# Chemistry Paper 1

# Model Exam Question Booklet

## Essential Content for the Higher Separate Science Exam (PBT/FKI)

| Chemistry Paper 1 | |
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| Topics in the Paper: | |
| **C2** | The Periodic Table |
| **C3** | Structure and Bonding |
| **C4** | Chemical Calculations |
| **C5** | Chemical Changes |
| **C6** | Electrolysis |
| **C7** | Energy Changes |
| **RP1** | Preparing a Salt |
| **RP2** | Titrations |
| **RP4** | Temperature Changes |

**This booklet is split into 3 parts:**

**Part 1**
The first part is a selection of short response questions and answers that are likely to come in your Chemistry exams this summer. Spend time learning the answers to these questions, for example you could produce flash cards. You should self quiz yourself on these questions regularly!

**Part 2**
Selection of extended response questions (4 to 6 marks) that are likely to be on your paper this year, either because they have not been assessed in the last couple of years, or because they come up most years in exams. Prepare and practice your responses to these questions.

**Part 3**
Required practical section. In this section you will find step by step guidance for each practical. This is followed by a page of short response questions and answers to learn for each of the practicals. There are also some extended response questions (4 to 6 marks) that are very likely to be on the exam paper this year.

# C2: Periodic Table

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1. How are elements in the periodic table arranged?
2. Why is the periodic table called this?
3. Why do elements in the same group have similar properties?
4. How were elements arranged in the past?
5. What were the problems with the early periodic table?
6. How did Mendeleev overcome the problems of the early periodic table?
7. What type of ions do metals form?
8. What type of ions do non-metals form?
9. Where are metals found on the periodic table?
10. Where are non-metals found on the periodic table?
11. What are the elements in group 0 known as?
12. Why are elements in group 0 unreactive?
13. Why are elements in group 0 monatomic?
14. What happens to boiling point down group 0?
15. What are elements in group 1 known as?
16. What happens to reactivity down group 1?
17. Why does reactivity increase down group 1?
18. What happens when a group 1 element reacts with oxygen?
19. What happens when a group 1 element reacts with chlorine?
20. What happens when a group 1 element reacts with water?
21. What are the elements in group 7 called?
22. What happens to reactivity down group 7?
23. Why does reactivity decrease down group 7?
24. Why are the halogens in group 7?
25. What colour vapour does fluorine have?
26. What colour vapour does chlorine have?
27. What colour vapour does bromine have?
28. What colour vapour does iodine?

1. In order of atomic number.
2. Elements with similar properties occur at regular properties.
3. They have the same number of electrons in their outermost shell.
4. In order of atomic weight.
5. Not all of the elements had been discovered and when elements were placed in order of atomic weight they ended up in the same group.
6. He left gaps for undiscovered elements and he the changed the order of some elements.
7. Positive
8. Negative
9. On the left and towards the bottom.
10. On the right and towards the top.
11. Noble gases.
12. The atoms have a stable arrangement of electrons. They all have full outermost shells.
13. They have a full shell and do not lose or gain electrons.
14. Boiling point increases.
15. Alkali Metals
16. It increases
17. Down the group atoms get bigger, there is a weaker attraction between the nucleus and so it becomes easier to lose electrons.
18. Alkali Metal + Oxygen → Metal Oxide
19. Alkali Metal + Chlorine → Metal Chloride
20. Alkali Metal + Water → Metal Hydroxide + Hydrogen
21. Halogens
22. It decreases.
23. Down the group atoms get bigger, there is a weaker attraction between the nucleus and so it becomes harder to lose electrons.
24. They have 7 electrons in their outermost shell.
25. Yellow
26. Green
27. Red-Brown
28. Purple

# C3: Structure and Bonding

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1. What are the three types of chemical bonds?
2. What is an ionic bond?
3. What is a covalent bond?
4. What is a metallic bond?
5. How does an ionic compound form?
6. What is the charge of an ion from group 1?
7. What is the charge of an ion from group 2?
8. What is the charge of an ion from group 6?
9. What is the charge of an ion from group 7?
10. What is an ionic compound?
11. What are simple molecules?
12. What is the state symbol for a solid?
13. What is the state symbol for a liquid?
14. What is the state symbol for a gas?
15. What is the state symbol for a solution?
16. What are the properties of ionic compounds?
17. Why do ionic compounds have high melting and boiling points?
18. Why can't ionic compounds conduct electricity when solid?
19. Why can ionic compounds conduct electricity when molten or dissolved?
20. What are the properties of simple molecules?
21. Why do simple molecules have low melting and boiling points?
22. What are examples of giant covalent structures?
23. What is the structure of diamond?
24. What is the structure of graphite?
25. Why can graphite conduct electricity?
26. Why do diamond and graphite have high melting and boiling points?
27. What is graphene?
28. What are the properties of graphene?
29. What are fullerenes?

1. Ionic, covalent and metallic bonds.
2. A bond between a metal and non-metal in which electrons have been exchanged.
3. A bond between two non-metals in which electrons are shared.
4. A bond between metal atoms in which electrons are delocalised.
5. The metal loses electrons to get a full outer shell becoming a positively charged ion while the non-metal gains electrons becoming a negatively charged ion. The oppositely charged ions are electrostatically attracted to each other.
6. +1
7. +2
8. -2
9. -1
10. A giant structure of ions which are held together by strong electrostatic forces of attraction between oppositely charged ions.
11. Small molecules such as oxygen and water that contain atoms joined together by covalent bonds.
12. (s)
13. (l)
14. (g)
15. (aq)
16. High melting and boiling point. Don't conduct electricity when solid but do when molten or dissolved.
17. Strong bonds between molecules which takes lots of energy to overcome.
18. Ions are unable to move freely.
19. Ions are free and so are able to move.
20. Low melting and boiling point. Poor conductors.
21. Weak bonds between the molecules and so little energy is needed to overcome these bonds.
22. Diamond and graphite
23. Each carbon atom is covalently bonded to 4 others in a giant structure.
24. Each carbon atom is covalently bonded to 3 others in a giant structure.
25. It has free electrons which are able to move.
26. Strong covalent bonds between atoms which take lots of energy to overcome.
27. A single layer of graphite.
28. Conducts electricity and very strong.
29. Molecules of carbon atoms with hollow shapes.

