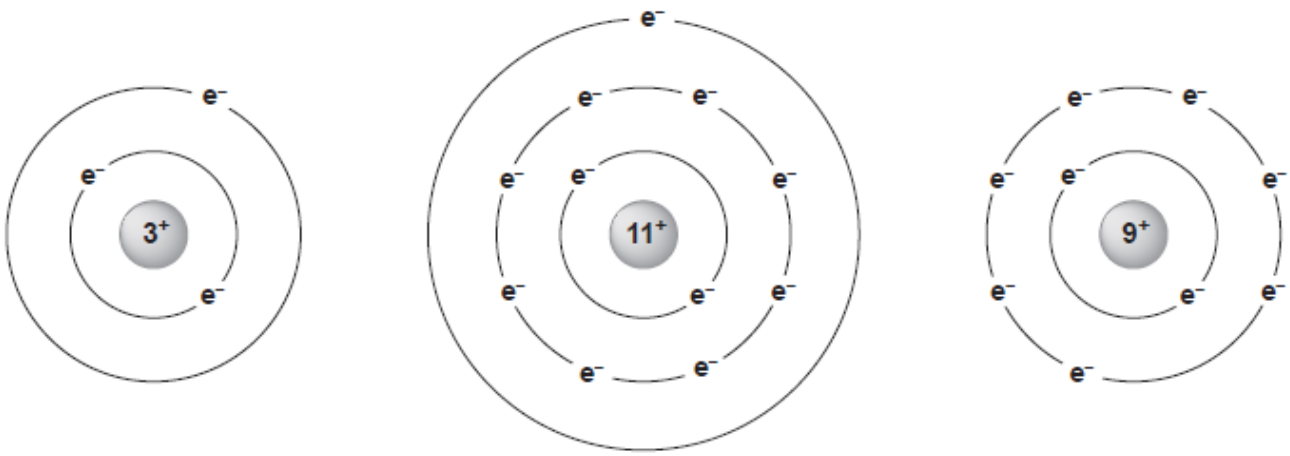
# NCEA Questions for Electron Configuration (Part THREE)

2017: 2a: Sodium and potassium are both highly reactive metals that react with oxygen gas. However, sodium and potassium do not react with each other.
(a) Why do sodium and potassium each react with oxygen, but not with each other?
In your answer you should:
• refer to the electron arrangements of each of the three atoms and three ions involved
• explain how the electron arrangement of each of the three atoms relates to its position in the periodic table
• explain how an ionic bond forms when sodium or potassium
reacts with oxygen.

2017: 2a: Sodium and potassium are both highly reactive metals that react with oxygen gas. However, sodium and potassium do not react with each other.
(a) Why do sodium and potassium each react with oxygen, but not with each other?

2018: 2a: Sodium and potassium are both highly reactive metals that react with oxygen gas. However, sodium and potassium do not react with each other.

(a) Why do sodium and potassium each react with oxygen, but not with each other?




Lithium Sodium Fluorine

(b) Sodium and fluorine form ions that both have the same electron arrangement.
How can sodium and fluoride ions have the same electron arrangement but different charges?
In your answer you should refer to the number of protons, charge, and electron arrangement of the two atoms and ions.

(c) Magnesium fluoride has the formula $MgF_2$.
Explain how the ratio of ions in the formula is linked to the charge on the ions.
In your answer you should include the number of electrons gained or lost by each atom as it forms the ionic compound.
*A diagram may assist your answer.*

# Writing Excellence answers to Ion formation questions

| ION FORMATION QUESTION |
|---|
| **Question:** Compare the atomic structure of $F^-$ and $Mg^{2+}$.<br>In your answer you should:<br>• describe the difference between an atom and an ion<br>• explain the charges on $F^-$ and $Mg^{2+}$ in terms of electron arrangement and number of protons<br>• relate the position of $F^-$and $Mg^{2+}$ on the periodic table to the charges and electron arrangement<br>• explain why they both have the same electron arrangement. |

| ANSWER | |
|---|---|
| 1. fluorine number of **protons,** and therefore **electrons** | |
| 2. draw/write fluorine **atom** electron configuration | |
| 3. magnesium number of **protons,** and therefore **electrons** | |
| 4. draw/write magnesium **atom** electron configuration | |
| 5. number of electrons **lost or gained** for fluorine to have stable full outer shell | |
| 6. **group number** of fluorine and number of **outer shell** electrons | |
| 7. draw/write fluorine **ion** electron configuration | |
| 8. number of **protons** and **electrons** in fluorine ion and **charge** of fluorine ion | |
| 9. number of electrons **lost or gained** for magnesium to have stable full outer shell | |
| 10. **group number** of magnesium and number of **outer shell** electrons | |
| 11. draw/write magnesium **ion** electron configuration | |
| 12. number of **protons** and **electrons** in magnesium ion and **charge** of magnesium ion | |
| **13. complete final statement** | Both have the same electron arrangement as they have either _____ or _____electrons. The electron arrangement is _____as this is the nearest possible _____ electron arrangement for both. |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# NCEA Questions for Ionic Compounds

2014: 1a: Write the formulae for the following ionic compounds.
(i) Calcium chloride
(ii) Sodium nitrate
(iii) Zinc nitrate

2014: 1c: The formula for magnesium oxide is MgO. The formula for aluminium oxide is $Al_2O_3$.Explain why the two formulae are different. In your answer:
• consider the ratio of ions in each formula and explain how the ratio is related to the charge on the ions
• relate the ratio of ions in the formula to the number of electrons lost or gained by each atom..

2015: 2c: Determine the ionic formulae of the compound that forms when aluminium combines with chlorine, AND when aluminium combines with sulfur.
In your answer you should:
• consider the ratio of ions in each formula, and explain how the ratio is related to the charge on the ions
• relate the ratio of ions in each formula to the number of electrons lost or gained by each atom when forming ions.

2016: 1b: Write the formulae for the following ionic compounds.
(i) Silver fluoride
(ii) Potassium sulfate
(iii) Calcium nitrate

2016: 1c (ii): Justify the ratio of $Na^+$ and $O^{2-}$ ions in the formula $Na_2O$, in terms of the electrons lost or gained, and the charge on each ion.
Include an explanation of the type of bonding between the $Na^+$ and $O^{2-}$ ions.

2017: 3a: (i) Explain why silver oxide, $Ag_2O$, has a 2:1 ratio of ions.
In your answer you should:
• relate the ratio of ions to the number of electrons lost or gained by each atom when forming ions
• explain how the ratio of the ions in the compound is related to the charge on the ions.

# Writing Excellence answers to Ionic Compound questions

| IONIC COMPOUND QUESTION |
|---|
| **Question:** The formula for magnesium oxide is MgO. The formula for aluminium oxide is $Al_2O_3$.Explain why the two formulae are different.<br>In your answer:<br>• consider the ratio of ions in each formula and explain how the ratio is related to the charge on the ions<br>• relate the ratio of ions in the formula to the number of electrons lost or gained by each atom. |

| | ANSWER |
|---|---|
| 1. **charge** of magnesium ion and oxide ion (write sentence) | |
| 2. number of electrons lost or gained by **magnesium** to form the ion to have a stable full outer shell (write sentence) | |
| 3. number of electrons lost or gained by **oxygen** to form the ion to have a stable full outer shell (write sentence) | |
| 4. write balanced **formula** for magnesium oxide | |
| 5. **ratio** of magnesium to oxide ions to form neutral compound and cancel out charges (write sentence) | |
| 6. **charge** of aluminium ion and oxide ion (write sentence) | |
| 7. number of electrons lost or gained by **aluminium** to form the ion to have a stable full outer shell (write sentence) | |
| 8. number of electrons lost or gained by **oxygen** to form the ion to have a stable full outer shell (write sentence) | |
| 9. write balanced **formula** for aluminium oxide | |
| 10. **ratio** of aluminium to oxide ions to form neutral compound and cancel out charges (write sentence) | |
| **11. complete final statement** | An ionic compound has no overall _____, therefore the charges in the ions in the compounds must _____ out |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# Writing Excellence answers to pH, Universal indicator and ions questions

