**Year 10 Pack - Catalysts, Formulations, Flame Tests and Instrumental Methods**

**Facts**

**Catalysts:**

* Catalysts increase the rate of the chemical reaction by providing a different pathway for the reaction to take place. They decrease the activation energy required for the reaction to occur.
* Catalysts are not used up in a chemical reaction. Different reactions need different catalysts.
* Enzymes are biological catalysts, made of proteins. They denature at high temperatures and have an optimum pH at which they work best.

**Purity and Formulations:**

* In chemistry, a pure substance is a single element or compound, not mixed with any other substance.
* Pure elements and compounds melt and boil at specific temperatures.
* Melting point and boiling point data can be used to distinguish pure substances from mixtures.
* A pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, e.g. pure milk.
* A formulation is a mixture that has been designed as a useful product.
* Many products are complex mixtures in which each chemical has a particular purpose.
* Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties.
* Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods.

**Ion Tests:**

* Analysts have developed a range of qualitative tests to detect specific chemicals.
* The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate.
* Flame tests can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests:

• lithium compounds result in a crimson flame

• sodium compounds result in a yellow flame

• potassium compounds result in a lilac flame

• calcium compounds result in an orange-red flame

• copper compounds result in a green flame.

* If a sample containing a mixture of ions is used some flame colours can be masked.
* Sodium hydroxide solution can be used to identify some metal ions (cations).
* Solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate dissolves in excess sodium hydroxide solution.
* Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added.
* Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate.

**Instrumental Methods:**

* Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small.
* Forensic scientists and drug control scientists rely on such instrumental methods in their work. Elements and compounds can be detected and identified.
* Flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions. The sample is put into a flame and the light given out is passed through a spectroscope. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.

**Task 1: Watch Free Science lessons (if you can) and do a mind map of the information**

**GCSE Science Chemistry (9-1) Catalysts**

**GCSE Science Chemistry (9-1) Purity and Formulations**

**GCSE Science Chemistry (9-1) Flame Tests**

**GCSE Science Chemistry (9-1) Metal Hydroxide Precipitates**

**Task 2: Test yourself! Answer these quick fire questions**

1. What is a catalyst?
2. How can a catalyst affect the rate of a reaction?
3. Sketch an energy profile for a catalysed and uncatalysed reaction.
4. What is an enzyme?
5. What is a formulation?
6. What are 7 examples of formulations?
7. Why are formulations important?
8. What colour is the flame test for lithium?
9. What colour is the flame test for sodium?
10. What colour is the flame test for potassium?
11. What colour is the flame test for calcium?
12. What colour is the flame test for copper?
13. What happens when you react aluminium with sodium hydroxide?
14. What happens when you react calcium with sodium hydroxide?
15. What happens when you react magnesium with sodium hydroxide?
16. What happens when you react copper (II) with sodium hydroxide?
17. What happens when you react iron (II) with sodium hydroxide?
18. What happens when you react iron (III) with sodium hydroxide?
19. How does GC-MS separate substances?
20. What are the advantages and disadvantages of instrumental methods?

**Task 3: Short Answer Questions**

1. Very small amounts of cerium oxide nanoparticles can be added to diesel fuel. The cerium oxide is a catalyst.
2. Draw a ring around the correct answer to complete the sentence. Only a very small amount of cerium oxide nanoparticles is needed because the nanoparticles:
* are elements.
* are very reactive.
* have a high surface area to volume ratio.
1. Explain how a catalyst increases the rate of a reaction. (2 marks)

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1. Calcium carbonate is a catalyst for the industrial production of biodiesel. Give one reason why using a catalyst reduces costs.

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**Task 4; Longer Answer Questions**

1. The colours of fireworks are produced by chemicals. Three of these chemicals are lithium sulfate, potassium chloride and sodium nitrate.

(i) A student wants to carry out flame tests on these three chemicals. Describe how to carry out a flame test. .............................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................. (2)

2. Flame emission spectroscopy can be used to analyse metal ions in solution.



**…………………………………………………….………………………… and ……………………………………………………………………………………… (2)**

3. Explain why a flame test could not be used to identify the two metal ions in the mixture.

**……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………. (2)**

4. This label has been taken from a packet of My Baby Food.



One of the minerals in My Baby Food is calcium carbonate, CaCO3. Chemical tests are used to identify elements and compounds.

(i) A flame test can be used to identify calcium ions.

What colour do calcium ions give in a flame test?

…………………………............................................. (1)

(ii) When a flame test was carried out on My Baby Food,

the presence of calcium ions was not seen. A yellow flame

was produced. Name the ion which gives a yellow flame

test. ........................................................................................(1)

1. Suggest one advantage of using an instrumental method

to detect the elements present in My Baby Food. ........................................................................................................

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1. Name an instrumental method for detecting elements. ............................................................................................................................................................. (1)

**Task 5: Research Question**

A formulation is a mixture that has been designed as a useful product, often a complex mixtures in which each chemical has a particular purpose. Formulations are prepared by mixing the components in carefully measured quantities (mass of solid or volume of liquid or solution) to ensure that the product has the required properties for the desired purpose which may include fuels, cleaning agents, paints, medicines, alloys, fertilisers, foods and many other proprietary products. Find out the purpose of adding these components to make the following formulations:

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| Formulation | Component | Purpose |
| fuel | Alkane hydrocarbons |  |
| alcohols |  |
| Shampoo | Surfactants |  |
| Antifoaming agents |  |
| thickeners |  |
| antistatic agents |  |
| buffers |  |
| colouring agents  |  |
| perfumes  |  |
| Detergents |  |
| Paints | Base pigment |  |
| Binder |  |
| Solvent |  |
| medicines | active substance |  |
|  | fillers |  |
| disintegrants |  |
| lubricants |  |
| [glidants](https://en.wikipedia.org/wiki/Glidants) |  |
| [binders](https://en.wikipedia.org/wiki/Binder_%28material%29) |  |
| coatings |  |
| Alloys e.g. stainless steel | Chromium  |  |
| Iron  |  |
| Carbon |  |
| fertilisers | Ammonium nitrate |  |
| Potassium salts |  |
| Ammonium Phosphate |  |
| foods | antioxidants - vitamin C  |  |
| flavourings - use of esters, ethanoic acid |  |
| flavour enhancers - monosodium glutamate |  |
| colourings - food colours like tartrazine |  |
| preservatives - benzoic acid/ethanoic acid (vinegar)  |  |
| sweeteners - aspartame  |  |
| thickeners - starch |  |
| emulsifiers |  |
|  stabilisers |  |