# C4: Chemical Calculations

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1. What are chemical amounts measured in?
2. What is the mass in grams of one mole equal to?
3. What are the units for moles?
4. What is the Avogadro constant?
5. What is the value of the Avogadro constant?
6. How can the balancing numbers in a symbol equation be calculated using reacting masses?
7. What is a limiting reagent?
8. In a reaction why should one reactant be added in excess?
9. What are the units for concentration?
10. Why is it not always possible to obtain the calculate amount of product?

1. Moles
2. Its RFM
3. Mol
4. The number of atoms in a mole of a given substance.
5. $6.02 \times 10^{23}$
6. The masses of reactants and products in grams is converted into moles which is then converted into a simple whole number ratio.
7. It is the reactant that is completely used up that limits the amount of product made.
8. To make sure that the other reactant is completely used up.
9. Mass per given volume.
10. The reaction may not go to completion because its reversible, some of the product may be lost when it is separated from the reaction mixture or some of the reactants may react in ways different to the expected reaction.

# C5: Chemical Changes

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1. How do metal oxides form?
2. What is reduction?
3. What is oxidation?
4. What happens to metals when they react with other substances?
5. What is the reactivity of a metal determined by?
6. List metals in order of reactivity.
7. Which two non-metals are often included in the reactivity series?
8. How can metals less reactive than carbon be extracted from their oxides?
9. What is typically made when an acid reacts with some metals?
10. How can acids be neutralised?
11. What is the general word equation for a metal reacting with an acid?
12. What is an example of an alkali?
13. What is an example of a base?
14. What is the general word equation for a metal hydroxide reacting with an acid?
15. What is the general word equation for a metal oxide reacting with an acid?
16. What is the general word equation for a metal carbonate reacting with an acid?
17. What type of salt does hydrochloric acid produce?
18. What type of salt does sulphuric acid produce?
19. What type of salt does nitric acid produce?
20. How can a soluble salt be made?
21. What type of ions do acids produce in solution?
22. What type of ions do alkalis produce in solution?
23. What is the pH scale?
24. What can be used to measure pH?
25. What is a pH of 7?
26. What is a pH value less than 7?
27. What is a pH value more than 7?
28. What happens during a neutralisation reaction?
29. Write an equation to represent a neutralisation reaction.

1. Metals react with oxygen in an oxidation reaction.
2. Loss of oxygen / gain of electrons.
3. Gain of oxygen / loss of electrons.
4. Metal atoms form positive ions.
5. Their tendency to make positive ions.
6. Potassium Sodium, Lithium, Calcium, Magnesium, Zinc, Iron, Copper
7. Hydrogen and carbon.
8. Reduction with carbon.
9. Salts and Hydrogen.
10. Adding it to an alkali.
11. Metal + Acid → Salt + Hydrogen
12. Soluble metal hydroxides.
13. Insoluble metal hydroxides and metal oxides.
14. Metal Hydroxide + Acid → Salt + Water
15. Metal Oxide + Acid → Salt + Water
16. Metal Carbonate + Acid → Salt + Water + Carbon Dioxide
17. Chloride
18. Sulphate
19. Nitrate
20. Add acid in excess to a solid insoluble substance such as metal, metal oxide, carbonate or hydroxide and filter off the excess. Crystallise the salt solution made.
21. $H^+$
22. $OH^-$
23. A scale from 0 to 14 that is a measure of acidity or alkalinity of a solution.
24. Universal indicator or pH probe.
25. Neutral solution
26. Acidic solution
27. Alkali solution
28. Hydrogen ions react with hydroxide ions to make water.
29. $H^+ (aq) + OH^- (aq) \rightarrow H_2O(l)$

# C6: Electrolysis

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1. When can an ionic compound conduct electricity?
2. What is an electrolyte?
3. What happens when an electric current is passed through an electrolyte?
4. What is the cathode?
5. What is the anode?
6. Which electrode are positive ions attracted to?
7. Which electrode are negative ions attracted to?
8. What happens at the electrode?
9. What happens when a simple ionic compound is electrolysed?
10. When is electrolysis used to extract metals?
11. What are the problems of extracting metals using electrolysis?
12. How is aluminium extracted using electrolysis?
13. Why is a mixture used as the electrolyte for the extraction of aluminium?
14. Why must the positive electrode be replaced during the electrolysis of aluminium?
15. During the electrolysis of an aqueous solution what does the ion discharged at the electrode depend on?
16. What is formed on the negative electrode if the metal is more reactive than hydrogen?
17. When is oxygen made at the positive electrode?
18. What happens at the cathode? (HT Only)
19. What happens at the anode? (HT Only)

1. When it is melted or dissolved.
2. A liquid or solution that is able to conduct electricity.
3. The ions move to the electrodes.
4. Negative electrode.
5. Positive electrode.
6. Negative electrode.
7. Positive electrode.
8. The ions are discharged at the electrodes producing elements.
9. The metal forms at the cathode and the non-metal is produced at the anode.
10. When the metal is too reactive to be extracted by reduction with carbon, or if the metal reacts with carbon.
11. Large amounts of energy are needed to melt the compound and produce the electrical current.
12. The aluminium oxide is melted and mixed with cryolite. The aluminium ions move to the negative electrode to make aluminium and the oxygen ions move to the positive electrode to react with the carbon electrode and make carbon dioxide.
13. The cryolite lowers the melting point of aluminium oxide.
14. The oxygen reacts with the carbon in the electrode burning it away.
15. The reactivity of the elements involved.
16. Hydrogen
17. When the solution does not contain halide ions.
18. Positive ions gain electrons and are reduced.
19. Negative ions lose electrons and are oxidised.