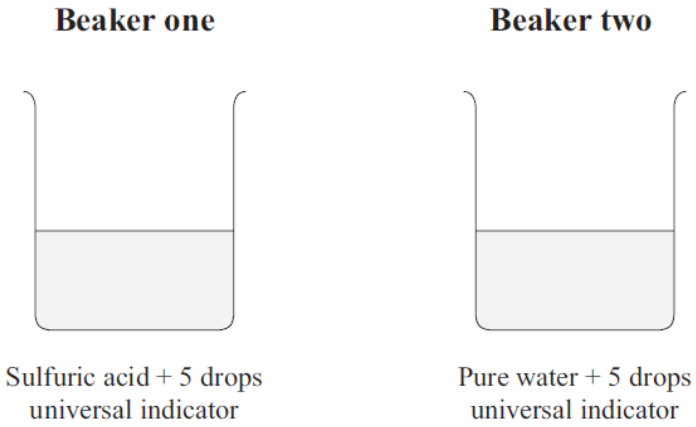
| pH, Universal Indicator and ions QUESTION | |
|---|---|
| **Question:** A beaker contains sodium hydroxide solution and 5 drops of universal indicator. Sulfuric acid was added to the beaker until no more changes were observed.<br><br>Describe how the **indicator colour** changes as the sulfuric acid is added to the beaker, AND explain what this tells you about the changing pH of this solution.<br><br>Explain the relationship between the changing **pH** of the solution and the **ions** in the solution as the sulfuric acid is added to the beaker.<br><br>Explain the advantages of using **universal indicator** compared to **litmus paper.** | |
| **ANSWER** | |
| 1. state the overall reaction that is occurring naming the acid and base and the product formed. | |
| 2. compare the colour and relative concentration of **$H^+$ and $OH^-$ ions** in beaker at the start and link to pH | **Step 1:** |
| 3. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added. | **Step 2:** |
| 4. describe the colour change, pH and concentration of $H^+/OH^-$ ions as yet more acid added to form a **neutral solution** | **Step 3:** |
| 5. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added **past neutral** | **Step 4:** |
| 6. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added to make a **strong acid solution** | **Step 5:** |
| 7. describe the colour changes of **litmus** (red and blue) linked to acid, base or neutral | |
| 8. describe the colour changes of **Universal indicator** linked to pH | |
| **9. complete final statement** | Universal Indicator tells us more information about a solutions pH than_____ and tells us **how** acidic, basic a solution is or if it is _____.<br>Litmus is _____as it only tells us if it is acid, basic, or neutral whereas Universal Indicator tells us how acidic or basic it is. |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# NCEA Questions for Ions, pH and Indicators (Part ONE)

2012: 3. Beaker one contains sulfuric acid solution and 5 drops of universal indicator. Beaker two contains pure water and 5 drops of universal indicator. Sodium hydroxide solution was added to both beakers until no more changes were observed.

(b) What is the colour of universal indicator in each solution at the start?
(c) Describe the colour changes as sodium hydroxide solution is added to each beaker, AND explain what this tells you about the changing pH of each solution.
(d) Explain the relationship between the pH of the solutions and the ions in the solutions, as the sodium hydroxide is added to each of the beakers.




2013: 2: Potassium hydroxide (KOH) was added to a solution of sulfuric acid containing universal indicator until no further change was observed.

The experiment was repeated, but a piece of red litmus paper and a piece of blue litmus paper were each dipped into the solution after each 5 mL of potassium hydroxide was added.
The results of the experiments are shown in the table below.

| Volume of KOH added (mL) | Colour of solution with universal indicator | Colour of red litmus paper | Colour of blue litmus paper |
|---|---|---|---|
| 0 | red | Stays red | Turns red |
| 5 | Orange-yellow | Stays red | Turns red |
| 10 | green | Stays red | Stays blue |
| 15 | blue | Turns blue | Stays blue |
| 20 | purple | Turns blue | Stays blue |

2a: Write a word equation AND a balanced symbol equation for the reaction between sulfuric acid and potassium hydroxide.
2b: Discuss what happened in this reaction as the potassium hydroxide was added to the sulfuric acid.
• relate the colours of the solution observed to the acidity and pH of the solution
• explain why the different colours of the solution were produced AND link these colours to the ions present during the reaction.
• explain the advantages of using universal indicator compared to litmus paper.

# NCEA Questions for Ions, pH and Indicators (Part TWO)

2014: 3a: A student has three unlabelled beakers each containing a colourless liquid. One contains water, one contains a solution of baking soda (sodium hydrogen carbonate), and one contains white vinegar (a solution of ethanoic acid).

To work out which liquid is which, the student put a drop from each beaker onto a piece of blue litmus paper and a piece of red litmus paper. She then added universal indicator to each beaker. The following results were obtained below.
Complete the last column of the table above to identify the three liquids.

| | Colour of blue litmus paper | Colour of red litmus paper | Colour with universal indicator | Name of liquid |
|---|---|---|---|---|
| **Beaker 1** | stays blue | stays red | turns green | |
| **Beaker 2** | turns red | stays red | turns orange | |
| **Beaker 3** | stays blue | turns blue | turns blue | |

2014: 3b: Use the information in the table to show how each of the liquids can be identified.
In your answer you should: • use all of the observations for each beaker
• state the approximate pH from the colour of the universal indicator.

2014: 3c: A student was given two beakers (Beaker 4 and Beaker 5) each containing different liquids. The liquid in Beaker 4 had a pH of 1. The liquid in Beaker 5 had a pH of 6.
Discuss which liquid is more acidic and how you know this.
In your answer you should: • use the pH to determine which liquid is more acidic
• compare the amount of hydrogen ions AND hydroxide ions in Beaker 4 (pH 1) with the amount of hydrogen ions AND hydroxide ions in Beaker 5 (pH 6).

2014: 4: A beaker contains sodium hydroxide solution and 5 drops of universal indicator. Sulfuric acid was added to the beaker until no more changes were observed.
(b) Describe how the indicator colour changes as the sulfuric acid is added to the beaker, AND explain what this tells you about the changing pH of this solution.
(c) Explain the relationship between the changing pH of the solution and the ions in the solution as the sulfuric acid is added to the beaker.

# NCEA Questions for Ions, pH and Indicators (Part THREE)

2015: 3a: The chemical equation below represents the reaction between hydrochloric acid and sodium hydroxide: $HCl + NaOH \rightarrow NaCl + H_2O$

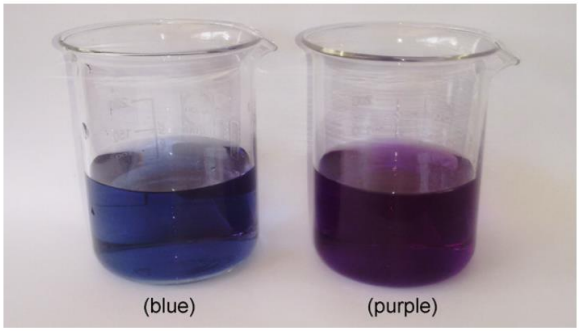
Complete the table below to show the approximate pH for each of the three solutions.

| | **Colour when UI is added** | **pH** |
|---|---|---|
| **HCl** | red | |
| **NaOH** | purple | |
| **$H_2O$** | green | |

2015: 3b: Water is formed in the reaction above. Explain what ions form water in this reaction, and where they come from. $HCl + NaOH \rightarrow NaCl + H_2O$

2015: 3c: NaOH is gradually added to a solution of HCl with universal indicator present, until no further colour change occurs. Discuss what is occurring in the beaker at each of the pH's shown, as the NaOH is added.
In your answer you should refer to:
• the colours that would occur at each pH
• the relative amounts of hydrogen and hydroxide present at each of the pH's shown.
pH = 1 (before any NaOH is added): pH = 4, pH = 7, pH = 10, pH = 13

2016: 3a: A student added universal indicator to the solutions in two beakers as shown below. Explain why the solutions are different colours.



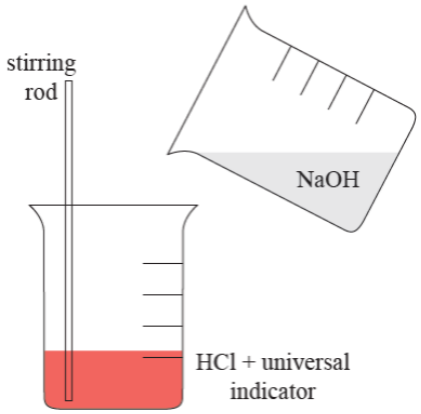

Beaker 1 Potassium carbonate | Beaker 2 Potassium hydroxide

2016: 3c: Explain what will happen to the indicator colour in Beaker 2 (potassium hydroxide) as the hydrochloric acid is added.

Relate this to the changing pH, the ions present in the beaker, and the type of reaction occurring.

# NCEA Questions for Ions, pH and Indicators (Part FOUR)

2017: 3b: A solution of sodium hydroxide (NaOH) is slowly stirred into a beaker of hydrochloric acid (HCl) with universal indicator added. The HCl and universal indicator solution starts out red.
Explain the changes in the colour of the universal indicator as the sodium hydroxide solution is slowly added until no further colour changes occur.
In your answer, you should:
• relate the changes in the colour of the universal indicator to the approximate pH of the solution
• link the pH to the relative concentrations of hydrogen ions and hydroxide ions in solution
• explain the neutralisation reaction occurring.




2018: 2c: A solution of potassium hydroxide is placed in a beaker. Universal indicator is added to it. The solution is purple, as shown in the diagram below.

Sulfuric acid is slowly added to the beaker until no more colour changes are seen.

Explain in detail what happens to the colour of the solution while the sulfuric acid is being added to the potassium hydroxide.

Link your answer to the concentration of ions and the changing pH of the solution.