# C7: Energy Changes

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| 1. What happens to energy in a chemical reaction? | 1. It is conserved. The amount of energy at the end of the reaction is the same as the amount of energy at the start. |
| 2. What is an exothermic reaction? | 2. A reaction in which energy is transferred to the surroundings so the temperature of the surroundings increases. |
| 3. What are examples of exothermic reactions? | 3. Combustion, oxidation reactions and neutralisation. |
| 4. What are everyday uses of exothermic reactions? | 4. Self heating cans and neutralisation. |
| 5. What is an endothermic reaction? | 5. A reaction in which energy is transferred from the surroundings to that the temperature of the surroundings decreases. |
| 6. What are examples of endothermic reactions? | 6. Thermal decomposition and reaction of citric acid and sodium hydrogencarbonate. |
| 7. What are everyday uses of endothermic reactions? | 7. Sports injury packs. |
| 8. What is activation energy? | 8. The minimum amount of energy that particles must have to react when the reacting particles collide with each other. |
| 9. What are reaction profiles? | 9. A diagram that can be used to show the relative energies of reactants and products. It shows the activation energy and the overall energy change of a reaction. |
| 10. In terms of particles when do chemical reactions occur? | 10. When reacting particles collide with enough energy. |
| 11. How could you identify an exothermic reaction using its reaction profile? | 11. The energy in the products is lower than the energy in the reactants. |
| 12. How could you identify an endothermic reaction using its reaction profile? | 12. The energy in the products is higher than the energy in the reactants. |
| 13. How could you change a reaction profile to show the use of a catalyst. | 13. Draw a ”humped line” connecting the reactant and product line that is lower than the activation energy line. |
| 14. What happens to bonds during a chemical reaction? (HT Only) | 14. Energy is supplied to break bonds in the reactants and energy is released when bonds in the products are formed. |
| 15. How can the overall energy change be calculated? (HT Only) | 15. Calculate the difference between the sum of the energy needed to break the bonds in the reactants and the sum of the energy released when bonds in the products are formed. |

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| **Topic** | C2 Periodic Table |
| **Qu** | Explain why _____ is **more/less** reactive than _____. |
| **Info** | You may be asked to explain why elements in group 1 or group 7 are more or less reactive than each other. To answer this, you will need to :<br>1. Identify which group the elements you have been asked about are in.<br>2. Identify the elements you have been asked to compare.<br>3. State that as you go down the group the atom gets bigger.<br>4. State that the outermost electron gets further from the nucleus.<br>5. State that there is a weaker force of attraction between the nucleus and the outer electrons.<br>6. If the element in in group 1 state "it is easier to lose an electron and so reactivity increases down the group" while if the element is in group 7 state "it is harder to gain an electron and so reactivity decreases down the group" |
| **Top Tip** | **Group 1**: Reactivity **increases** down the group, they **lose** one electron in their outer shell<br>**Group 7**: Reactivity **decreases** down the group, they **gain** one electron in their outer shell |
| **Model Answer** | **Explain why potassium is more reactive than lithium.**<br><br>1. *Lithium and potassium are in group 1 in the periodic table.*<br>2. *Potassium is more reactive than lithium because .....*<br>3. *...as you go down the group the atom gets bigger*<br>4. *The outermost electron is further away from the nucleus*<br>5. *There is a weaker force of attraction between the nucleus and the outer electrons.*<br>6. *It is easier to lose an electron and so reactivity increases down the group* |
| **Practice** | 1. Explain why chlorine is less reactive than fluorine<br>2. Explain why sodium is less reactive than potassium<br>3. Explain why chlorine is more reactive than iodine<br>4. Explain why reactivity increases down group 1<br>5. Explain why reactivity decreases down group 7 |

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| **Topic** | C2 Periodic Table |
| **Qu** | Explain the arrangement of the first 20 elements in todays periodic table.<br>Identify and explain the changes that Mendeleev made to the periodic table.<br>Explain why Mendeleev's periodic table was accepted over time. |
| **Info** | At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence. |
| **Top Tip** | Be careful that you use key words/phrases accurately (these are in bold in your model answers below). |
| **Model Answer** | **Explain the arrangement of the first 20 elements in todays periodic table.**<br><br>The elements are arranged in order of their **atomic number**. Elements in the same group have the **same number of electrons** in their **outermost shell**. |
| **Model Answer** | **Identify and explain the changes that Mendeleev made to the periodic table.**<br><br>Mendeleev **left gaps** for the discovery of new elements. He also rearranged the position of some of the elements so that the properties fitted other elements in the same group. |
| **Model Answer** | **Explain why Mendeleev's periodic table was accepted over time.**<br><br>New elements were discovered that fitted into the gaps that Mendeleev had predicted. Also, when the **neutron** was discovered, this led to an understanding of **isotopes** which explained why Mendeleev needed to swap the position of some elements. |
| **Practice** | 1. Learn and practice the model answers above. |

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| **Topic** | C3 Structure and Bonding |
| **Qu** | Explain the properties of _____ |
| **Info** | You could be asked to explain the properties of different materials. Examples of materials include:<br>• Any named salt<br>• Any named metal<br>• Diamond<br>• Graphite<br>To answer this question, you will need to do the following:<br>1. Identify the type of bond involved.<br>2. Describe the structure of the material.<br>3. Identify a property of the material<br>4. Explain why it has this property linking back to its structure.<br>5. Repeat steps 3 and 4 until you have no more properties. |
| **Top Tip** | Went explaining why a material does or does not conduct electricity by careful. When talking about materials with covalent or metallic bonds you need to use the key term **"electron",** when you are discussing a material with ionic bonds you need to use the key term **"ion".** |
| **Model Answer** | **Explain the properties of graphite.**<br><br>1. *Graphite has covalent bonds.*<br>2. *Graphite is made up of layers of carbon* atoms. Each carbon atom is covalently bonded to 3 others in a giant structure.<br>3. Graphite conducts electricity.<br>4. It conducts electricity because it has delocalised electrons which are able to move.<br>5. Graphite is slippery and soft. It *is slippery and soft because it is made up of layers that can slide over each other. Graphite also has high melting and boiling points. This is because it has strong covalent bonds between atoms which take lots of energy to overcome.* |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Explain the properties of diamond<br>3. Explain the properties of the metal copper<br>4. Explain the properties of sodium chloride<br>5. Explain the properties of carbon nanotubes. |

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| **Topic** | C3 Structure and Bonding |
| **Qu** | Describe what happens to _____ atoms and _____ atoms when they react. |
| **Info** | You could be asked to explain what happens in terms of electrons for different ionic compounds. Examples from exams in the past include:<br>• Lithium and chlorine atoms making lithium chloride.<br>• Caesium and oxygen atoms making caesium oxide.<br>• Lithium and bromine atoms making lithium bromide.<br>• Calcium and fluorine atoms making calcium fluoride.<br>• Calcium and oxygen atoms making calcium oxide.<br>• Sodium and fluorine making sodium fluoride.<br><br>To answer this question, you will need to do the following:<br>1. Identify how many electrons the metal loses.<br>2. State that the metal atom becomes a positive ion.<br>3. Identify how many electrons the non-metal gains.<br>4. State that the non-metal atom becomes a negative ion. |
| **Top Tip** | Use the group the atom is in to check you have the correct charge. Elements in group 1 form ions with a +1 charge, group 2 form ions with a +2 charge, group 6 form ions with a -2 ion while atoms in group 7 form ions with -1 charge. |
| **Model Answer** | **Describe what happens to lithium atoms and chlorine atoms when they react to form lithium chloride.**<br><br>*The lithium atom loses one electron to form a +1 ion. The chlorine atom gains one electron to form -1 ions.* |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Describe what happens when the following atoms react: caesium and oxygen, lithium and bromine, calcium and fluorine, calcium and oxygen, sodium and fluorine. |

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| **Topic** | C4 Chemical Calculations |
| **Qu** | Calculate the number of moles of _____ in _____ |
| **Info** | You could be given a mass of any compound or element and be asked to calculate the number of moles that it contains.<br><br>To answer this question, you will need to do the following:<br>1. Identify the formula of the substance. This may well be in the question.<br>2. Calculate the RFM of the substance.<br>3. Check that the mass you have been given is in grams. If not convert the units.<br>4. Divide the mass in grams by the RFM<br>5. Round your answer to the correct number of significant figures. |
| **Top Tip** | **Read the question carefully. Make sure you have checked how many significant figures you have been asked to give your answer to! If you haven't been given atomic masses remember to use your periodic table.** |
| **Model Answer** | **Calculate the number of moles of calcium carbonate in 64mg. Give your answer to 3 sf**<br><br>1. Formula of magnesium carbonate: $MgCO_3$<br>2. RFM: = 24 + 12 + (16 x 3) = <u>84</u><br>3. Mass in grams 64/1000 = 0.064g<br>4. Divide mass by RFM: 0.064/84 = 0.0007619047619<br>5. Round to correct sig fig **<u>0.000762</u>** |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Calculate the number of moles in 150mg of: Carbon Dioxide, Water, Sodium Chloride, Magnesium Oxide, Lithium Fluoride, Copper Sulfate and Copper Carbonate. |

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| **Topic** | C4 Chemical Calculations |
| **Qu** | Calculate the concentration of a solution. |
| **Info** | You could be given a volume of a solution and the mass of a substance that it contains and be asked to use this to calculate a concentration.<br><br>To answer this question, you will need to do the following:<br>1. Check the volume you have been given in the question is in the same units as the units you have been asked to give in your answer. If not convert!<br>2. Check the mass you have been given is in the same units as the units you have been asked to give in your answer. If not convert!<br>3. Divide the known mass by the volume you have been given.<br>4. Check your answer is to the correct number of significant figures.<br>5. Add units |
| **Top Tip** | **To convert from $cm^3$ into $dm^3$ divide by 1000.** |
| **Model Answer** | **Calculate concentration of hydrochloric acid when it contains 3.2g of hydrogen chloride in 50$cm^3$ of solution. Give your answer to 2 s.f in g/$dm^3$**<br><br>1. Check volume units: 50/1000 = 0.05$dm^3$<br>2. Check mass units: 3.2g<br>3. Divide mass by volume: 3.2/0.05 = 64<br>4. Round to correct sig fig 64<br>5. Add units 64g/$dm^3$ |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Calculate the concentrations of hydrochloric acid in g/$dm^3$ when: 6.8g is dissolved in 100$cm^3$, when 12.2g is dissolved in 250$cm^3$, when 0.1kg is dissolved in 750$cm^3$ and when 0.25kg is dissolved in 1.5$dm^3$. |

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| **Topic** | C5 Chemical Changes |
| **Qu** | Explain what you would observe when a metal is added to an acid.<br>Explain what happens when any acid reacts with any alkali.<br>Describe how you could determine the pH of a substance. |
| **Info** | At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence. |
| **Top Tip** | Be careful that you use key words/phrases accurately (these are in bold in your model answers below). |
| **Model Answer** | **Explain what you would observe when a metal is added to an acid.**<br><br>When a metal is added to an acid, I would predict that I would observe **bubbles**. This is because when a metal is added to an acid **hydrogen** is produced. I would also expect the container to **feel warm**, this is because a metal reacting with an acid is an **exothermic reaction**. Finally, I would expect the metal to disappear over time. This is because it is reacting and making the **salt** which would **dissolve**. |
| **Model Answer** | **Explain what happens when any acid reacts with any alkali.**<br><br>When an acid and alkali react the **$H^+$ ions** from the acid react with the alkalis **$OH^-$ ions** to make **water**. |
| **Model Answer** | **Describe how you could determine the pH of a solution.**<br><br>To determine the pH of a solution you could add **universal indicator**. You would observe the colour that the indicator turned and use a chart to identify the pH. You could alternatively use a **pH probe** by dipping this into the solution and recording the value on the digital display. |
| **Practice** | 1. Learn and practice the model answers above. |