# Writing Excellence answers to Acid Base Reaction questions

## Reaction Rates Factors QUESTION

**Question: 2b:** Three unlabelled colourless solutions are known to be:
- nitric acid ($HNO_3$)
- sodium chloride (NaCl)
- sodium hydrogen carbonate ($NaHCO_3$).

How could each of these unlabelled solutions be identified using only **potassium carbonate ($K_2CO_3$)** solution, and **red litmus paper**?
In your answer you should:
- complete the table
- explain how the observations allow you to identify each solution
- include balanced symbol equation(s) for any reactions.

## ANSWER

1. Complete table

| Unlabelled solution | Observation (if any) with red litmus paper | Observation (if any) with potassium carbonate ($K_2CO_3$) |
|---|---|---|
| Nitric acid ($HNO_3$) | | |
| Sodium chloride (NaCl) | | |
| Sodium hydrogen carbonate ($NaHCO_3$) | | |

2. Describe **steps** to testing solutions with red litmus paper

3. describe **observations** of acids and/or neutral solutions

4. link **observations** to base solution

5. Describe **steps** to testing solutions with potassium carbonate

6. link **observations** to acid solution
.

7. write balanced equation for the acid base reaction

8. link **observations** to neutral solution

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# NCEA Questions for Acid Base Reactions (Part ONE)

2012: 2a: A student wanted to make the neutral salt, sodium nitrate.

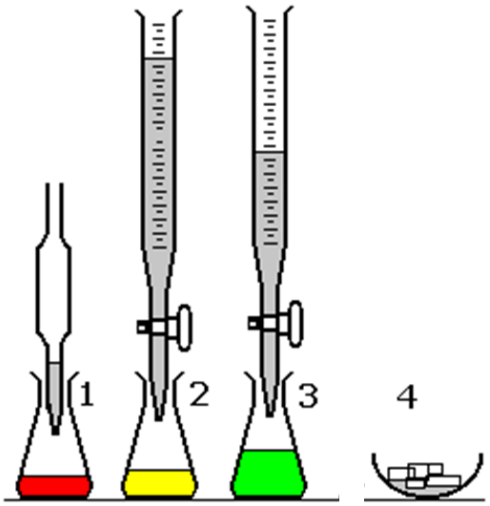
Explain how to make sodium nitrate by mixing sodium carbonate and nitric acid solutions using school laboratory equipment. Explain how litmus paper could be used during the process described to show the salt being produced is neutral.

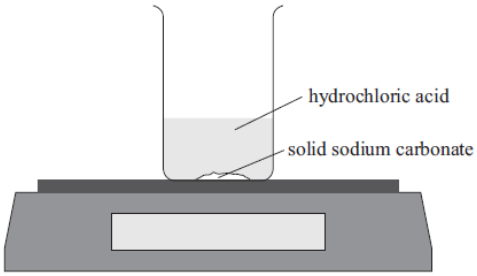
2012: 2c: Write a word equation AND a balanced symbol equation for the reaction between sodium carbonate and nitric acid.

2012: 3a: Write a word equation AND a balanced symbol equation for the reaction between sulfuric acid and sodium hydroxide.

2013: 2a: Write a word equation AND a balanced symbol equation for the reaction between sulfuric acid and potassium hydroxide.

2013: 4b: Experiment One
A student carried out an experiment in the lab using the following method:
Step one: Universal indicator was added to a solution of hydrochloric acid in a beaker.
Step two/three: Calcium hydroxide was added slowly until the solution turned yellow then green.
Step four: The contents of the beaker were then poured into an evaporating dish and left in a sunny place for several days.
Explain the purpose of each step in the method and how the




Experiment Two
In another experiment the following method was used:
Step one: A beaker was placed on a balance as shown in the diagram below.
Step two: Hydrochloric acid was added to solid sodium carbonate in the beaker.
Step three: The mass was recorded over time.

Write a word equation AND a balanced symbol equation for the reaction between hydrochloric acid and sodium carbonate.

2013: 4d. Experiment Two
Explain why the mass of the beaker and contents would decrease over time.
In your answer you should:
• state any other observations that would be made as hydrochloric acid reacts with the sodium carbonate
• explain how the products formed by the reaction lead to the decrease in mass of the beaker and contents.

# NCEA Questions for Acid Base Reactions (Part TWO)

2014: 2c: Write a word equation AND a balanced symbol equation for the reaction between calcium carbonate and hydrochloric acid.

2014: 4a: A beaker contains sodium hydroxide solution and 5 drops of universal indicator.
Sulfuric acid was added to the beaker until no more changes were observed. Write a word equation AND a balanced symbol equation for the reaction between sulphuric acid and sodium hydroxide.

2015: 1c: Write a word equation AND a balanced symbol equation for the reaction between nitric acid and calcium carbonate.

2015: 3d: In a different chemical reaction, hydrochloric acid reacts with magnesium hydroxide.
Write a word equation and a balanced chemical equation for this reaction in the boxes below.

2016: 1d: Write a word equation AND a balanced symbol equation for the reaction between sodium hydroxide and sulfuric acid.

2016: 3b: Write a word equation AND a balanced symbol equation for the reaction between hydrochloric acid and potassium carbonate in Beaker 1.

2017: 1d: Write a word equation AND a balanced symbol equation for the reaction between sodium hydrogen carbonate ($NaHCO_3$) and sulfuric acid ($H_2SO_4$).

2017: 2b: Three unlabelled colourless solutions are known to be: • nitric acid ($HNO_3$) • sodium chloride (NaCl) • sodium hydrogen carbonate ($NaHCO_3$).
How could each of these unlabelled solutions be identified using only potassium carbonate ($K_2CO_3$) solution, and red litmus paper?
In your answer you should: • complete the table • explain how the observations allow you to identify each solution • include balanced symbol equation(s) for any reactions.

| Unlabelled solution | Observation (if any) with red litmus paper | Observation (if any) with potassium carbonate ($K_2CO_3$) |
|---|---|---|
| Nitric acid ($HNO_3$) | | |
| Sodium chloride (NaCl) | | |
| Sodium hydrogen carbonate ($NaHCO_3$) | | |

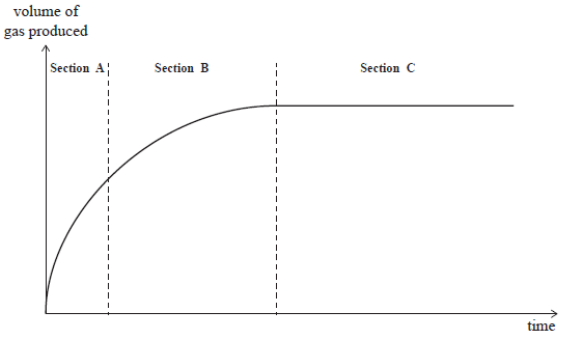
2017: 3a: (ii) Silver oxide is a base and will react with hydrochloric acid.
Write a word equation AND a balanced symbol equation for the reaction between silver oxide and hydrochloric acid.

2018: 2: Solutions of potassium hydroxide, KOH, and sulfuric acid, $H_2SO_4$, are added together in a beaker.
(a) Name the type of reaction occurring.
(b) Write the word equation and the balanced symbol equation for this reaction.
2018: 3a: Some magnesium carbonate powder is added to dilute nitric acid in an open conical flask. The flask is on an electronic balance, as shown in the illustration.

Write the word equation AND the balanced symbol equation for the reaction between the nitric acid and magnesium carbonate.

# Writing Excellence answers to Reaction Rate Graphs questions

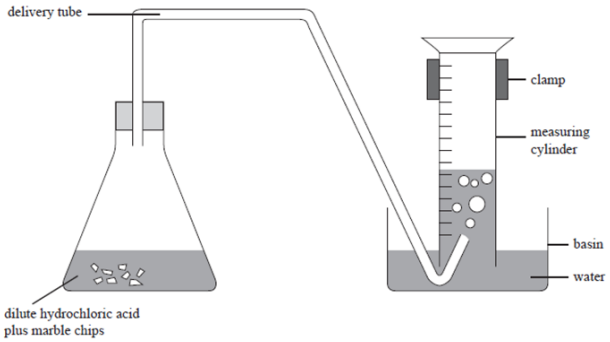
| Reaction Rate Graphs QUESTION |
|---|
| **Question:** The reaction between calcium carbonate and nitric acid is carried out at 20°C and 50 °C. The mass and size of the marble chips, and the concentration and volume of nitric acid used **were kept the same.**<br>(i) Draw a line on the graph that represents the reaction at 20°C (the line for 50 °C has already been drawn)<br>(ii) Explain why you drew this line where you did, and explain if this means that the rate of reaction is slower, the same, or faster.<br>In your answer you should<br>• discuss why you drew your line with the slope that you did, and why you stopped the line at the point that you did<br>• explain the effect of temperature on reaction rate, in terms of particle collisions. |