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| **Topic** | C6 Electrolysis |
| **Qu** | Identify what forms at the _____ electrode and explain how this happens. |
| **Info** | You will usually be given a diagram of the electrolysis and the name of the solution that is undergoing electrolysis. You will then be asked what forms at one or both electrodes and be asked to explain how this happens.<br><br>To answer this question:<br>1. Identify what forms at the electrode. You can use the tips below to help you with this.<br>2. Identify the charge of the ion.<br>3. Identify that they are attracted to the oppositely charged electrode.<br>4. Identify if the ion loses or gains electrons.<br>5. Identify if they are reduced or oxidised<br>6. Identify (again) what is formed |
| **Top Tip** | Anode: At the **positive electrode** negative ions **lose** their electrons and are **oxidised**. If the solution doesn't contain halides oxygen is made. This oxygen then reacts with the carbon in the electrode to make carbon dioxide.<br>Cathode: At the **negative electrode** positive ions **gain** electrons and are **reduced**. If the metal is more reactive than hydrogen, then hydrogen forms at the electrode instead. |
| **Model Answer** | **Explain what forms at the cathode during the electrolysis of copper sulfate.**<br>*1. Copper forms at the negative electrode.*<br>*2. Copper ions have a positive charge...*<br>*3. ...and so are are attracted to the oppositely charged negative electrode.*<br>*4. The copper ions gain electrons...*<br>*5. ...and are reduced...*<br>*6. To form copper*<br>**Explain what forms at the anode during the electrolysis of copper sulfate.**<br>*1. Oxygen forms at the negative electrode.*<br>*2. Oxygen ions have a negative charge...*<br>*3. ...and so are are attracted to the oppositely charged positive electrode.*<br>*4. The oxygen ions lose electrons...*<br>*5. ...and are oxidised...*<br>*6. To form oxygen. The oxygen then goes on to react with carbon in the electrode to make carbon dioxide gas.* |
| **Practice** | 1. Explain what forms at the electrodes during electrolysis of iron sulfate<br>2. Explain what forms at the electrodes during electrolysis of copper chloride<br>3. Explain what forms at the electrodes during electrolysis of sodium chloride |

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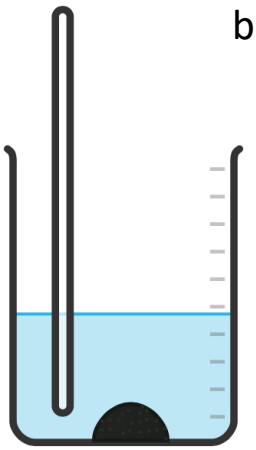
| **Topic** | C6 Electrolysis |
| **Qu** | Explain why the electrodes are replaced when $O_2$ is formed at electrolysis.<br>Explain when hydrogen gas forms at the negative electrode.<br>Explain how halogen gases can be formed at the positive electrode. |
| **Info** | At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence. |
| **Top Tip** | Be careful that you use key words/phrases accurately (these are in bold in your model answers below). |
| **Model Answer** | **Explain why the electrodes are replaced when $O_2$ is formed at electrolysis.**<br><br>During electrolysis the **negative oxygen ions** will be attracted to the **positive electrode** that is made of **carbon**. The oxygen will then react with the carbon electrode **forming carbon dioxide** due to the **high temperatures**. This means that over time the electrode will **wear away**. |
| **Model Answer** | **Explain when hydrogen gas forms at the negative electrode.**<br><br>During electrolysis water breaks down to form hydrogen **$H^+$ ions**. If the metal ions produced during electrolysis are **less reactive than hydrogen**, then it is the hydrogen ions that are **discharged** at the negative electrode. Here they **gain electrons** to form hydrogen **molecules**. |
| **Model Answer** | **Explain how halogen gases can be formed at the positive electrode.**<br><br>Halide ions are **negatively charged** and so will be attracted to the **positive electrode**. Here the halide will **lose electrons** and **form molecules**. For example, chloride ions will form chlorine gas. |
| **Practice** | 1. Learn and practice the model answers above. |

| | |
|---|---|
| **Topic** | C7 Energy Changes |
| **Qu** | When an acid is added to an alkali the energy changes. Explain this change.<br>Define exothermic reaction.<br>Define activation energy. |
| **Info** | At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence. |
| **Top Tip** | Be careful that you use key words/phrases accurately (these are in bold in your model answers below). |
| **Model Answer** | **When an acid is added to an alkali the energy changes. Explain this change.**<br><br>An acid reacting with an alkali is an **exothermic reaction**. This means that heat is released to the environment and so the **energy** within the **products** will be less than the energy in the **reactants**. |
| **Model Answer** | **Define exothermic reaction.**<br><br>A reaction in which heat is released to the surroundings. |
| **Model Answer** | **Define activation energy.**<br><br>The minimum amount of energy that particles must have to react when the reacting particles collide with each other. |
| **Practice** | 1. Learn and practice the model answers above. |

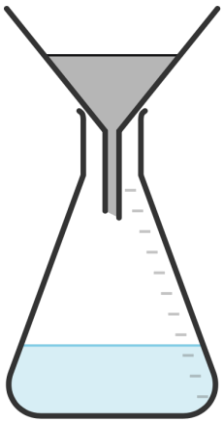
# RP1 Making Salts

**1**
Add the insoluble base in excess to warmed acid.

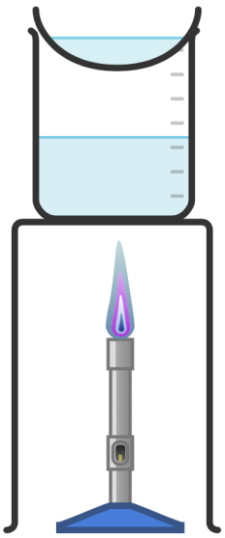
**2**
Stir the solution until no more base will react.