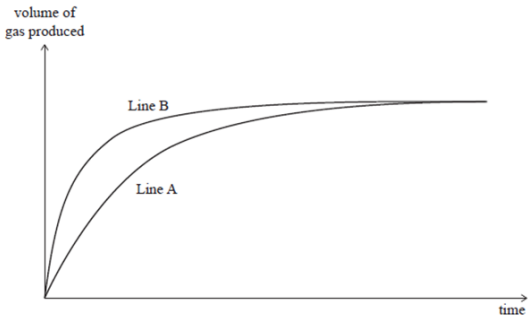
| | ANSWER |
|---|---|
| 1. Draw the line for the reaction at 20°C (use another colour) |  |
| 2. **link the slope of the graph** to a faster or slower reaction. | |
| 3. **link the line** stopping (zero gradient) to all of the reactants being used up and changed to products. | |
| 4. link the **same amount of products** made to the initial concentration/ amount of products in both cases | |
| 5. State whether the higher temperature causes a faster or slower **reaction rate** | |
| 6. link the temperature of the particles to more or less **kinetic energy** and more or less **speed**. | |
| 7. state that particles need to collide with enough energy (to overcome activation energy) to be a **successful collision**, and therefore a reaction occurs | |
| 8. link faster moving particles to more **successful, frequent** (or per unit of time) collisions | |
| 9. link more frequent successful collisions to a **faster reaction rate** | |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# NCEA Questions for Reaction Rate Graphs (Part ONE)

2012: 4a: The following experiment was carried out at 20°C and then repeated at 40°C.
Marble chips (calcium carbonate) were added to hydrochloric acid in a conical flask. The mass and size of marble chips, and the concentration and volume of hydrochloric acid used, were the same for both experiments. The flask was connected to an inverted measuring cylinder in a basin of water, as shown in the diagram below. The volume of gas produced at the two different temperatures was measured for a few minutes and the results were used to sketch the graph shown below.



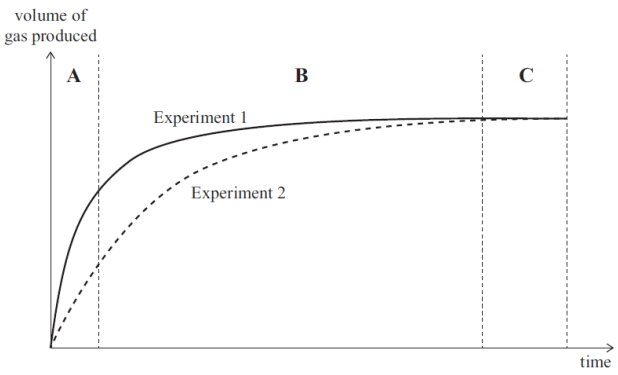




4a: State which line on the graph above represents the reaction at 40°C and explain how you worked this out.
In your answer you should: • identify which line represents the reaction at 40°C • explain why the line you have identified is the reaction at 40°C • give reasons for the different rates of reaction in terms of particles
• explain why both lines end up horizontal.

2013: 3a: The table below shows the size of marble chips (calcium carbonate) used in a chemical investigation into factors affecting rate of reaction.

| Experiment | Size of marble chips (calcium carbonate) |
|---|---|
| Experiment 1 | small marble chips |
| Experiment 2 | large marble chips |

Experiment 1: 10 mL of hydrochloric acid was added to a boiling tube containing small marble chips.
Experiment 2: 10 mL of hydrochloric acid of the same concentration as in Experiment 1 was added to another boiling tube containing large marble chips.
In both experiments the total mass of the marble chips was the same. The boiling tubes were connected to an inverted measuring cylinder in a basin of water (see above)




3a: The graph beside shows the results for the volume of gas produced over a period of time.

State what factor affecting the rate of reaction is being investigated in this experiment.

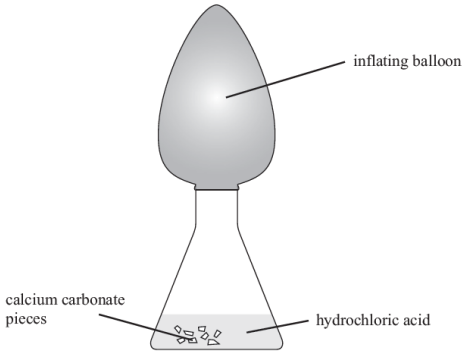
3b: Explain what is happening in Experiment 1 in sections A, B, and C of the graph in terms of reaction rate.

In your answer you should refer to particle collisions.

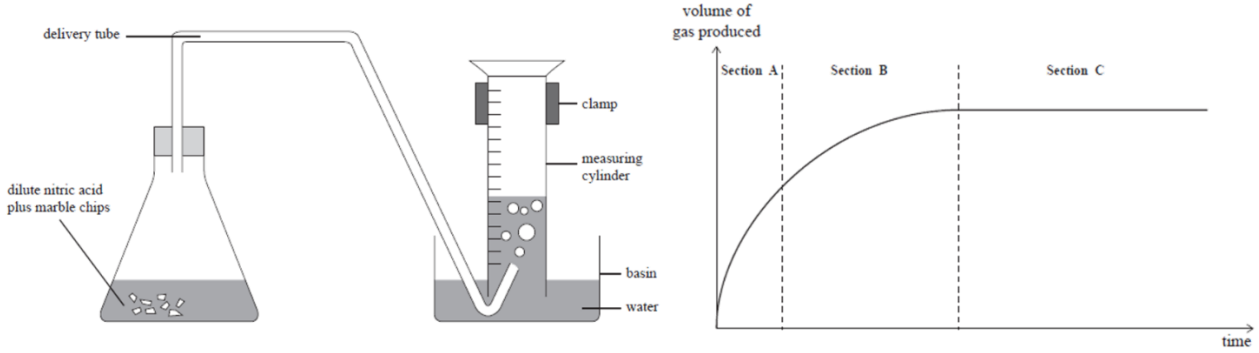
# NCEA Questions for Reaction Rate Graphs (Part ONE)

2014: 2a (i): Calcium carbonate pieces are placed in a flask and hydrochloric acid is added. Immediately a balloon is placed over the top of the flask. The balloon then starts to inflate.

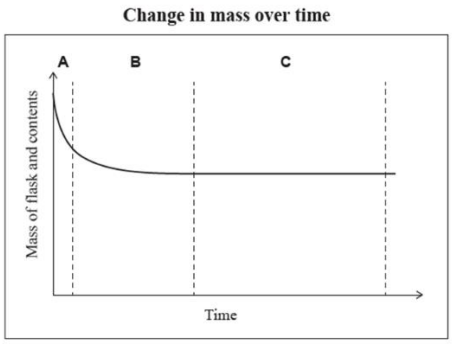
Explain why the balloon inflates.




2015: 1a: Marble chips (calcium carbonate) were added to nitric acid in a conical flask. The temperature of the acid was 50°C. The flask was connected to an inverted measuring cylinder in a basin of water to measure the volume of gas produced, as shown in the diagram beside. The graph beside shows the volume of gas produced against time.
Explain what is happening in terms of particle collisions and rate of reaction in each section of the graph.




2018: 3b: Some magnesium carbonate powder is added to dilute nitric acid in an open conical flask. The flask is on an electronic balance. The total mass of the flask and its contents is measured over time and recorded on the graph below. (i) Why does the mass of the flask and its contents decrease during the reaction?




2018: 3b: Some magnesium carbonate powder is added to dilute nitric acid in an open conical flask.
(ii) Explain what is happening in sections A, B, and C of the graph.
Link your answer to rates of reaction and particle collisions

# Writing Excellence answers to Reaction Rate Factors questions

| Reaction Rate Factors QUESTION |
|---|
| **Question: (i):** Identify the factor affecting the reaction rate being investigated in **Experiments 1 and 2**.<br>**(ii):** Explain how this factor affects the rate of reaction in the two flasks, with reference to particle collisions. Explain any observations, including changes in mass, over the course of **Experiments 1 and 2** until the reactions are finished.<br>**(iii)** Compare and contrast the rate of reaction of **Experiments 2 and 3**, with reference to particle collisions and the **concentration of hydrogen ions** in the solution. |

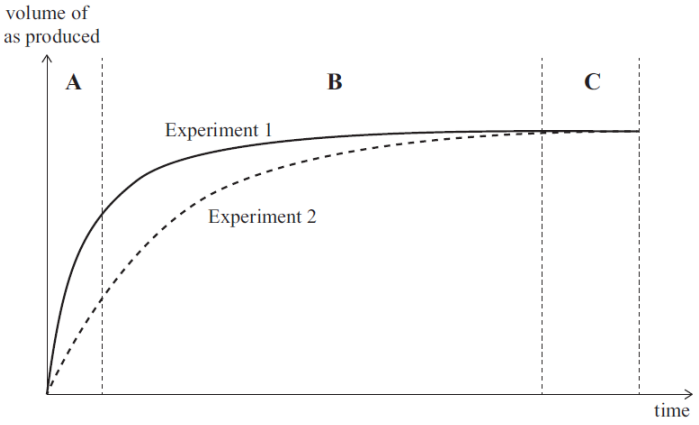
| | Calcium carbonate pieces | pH of acid |
|---|---|---|
| **Experiment 1** | Chips | 1 |
| **Experiment 2** | Powdered | 1 |
| **Experiment 3** | Powdered | 5 |

| ANSWER | |
|---|---|
| 1. Identify the **factor** (Either temperature, concentration or surface area) | |
| 2. **compare** the two experiments in terms of which mass decreases faster | |
| 3. **link** to gas production. | |
| 4. **link** factor to particle collision | |
| 5. **link** further to successful collisions and reaction rate | |
| 6. explain that both reactions will produce the **same amount of products** (name product), despite different reaction rates | |
| 7. **link** pH to ion amount ($H^+$), and which experiment has the greatest amount | |
| 8. **Link** ion ($H^+$) to factor for each experiment | |
| 9. **link** to frequency of successful collisions | |
| 10. **link** to reaction rate | |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# NCEA Questions for Reaction Rate Factors questions (Part ONE)

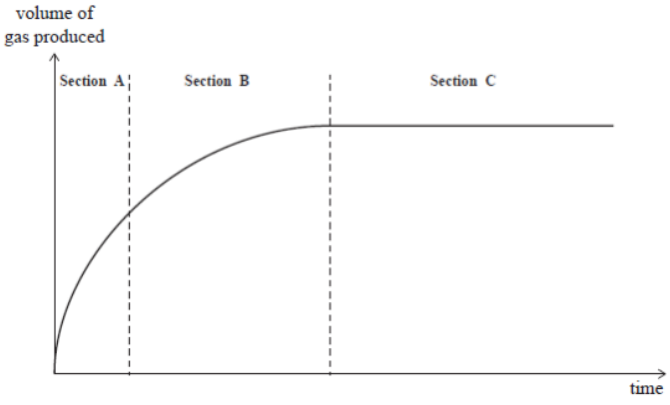
2013: 3c: Explain why Experiment 1 was faster than Experiment 2.
In your answer you should:
• explain how the graph shows that Experiment 1 is faster
• explain how the size of the marble chips affects the number of particle collisions.
Experiment 1: small marble chips.
Experiment 2: large marble chips.




2014: 2a (ii): In a second experiment, the same mass of calcium carbonate in a powdered form is used. Explain why the balloon inflates faster when powdered calcium carbonate is used. (compared to chips)

2014: 2b: Using the same chemical substances (calcium carbonate and hydrochloric acid), discuss a different way to make the balloon inflate faster.
In your answer you should refer to rates of reaction and particle collisions.

2015: 1b: The reaction was carried out again but this time at 20°C. The mass and size of the marble chips, and the concentration and volume of nitric acid used were kept the same.




(i) Draw a line on the graph that represents the reaction at 20°C.
(ii) Explain why you drew this line where you did, and explain if this means that the rate of reaction is slower, the same, or faster.
In your answer you should
• discuss why you drew your line with the slope that you did, and why you stopped the line at the point that you did
• explain the effect of temperature on reaction rate, in terms of particle collisions.

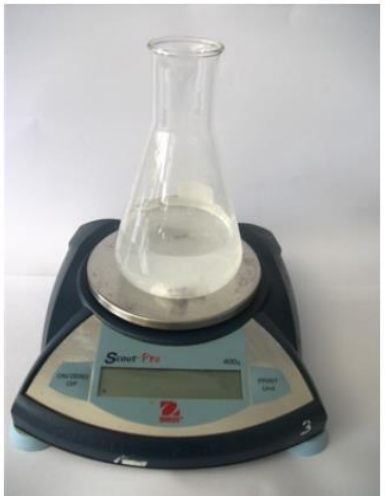
2016: 2a: A sample of calcium carbonate is added to dilute hydrochloric acid in an open conical flask. The total mass of the flask and contents is measured over time.
Three experiments are carried out at 25°C using the same mass of calcium carbonate, and the same volume of acid:
For each of the experiments reacting calcium carbonate and dilute acid together, the mass of the flask and its contents decreases over time.
Describe why this happens.

# NCEA Questions for Reaction Rate Factors questions (Part TWO)

2016: 2b (i): Identify the factor affecting the reaction rate being investigated in Experiments 1 and 2.

| | Calcium carbonate pieces | pH of acid |
|---|---|---|
| **Experiment 1** | Chips | 1 |
| **Experiment 2** | Powdered | 1 |
| **Experiment 3** | Powdered | 5 |

2b (ii): Explain how this factor affects the rate of reaction in the two flasks, with reference to particle collisions.
Explain any observations, including changes in mass, over the course of Experiments 1 and 2 until the reactions are finished.



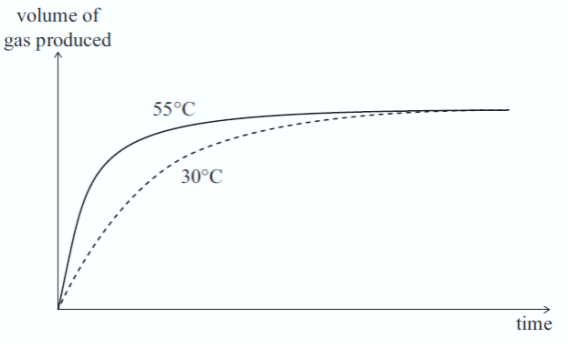
2c: Compare and contrast the rate of reaction of Experiments 2 and 3, with reference to particle collisions and the concentration of hydrogen ions in the solution.

2017: 1a: A sample of powdered sodium hydrogen carbonate ($NaHCO_3$) was added to sulfuric acid ($H_2SO_4$) in a flask, and fizzing was observed.
Two experiments were carried out with the acid at different temperatures, using the same amount of powdered sodium hydrogen carbonate and the same concentration and volume of sulfuric acid:
What caused the fizzing?

| Experiment | Temperature of acid, °C |
|---|---|
| 1 | 30 |
| 2 | 55 |

1b: Why was the fizzing fastest immediately after the sodium hydrogen carbonate had been added? Your answer should refer to particle collisions.

1c: The rate of reaction for each experiment was found by measuring the volume of gas produced over time, as shown in the graph below. What is the effect of increasing temperature on the rate of reaction?
Your answer should refer to particle collisions and explain why both lines finish at the same point.




2018: 3c: Explain how increasing the temperature will make the reaction between magnesium carbonate and nitric acid faster.

Link your answer to rates of reaction and particle collisions.

# ANSWERS: Writing Excellence answers to Ion formation questions

| ION FORMATION QUESTION |
|---|
| **Question:** Compare the atomic structure of $F^-$ and $Mg^{2+}$.<br>In your answer you should:<br>• describe the difference between an atom and an ion<br>• explain the charges on $F^-$ and $Mg^{2+}$ in terms of electron arrangement and number of protons<br>• relate the position of $F^-$ and $Mg^{2+}$ on the periodic table to the charges and electron arrangement<br>• explain why they both have the same electron arrangement. |

| ANSWER | |
|---|---|
| 1. fluorine number of **protons** | The Fluorine atom has 9 protons, and therefore 9 electrons |
| 2. Draw fluorine **atom** electron configuration | The configuration of the Fluorine atom is 2,7 |
| 3. magnesium number of **protons** | The Magnesium atom has 12 protons, and therefore 12 electrons |
| 4. draw magnesium **atom** electron configuration | The configuration of the Magnesium atom is 2,8,2 |
| 5. number of electrons **lost or gained** for fluorine to have stable full outer shell | Fluorine must gain 1 electron to have a stable full outer shell of electrons and form a $F^-$ ion |
| 6. **group number** of fluorine and number of **outer shell** electrons | Fluorine is in group 17 and therefore has 7 valence (outer shell) electrons |
| 7. draw fluorine **ion** electron configuration | The configuration of the fluorine ion becomes 2,8 |
| 8. number of **protons** and **electrons** in fluorine ion and **charge** of fluorine ion | The fluorine ion has 9 protons and 10 electrons so the overall charge of the ion becomes -1 |
| 9. number of electrons **lost or gained** for magnesium to have stable full outer shell | Magnesium must lose 2 electrons to have a stable full outer shell of electrons and form a $Mg^{2+}$ ion |
| 10. **group number** of magnesium and number of **outer shell** electrons | Magnesium is in group 2 and therefore has 2 valence (outer shell) electrons |
| 11. draw magnesium **ion** electron configuration | The configuration of the magnesium ion becomes 2,8 |
| 12. number of **protons** and **electrons** in magnesium ion and **charge** of magnesium ion | The magnesium ion has 12 protons and 10 electrons so the overall charge of the ion becomes +2 |
| **13. complete final statement** | Both have the same electron arrangement as they have either <u>gained</u> or <u>lost</u> electrons. The electron arrangement is <u>2, 8</u> as this is the nearest possible <u>stable</u> electron arrangement for both. |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# ANSWERS: Writing Excellence answers to Ionic Compound questions