**3**
Filter the contents to remove the excess base.



**4**
Pour the filtered solution into an evaporating basin and evaporate the water using a water bath.



**5**
Stop heating when crystals start to appear.

**6**
Leave the remaining solution to crystallise over time.

**Practical Video**

# RP1: Making Salts Practical

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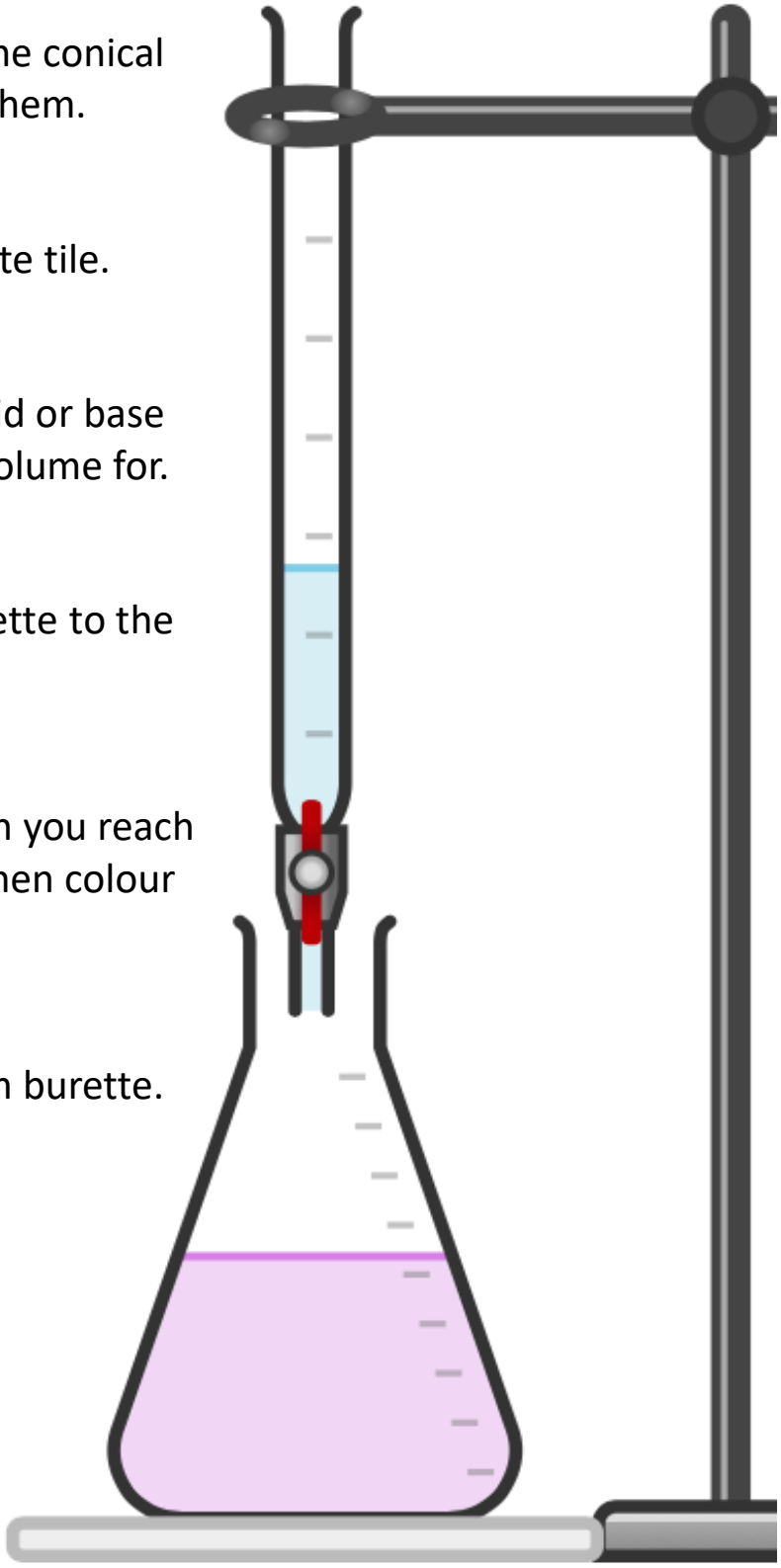
1. What is neutralisation?
2. What is filtration?
3. What is evaporation?
4. What is crystallisation?
5. Why is the insoluble base added in excess?
6. Why is the insoluble base added to warm acid?
7. Why is the mixture stirred?
8. What type of acid would you need to use if you wanted to make a sulfate?
9. What type of acid would you need to use if you wanted to make a chloride?
10. What type of acid would you need to use if you wanted to make a nitrate?
11. How is the remaining insoluble base removed from the solution?
12. What is made during neutralisation?
13. How is the water removed from the salt solution?
14. What substances can react with an acid to make a soluble salt?
15. How can we make sure that all the substances have reacted when making salts?
16. What safety precautions should you use when making salts?