| IONIC COMPOUND QUESTION |
|---|
| **Question:** The formula for magnesium oxide is MgO. The formula for aluminium oxide is $Al_2O_3$.Explain why the two formulae are different.<br>In your answer:<br>• consider the ratio of ions in each formula and explain how the ratio is related to the charge on the ions<br>• relate the ratio of ions in the formula to the number of electrons lost or gained by each atom. |

| ANSWER | |
|---|---|
| 1. **charge** of magnesium ion and oxide ion (write sentence) | The charge of the magnesium ion is $Mg^{2+}$ and the charge on the oxide ion is $O^{2-}$ |
| 2. number of electrons lost or gained by **magnesium** to form the ion to have a stable full outer shell (write sentence) | Magnesium must lose 2 electrons to form the $Mg^{2+}$ ion to form a stable full outer shell |
| 3. number of electrons lost or gained by **oxygen** to form the ion to have a stable full outer shell (write sentence) | Oxygen must gain 2 electrons to form the $O^{2-}$ ion (oxide) to form a stable full outer shell |
| 4. write balanced **formula** for magnesium oxide | The formula for magnesium oxide becomes MgO |
| 5. **ratio** of magnesium to oxide ions to form a neutral compound and cancel out charges (write sentence) | The ration of magnesium to oxide ions is 1:1 to form a neutral compound and cancel out the charges |
| 6. **charge** of aluminium ion and oxide ion (write sentence) | The charge of the aluminium ion is $Al^{3+}$ and the charge on the oxide ion is $O^{2-}$ |
| 7. number of electrons lost or gained by **aluminium** to form the ion to have a stable full outer shell (write sentence) | Aluminium must lose 3 electrons to form the $Al^{3+}$ ion to form a stable full outer shell |
| 8. number of electrons lost or gained by **oxygen** to form the ion to have a stable full outer shell (write sentence) | Oxygen must gain 2 electrons to form the $O^{2-}$ ion (oxide) to form a stable full outer shell |
| 9. write balanced **formula** for aluminium oxide | The formula for aluminium oxide becomes $Al_2O_3$ |
| 10. **ratio** of aluminium to oxide ions to form neutral compound and cancel out charges (write sentence) | The ration of aluminium to oxide ions is 2:3 to form a neutral compound and cancel out the charges |
| **11. complete final statement** | An ionic compound is neutral has no overall <u>charge</u> therefore the charges in the ions in the compounds must <u>cancel</u> out |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# ANSWERS: Writing Excellence answers to **pH, Universal indicator and ions** questions

| pH, Universal Indicator and ions QUESTION | |
|---|---|
| **Question:** A beaker contains sodium hydroxide solution and 5 drops of universal indicator. Sulfuric acid was added to the beaker until no more changes were observed.<br><br>Describe how the **indicator colour** changes as the sulfuric acid is added to the beaker, AND explain what this tells you about the changing pH of this solution.<br><br>Explain the relationship between the changing **pH** of the solution and the **ions** in the solution as the sulfuric acid is added to the beaker.<br><br>Explain the advantages of using **universal indicator** compared to **litmus paper.** | |
| **ANSWER** | |
| 1. state the overall reaction that is occurring naming the acid and base and the product formed. | When sulfuric acid is added to sodium hydroxide the solution turns from base to a neutral solution where a salt and water are made. When more sulfuric acid is added the solution will become more acidic. |
| 2. compare the colour and relative concentration of **$H^+$ and $OH^-$ ions** in beaker at the start and link to pH | **Step 1:** When no acid has been added, the solution is purple and has a pH of 12–14 and there is an excess of OH- ions and very few $H^+$ ions. This solution will be a strong base. |
| 3. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added. | **Step 2:** When a small amount of acid has been added, the solution is blue and has a pH of 8–11 and there is an still an excess of OH- ions, but less than when no acid was added and few $H^+$ ions. This solution will be a weak base |
| 4. describe the colour change, pH and concentration of $H^+/OH^-$ ions as yet more acid added to form a **neutral solution** | **Step 3:** When more acid has been added, the solution becomes neutral and is green and has a pH of 7, there will be an equal amount of OH- ions and $H^+$ ions. |
| 5. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added **past neutral** | **Step 4:** When more acid has been added, the solution will turn orange/yellow and has a pH of 6-3 and there is now an excess of H+ ions and less $OH^-$ ions than that. This solution will be a weak acid |
| 6. describe the colour change, pH range and concentration of $H^+/OH^-$ ions as more acid added to make a **strong acid solution** | **Step 5:** When even more acid has been added, the solution will turn red and has a pH of 1-2 and there is now a large excess of H+ ions and very few $OH^-$ ions. This solution will be a strong acid. |
| 7. describe the colour changes of **litmus** (red and blue) linked to acid, base or neutral | Litmus paper is useful to tell us if a solution is acidic, basic or neutral. (When blue litmus turns red and red litmus stays red, this tells us the solution is acidic. When both blue and red litmus papers stay the same, this tells us the solution is neutral. When red turns blue, this tells the solution is basic) |
| 8. describe the colour changes of **Universal indicator** linked to pH | Universal indicator has many different colours that not only tell us if a solution is acid, base or neutral but allows us to tell the pH of the solution |
| **9. complete final statement** | Universal Indicator tells us more information about a solutions pH than Litmus paper and tells us **how** acidic, basic a solution is or if it is neutral.<br>Litmus is limited as it only tells us if it is acid, basic, or neutral whereas Universal Indicator tells us how acidic or basic it is. |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# Writing Excellence answers to Acid Base Reaction questions

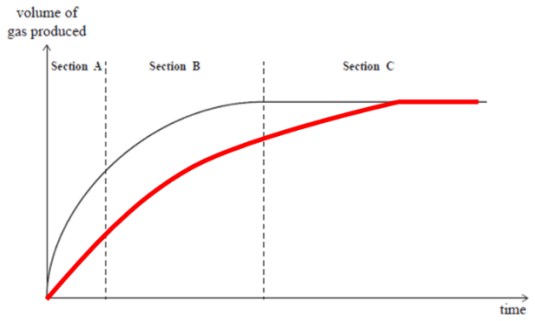
| Acid and Base Reactions QUESTION |
|---|
| **Question: 2b:** Three unlabelled colourless solutions are known to be:<br>• nitric acid ($HNO_3$)<br>• sodium chloride (NaCl)<br>• sodium hydrogen carbonate ($NaHCO_3$).<br>How could each of these unlabelled solutions be identified using only **potassium carbonate ($K_2CO_3$)** solution, and **red litmus paper**?<br>In your answer you should:<br>• complete the table<br>• explain how the observations allow you to identify each solution<br>• include balanced symbol equation(s) for any reactions. |

**ANSWER**

| | |
|---|---|
| 1. Complete table | http://www.nzqa.govt.nz<br>**Unlabelled solution** / **Observation (if any) with red litmus paper** / **Observation (if any) with potassium carbonate ($K_2CO_3$)**<br>Nitric acid ($HNO_3$) / Remain red / Bubbles of gas form/fizzes/heat<br>Sodium chloride (NaCl) / Remain red / No reaction<br>Sodium hydrogen carbonate ($NaHCO_3$) / Turn blue / No reaction |
| 2. Describe **steps** to testing solutions with red litmus paper | Prepare a test tube each filled with a sample (5mL) of the unknown substance.<br>Test each sample with dampened red litmus paper. |
| 3. describe **observations** of acids and/or neutral solutions | Observations of 2 samples will be for the red litmus paper to remain red – place those 2 samples to one side. |
| 4. link **observations** to base solution | 1 of the samples will turn the red litmus paper blue. This solution can be identified as sodium hydrogen carbonate as it is a base. |
| 5. Describe **steps** to testing solutions with potassium carbonate | With the remaining 2 samples add a small amount of potassium carbonate to both. |
| 6. link **observations** to acid solution<br>. | The sample that bubbles are observed to form will be nitric acid – as this is a neutralisation reaction between and acid and a base (the potassium carbonate) and the bubbles of gas will be carbon dioxide. |
| 7. write balanced equation for the acid base reaction | $2HNO_3 + K_2CO_3 \rightarrow 2KNO_3 + H_2O + CO_2$ |
| 8. link **observations** to neutral solution | The third test tube that does not react will be sodium chloride solution as this is neutral. |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# ANSWERS: Writing Excellence answers to Reaction Rate Graphs questions