1. A chemical reaction between an acid and a base in which a salt and water are formed.
2. A separation technique used to remove an insoluble substance from a solution.
3. A separation technique used to remove water from a solution.
4. A technique that follows evaporation in which crystals form.
5. To make sure that all of the acid has reacted and is neutralised.
6. To increase the rate or reaction.
7. To increase the rate of reaction.
8. Sulfuric Acid
9. Hydrochloric Acid
10. Nitric Acid
11. Filtration
12. Salt and water.
13. Evaporation
14. Metal, metal hydroxide, metal oxide, metal carbonate, alkali.
15. Warm the solution and stir.
16. Wear safety goggles.

| | |
|---|---|
| **Practical** | RP1 Making Salts |
| **Qu** | Explain how you could make a pure dry sample of _____. |
| **Info** | You could be asked this question for lots of different salts. Some that have come up in the past include:<br>• Magnesium Sulfate<br>• Calcium Chloride<br>• Potassium Chloride<br>• Sodium Sulfate<br><br>To answer this question you will need to do the following:<br>1. Identify the base and acid that you would add together.<br>2. Describe how you would ensure all the base had reacted.<br>3. Describe how you would remove the unreacted base.<br>4. Describe how you will make sure all the water is removed from the salt. |
| **Top Tip** | Sometimes you can be asked to write a method, while sometimes they give you a method and ask you to improve it – watch out here that they are adding the correct chemicals together. |
| **Model Answer** | **Explain how you could make a pure dry sample of magnesium sulfate.**<br><br>*I would add magnesium oxide in excess to warmed sulfuric acid. This would be stirred until no more magnesium oxide will react. To remove the excess magnesium oxide the solution should be filtered using a funnel and filter paper. The solution will then be warmed in an evaporating dish using a water bath to evaporate the water. As soon a crystals start to form the solution will be removed from the heat so that crystallisation can occur.* |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Prepare and learn model answers to explain how you would make pure dry samples of calcium chloride, potassium chloride and sodium sulfate. |

# RP2 Titrations

1. Add your acid or base with a known volume to the conical flask.
2. Add indicator solution to the conical flask and swirl to mix them.
3. Stand the flask on a white tile.
4. Fill the burette with the acid or base that you need to find the volume for.
5. Add chemical from the burette to the conical flask.
6. Swirl and add dropwise when you reach near the end point. Stop when colour changes.
7. Measure volume used from burette.
8. Repeat.



**Practical Video**

# RP2: Titrations

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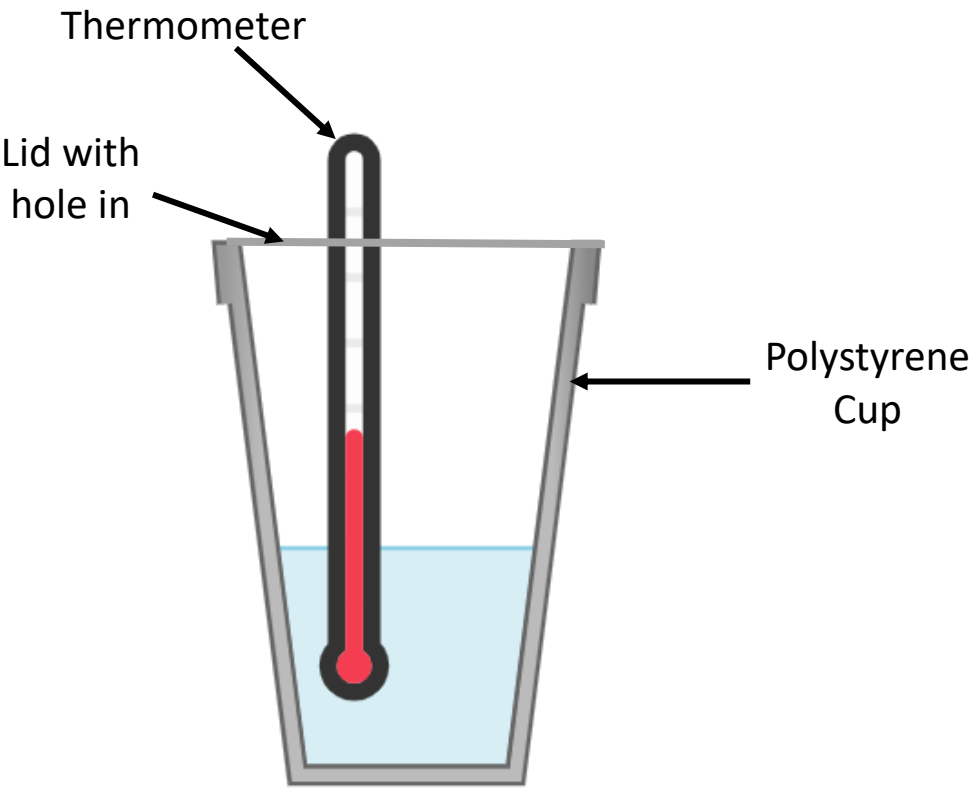
1. What is a titration?
2. What do you add your known reagent to?
3. What do you use to measure the volume of the known reagent.
4. Why is a pipette used to measure out the known reagent?
5. What do you add your unknown reagent to?
6. Why is the unknown reagent added to the burette?
7. What is the end point?
8. What happens at the end point of a titration?
9. What would you see when the end point of a titration has been reached?
10. What should be added to the known reagent in the conical flask before adding the unknown reagent?
11. When repeating a titration 3 times what variables should be controlled?
12. How can a titration be made more reliable?
13. What colour is phenolphthalein in acidic solutions?
14. What colour is phenolphthalein in alkali solutions?
15. What is a strong acid?
16. What is a weak acid?

1. It is a method used to determine the volume of an acid or alkali that would neutralise an unknown volume of an acid or alkali.
2. Conical flask.
3. Pipette
4. It accurately measures a fixed volume.
5. Burette
6. It measures variable volumes and you can measure drop by drop.
7. It is the point in the reaction where the acid and alkali are completely neutralised and the titration should be stopped.
8. The indicator changes colour when the acid and alkali are exactly neutralised.
9. A change in colour.
10. An indicator.
11. Volume of known reagent, concentration of known reagent, concentration of unknown reagent.
12. Repeat it and calculate an average.
13. Colourless
14. Red/pink
15. An acid that completely ionises in solution.
16. An acid that partially ionises in solution.

| | |
|---|---|
| **Practical** | RP2: Titrations |
| **Qu** | Describe a method to find the exact volume of _____that reacts with _____. |
| **Info** | You could be asked this question for different titrations. Some that have come up in the past include:<br>• Volume of citric acid needed to neutralise 25cm$^3$ of sodium hydroxide.<br>• The volume of sulfuric acid needed to neutralise 25cm$^3$ of sodium hydroxide.<br>• The volume of sodium hydroxide needed to neutralise 25cm$^3$ of rainwater.<br><br>To answer this question you will need to do the following:<br>1. Identify what reagent goes into a conical flask and the equipment you would measure this out with.<br>2. Identify what reagent goes into the burette.<br>3. Describe what you would then do and when you would stop adding the reagent in the conical flask. |
| **Top Tip** | Be careful with which chemical you add to the burette and which you add to the conical flask. The reagent with the known volume should be in the conical flask with an indicator in while the reagent with the unknown volume should be in the burette. |
| **Model Answer** | **Describe a method to find the exact volume of sodium hydroxide that reacts with 25.0 cm$^3$ of hydrochloric acid.**<br><br>*I will add the sodium hydroxide to the burette and measure out 25cm$^3$ of hydrochloric acid using a pipette and add it to the conical flask. An indicator would also be added to the conical flask. This flask will be placed on a white tile. The sodium hydroxide in the burette will be added to the conical flask, while the conical flask is swirled. Near the end point the sodium hydroxide will be added drop by drop until the indicator changes colour. The volume of sodium hydroxide will be recorded, and the titration repeated so that an average can be calculated.* |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Prepare and learn model answers to explain how you would carry out a titration to find the volume of sulfuric acid and citric acid that would neutralise 25cm$^3$ of sodium hydroxide. |

# RP4 Temperature Changes

1. Add the acid into a polystyrene cup.
2. Record the start temperature of the solution.
3. Add the other reactant (test solution) to the polystyrene cup.
4. Add the lid and stir the solution
5. Record the highest/lowest temperature that you observe.
6. Calculate the temperature change.
7. Repeat steps 1-6 2 more times to identify outliers and calculate an average.
8. Repeat sets 1-7 with 4 different test solutions.




**Practical Video**

# RP4: Temperature Changes

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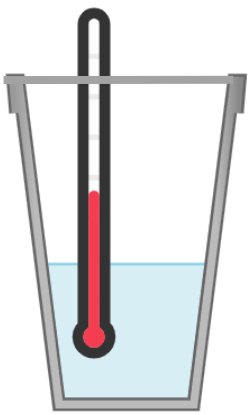
1. If you are investigating the effect of a particular factor on the temperature change what are the possible variables, one you could change, and the others you would need to keep the same?
2. When investigating the effect of a particular factor on temperature change what will be your dependent variable?
3. How do you determine temperature change?
4. Why should a polystyrene cup be used when investigating temperature change?
5. Why should the polystyrene cup used have a lid?
6. How can you use temperature change to determine the reactivity of some metals?
7. What equipment would you use to measure the volume of your solutions?
8. If you were adding a solid to the acid, what equipment would you use to measure the mass?
9. What equipment would you use to measure the start and end temperature?
10. How would you know if the reaction was endothermic?
11. What is an endothermic reaction?
12. What is an exothermic reaction?
13. How would you know if the reaction was exothermic?

1. Type of acid, concentration of acid, volume of acid, type of metal, surface area of metal, mass of metal
2. Temperature change.
3. Measure the start and end temperature. Take the start temperature away from the end temperature.
4. Polystyrene is a good insulator and reduces energy transfers with the surroundings.
5. Reduces energy transfers with the surroundings.
6. Add the metals to a controlled volume of acid in a polystyrene cup and record the temperature change. The larger the temperature change the more reactive the metal.
7. Measuring cylinder
8. Balance
9. Thermometer
10. The temperature would decrease.
11. A reaction that transfers energy from the surroundings.
12. A reaction that transfers energy to the surroundings.
13. The temperature would increase.

| | |
|---|---|
| **Practical** | RP4: Temperature Change |
| **Qu** | Explain how you could investigate the effect of _____ on temperature change. |
| **Info** | You could be asked this question for some different variables. Some that have come up in the past include:<br>• The reacting acid and metal<br>• The reacting acid and metal carbonate<br>• Neutralisation reactions<br>• Displacement of metals<br><br>To answer this question you will need to do the following:<br>1. Describe how to set up the equipment (drawing a labelled diagram is even better)<br>2. Identify what you will be changing<br>3. Identify what you will record/measure<br>4. Identify what you will control |
| **Top Tip** | You could be asked to write a method to explain how you would determine the reactivity of some metals. To do this you need to write a method for investigating temperature change. The more reactive the metal, the greater the change in temperature. When you have your results for the different metals you would list them in order of biggest temperature to smallest temperature change. By doing this you are listing the metals in order of reactivity. |
| **Model Answer** | **Explain how you could investigate the effect of the reacting acid and metal on temperature change.**<br>Set up equipment as shown in the diagram. Add 50cm³ acid into a polystyrene cup and record the start temperature of the solution. Add a metal to the cup and then add the lid. Stir the solution through the hole in the lid using the thermometer and record the highest/lowest temperature change observed. Calculate the temperature change and repeat twice more to calculate an average. Repeat the whole practical with 4 different metals. Control the type, volume and concentration of acid.<br>  |
| **Practice** | 1. Learn and practice the model answer above.<br>2. Prepare and learn model answers to explain how you could investigate the effects of reacting acid and metal carbonate, neutralisation reactions and displacement reactions on temperature change. |