| Reaction Rate Graphs QUESTION | |
|---|---|
| **Question:** The reaction between calcium carbonate and nitric acid is carried out at 20°C and 50 °C. The mass and size of the marble chips, and the concentration and volume of nitric acid used **were kept the same.**<br>(i) Draw a line on the graph that represents the reaction at 20°C (the line for 50 °C has already been drawn)<br>(ii) Explain why you drew this line where you did, and explain if this means that the rate of reaction is slower, the same, or faster.<br>In your answer you should<br>• discuss why you drew your line with the slope that you did, and why you stopped the line at the point that you did<br>• explain the effect of temperature on reaction rate, in terms of particle collisions. | |
| **ANSWER** | |
| 1. Draw the line for the reaction at 20°C (use another colour) |  |
| 2. **link the slope of the graph** to a faster or slower reaction. | **The line showing the reaction at** 20°C is less steep (lower gradient) than the line for 50 °C. This shows that the reaction is slower at 20°C than at 50 °C |
| 3. **link the line** stopping (zero gradient) to all of the reactants being used up and changed to products. | Both lines become horizontal at the same point on the Y-axis, as this is when both reactions have finished, i.e. one of the reactants has been completely used up and therefore no more gas is produced. |
| 4. link the **same amount of products** made to the initial concentration/ amount of products in both cases | Both finished with same amount of gas produced, as both reactions had the same amount of reactants to start with. |
| 5. State whether the higher temperature causes a faster or slower **reaction rate** | A higher temperature will cause a faster reaction rate (OR: a lower temperature will produce a slower reaction rate) |
| 6. link the temperature of the particles to more or less **kinetic energy** and more or less **speed**. | The reaction is faster at the higher temperature, because the particles have more **kinetic energy**, and therefore are **moving faster**. (OR: the reaction is slower at the lower temperature, because the particles have less kinetic energy, and therefore are moving slower |
| 7. state that particles need to collide with enough energy (to overcome activation energy) to be a **successful collision**, and therefore a reaction occurs | Particles need to collide with enough energy (to overcome activation energy) to be a **successful collision**, and therefore a reaction occurs |
| 8. link faster moving particles to more **successful, frequent** (or per unit of time) collisions | When particles are moving faster, there will be **more frequent collisions**, and more of these **collisions will be effective**, as the particles will collide with more energy. (OR: When they are moving slower, there will be less frequent collisions, and less of these collisions will be effective, as the particles will collide with less energy.) |
| 9. link more frequent successful collisions to a **faster reaction rate** | More frequent successful collisions will result in a faster **reaction rate**. (in the higher temperature compared to the lower temperature) |

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# Writing Excellence answers to Reaction Rate Factors questions

| Reaction Rate Factors QUESTION |
|---|
| **Question: (i):** Identify the factor affecting the reaction rate being investigated in **Experiments 1 and 2**.<br>**(ii):** Explain how this factor affects the rate of reaction in the two flasks, with reference to particle collisions. Explain any observations, including changes in mass, over the course of **Experiments 1 and 2** until the reactions are finished.<br>**(iii)** Compare and contrast the rate of reaction of **Experiments 2 and 3**, with reference to particle collisions and the **concentration of hydrogen ions** in the solution. |

| | Calcium carbonate pieces | pH of acid |
|---|---|---|
| **Experiment 1** | Chips | 1 |
| **Experiment 2** | Powdered | 1 |
| **Experiment 3** | Powdered | 5 |

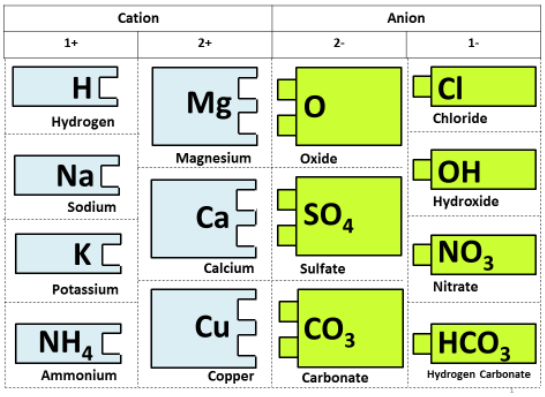
| ANSWER | |
|---|---|
| 1. Identify the **factor** (Either temperature, concentration or surface area) | Surface area |
| 2. **compare** the two experiments in terms of which mass decreases faster | The mass of the flask and its contents will decrease faster with the powder (experiment 2) compared to the chunks (experiment 1), |
| 3. **link** to gas production. | and the gas production will be faster. |
| 4. **link** factor to particle collision | This is because the powder has a larger surface area than the large chips, so more particles of calcium carbonate are exposed for the acid to react with / collide with, |
| 5. **link** further to successful collisions and reaction rate | and therefore experiment 2 has a higher frequency of successful collisions, and subsequently a faster rate of reaction. |
| 6. explain that both reactions will produce the **same amount of products** (name product), despite different reaction rates | Both reactions will get to the same mass, as both have the same amount of reactants and therefore release the same amount of $CO_2$, but at different rates. |
| 7. **link** pH to ion amount ($H^+$), and which experiment has the greatest amount | An acid with a pH of 1 has a higher [$H^+$] than an acid with a pH of 5. |
| 8. **Link** ion ($H^+$) to factor for each experiment | Since experiment 2 has more $H^+$ ions per unit volume / a higher concentration of $H^+$ ions, |
| 9. **link** to frequency of successful collisions | it will have a higher frequency of successful collisions (more successful collisions per second) |
| 10. **link** to reaction rate | and subsequently a higher / faster rate of reaction. |

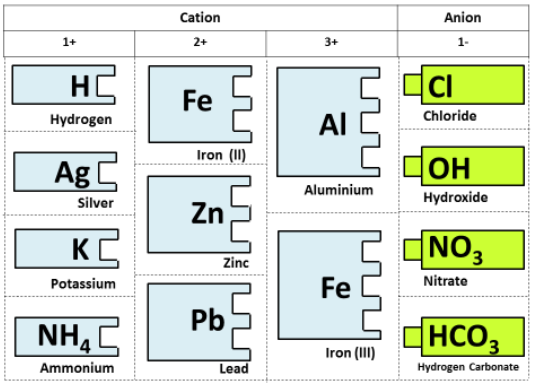
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

# Changing compound words into formulas – Visual balancing

**Success Criteria: complete each level before moving onto the next**

- Basic: write **ion formula** for the following named ion compounds
- Proficient: write **the number of each ion** required to balance the charges
- Advanced: **balance the ion compounds** to create a neutral compound




## Example

| | |
|---|---|
| **Name of compound** | calcium hydroxide |
| **Formula of ions** | $Ca^{2+}$ $OH^-$ |
| **Number of each ion required to balance charges** | 1 2 |
| **Formula of compound** | $Ca(OH)_2$ |

**Remember:**

**+ charge** means electrons are missing from the ion compared to when they were atoms, the number by the + tells us how many electrons are missing. Each missing electron is a space.

**- charge** means electrons are added to the ions compared to when they were atoms, the number by the – tells us how many electrons are added. Each added electron is a tab.

**The total number of tabs and spaces in the ions must match to make a neutral compound.**

We don't write the number 1 in compounds.

Put brackets around a compound ion (that has more than one type of atom in it) if you need 2 or more of them to balance in a compound

| | |
|---|---|
| **Name of compound** | magnesium chloride |
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| | |
|---|---|
| **Name of compound** | sodium carbonate |
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | copper nitrate |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | iron (II) hydroxide |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | lead oxide |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | silver nitrate |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | calcium carbonate |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

| **Name of compound** | iron (III) nitrate |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

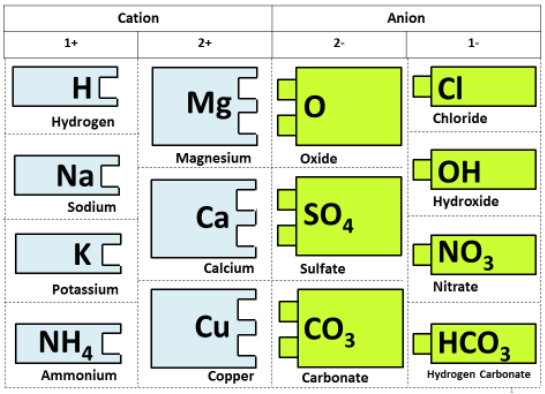
| **Name of compound** | zinc oxide |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

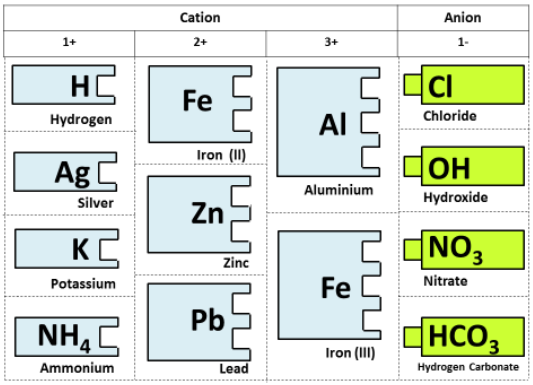
| **Name of compound** | lead chloride |
|---|---|
| **Formula of ions** | |
| **Number of each ion required to balance charges** | |
| **Formula of compound** | |

# Changing compound words into formulas – Visual balancing

**Success Criteria: complete each level before moving onto the next**

- Basic: write **ion formula** for the following named ion compounds
- Proficient: write **the number of each ion** required to balance the charges
- Advanced: **balance the ion compounds** to create a neutral compound




| Name of Compound | Positive ion (cation) | Negative ion (anion) | Formula of compound |
|---|---|---|---|
| Magnesium Chloride | | | |
| Lead oxide | | | |
| Sodium chloride | | | |
| Potassium chloride | | | |
| Copper sulfate | | | |
| Silver chloride | | | |
| Ammonium sulfate | | | |
| Calcium hydroxide | | | |
| Zinc nitrate | | | |
| Copper hydrogen carbonate | | | |
| Lead nitrate | | | |
| Iron (iii) hydroxide | | | |
| Potassium oxide | | | |
| Iron (ii) carbonate | | | |
| Ammonium carbonate | | | |
| Silver hydrogen carbonate | | | |
| Sodium carbonate | | | |

# Changing general word equations into balanced symbol equations

**Success Criteria: complete each level before moving onto the next**

- Basic: write **word equations** for the following reactions
- Proficient: write **symbol equations** for the following reactions
- Advanced: **balance the symbol equations** for the following reactions

Acid + Hydroxide (Base):

**Acid** + **Base** → **salt** + **water**

1. hydrochloric acid is mixed with copper hydroxide to produce copper chloride and water.

Word equation _____

Symbol equation _____

Acid + carbonate (Base):

**Acid** + **Base** → **salt** + **water** + **carbon dioxide**

2. sulfuric acid is mixed with sodium carbonate to produce sodium sulfate and water and carbon dioxide .

Word equation _____

Symbol equation _____

Acid + oxide (Base):

**Acid** + **Base** → **salt** + **water**

3. nitric acid is heated with magnesium oxide to produce magnesium nitrate and water

Word equation _____

Symbol equation _____

Acid + hydrogen carbonate (Base):

**Acid** + **Base** → **salt** + **water** + **carbon dioxide**

4. hydrochloric acid is added to calcium hydrogen carbonate solution to produce calcium chloride and water and carbon dioxide

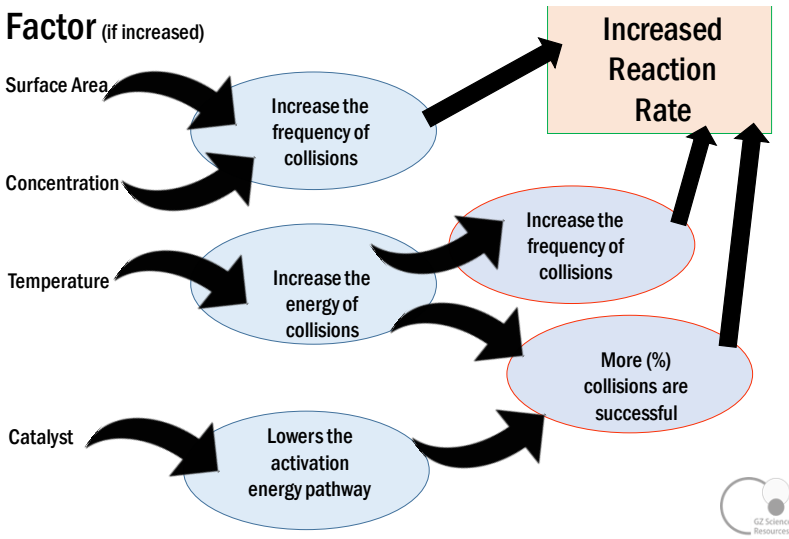
Word equation _____

Symbol equation _____

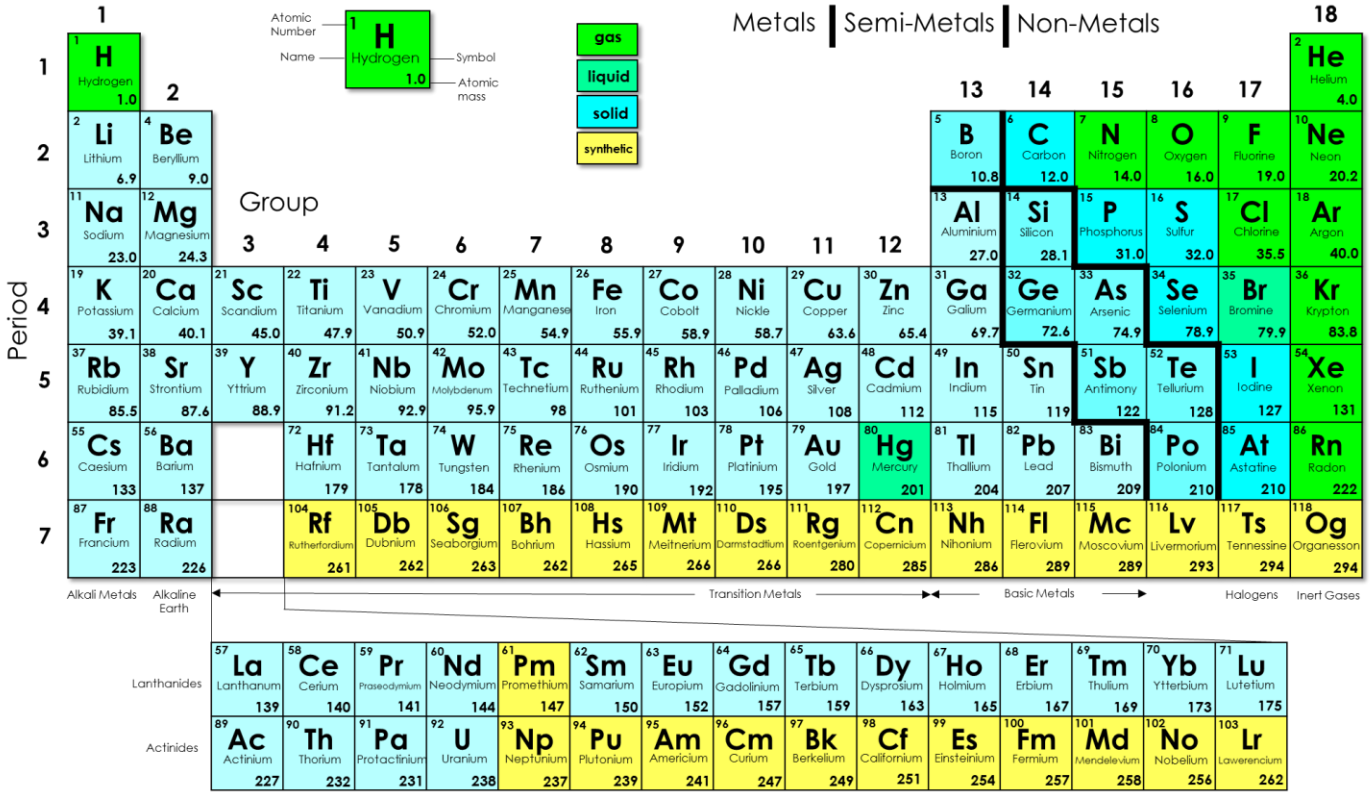
# Information Sheet

| Name of acid | Formula of acid | Name of salt formed | Formula of ion |
|---|---|---|---|
| hydrochloric acid | HCl | chloride | $Cl^-$ |
| sulfuric acid | $H_2SO_4$ | sulfate | $SO_4^{2-}$ |
| nitric acid | $HNO_3$ | nitrate | $NO_3^-$ |

| Cation | | | Anion | |
|---|---|---|---|---|
| 1+ | 2+ | 3+ | 2- | 1- |
| H Hydrogen | Mg Magnesium | Fe Iron (III) | O Oxide | Cl Chloride |
| Na Sodium | Ca Calcium | | $SO_4$ Sulfate | OH Hydroxide |
| K Potassium | Cu Copper | Al Aluminium | $CO_3$ Carbonate | $NO_3$ Nitrate |
| $NH_4$ Ammonium | Pb Lead | | S Sulfide | $HCO_3$ Hydrogen Carbonate |
| Ag Silver | Zn Zinc | Fe Iron (III) | | F fluoride |
| Li Lithium | Fe Iron (II) | | | |



# Periodic Table of the Elements




| | Blue litmus | Red litmus | Universal indicator | pH |
|---|---|---|---|---|
| | | | | 1 - 2 |
| | | | | 3 - 6 |
| | | | | 7 |
| | | | | 8 - 12 |
| | | | | 13 - 14 |

| description | $H_3O^+$ / $OH^-$ concentration |
|---|---|
| **Strong Acids** Readily donate all their protons when dissolved | Concentration of H+ ions is **greater** than that of OH- ions |
| **Weak Acids** donate only a small proportion of protons | |
| **Neutral solution** | Concentration of H+ ions is the **same** as that of OH- ions |
| **Weak Bases** Accept only a small proportion of protons | |
| **Strong Bases** Readily accept protons | Concentration of H+ ions is **less** than that of OH- ions |

**Increasing acidity** ← → **Increasing alkalinity**