

3. Rusting

Q1.

Iron rusts when in contact with air and water.

You are provided with iron nails and three different samples of water:

tap water,
sea water,
distilled water.

Plan an investigation to find out which sample of water causes iron to rust the fastest.

Steps:

- Get an iron nail with 2g mass
- Get a test-tube and add 10 cm³ of tap water
- Place the iron nail in the test-tube and leave it to rust
- Observe the nail after a week
- Repeat the experiment using the other two water samples using same volume of water and same surface area of nails and leave for same time.
- compare the mass of the rusted nails and the largest change in mass will have rusted the fastest

Q2.

STOP RUST!

Solutions of chemicals known as corrosion inhibitors are added to the water in steel radiators to reduce rust.

You are provided with three different bottles of liquid corrosion inhibitors, **R**, **S** and **T**, and some steel nails.

Plan an experiment to test if these inhibitors prevent the corrosion of steel and which of these inhibitors is the most effective.

Steps:

- Get a steel nail with 2g mass
- Add 10 cm³ of water and 5 cm³ of corrosion inhibitor R to a test-tube
- Place the nail in the test-tube and leave it for a week to rust
- Repeat this process with the inhibitors Q and S using same volumes and duration (1 week) and same mass and surface area of the nail
- Compare the results, the nail with the least change in mass will have the strongest corrosion inhibitor.

5. Preparation of salts.

Q1.

A solution of magnesium sulphate can be made by reacting magnesium oxide with warm sulphuric acid.

(a) Describe how you could make a solution of magnesium sulphate starting with magnesium oxide powder and dilute sulphuric acid.

- Add dilute sulfuric acid to a beaker
- Add excess magnesium oxide to the beaker
- Heat the beaker on a Bunsen burner
- Filter the excess unreacted magnesium oxide

(b) Describe how you would obtain pure dry crystals of hydrated magnesium sulphate, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, from the solution of magnesium sulphate in (a).

- Heat the solution (filtrate) till crystallization point , check for crystallization point by using a glass rod
- Leave solution to cool
- Filter crystals
- Dry crystals gently using filter paper

6. Extraction of metals.

Q1.

Malachite is a naturally occurring form of copper carbonate. Outline how a sample of copper metal could be obtained from large lumps of malachite in the laboratory.

Copper is one of the least reactive metals.

Your answer should include any chemicals used and conditions.

Steps:

- Crush malachite using mortar and pestle
- Add nitric acid to the malachite
- Solution is formed

- Add zinc metal or magnesium metal (any metal more reactive than copper)
- Displacement reaction occur
- Filter
- Wash residue and dry between two filter paper .

Ideas for paper 6

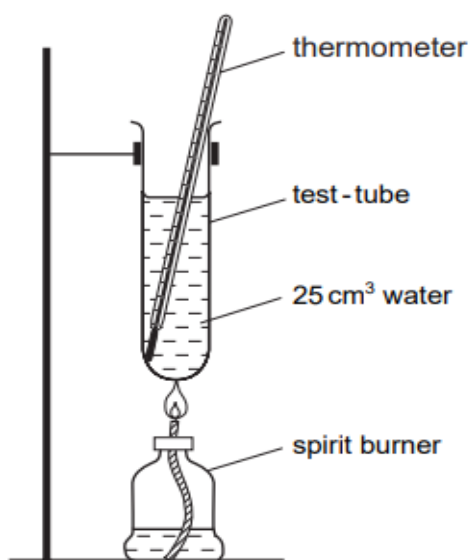
(last question)

1. Comparison between production of energy :

Q1:

Diesel is a liquid fuel obtained from crude oil. Biodiesel is a fuel made from oil obtained from the seeds of plants such as sunflowers.

Using the apparatus below plan an experiment to investigate which of these two fuels produces more energy.

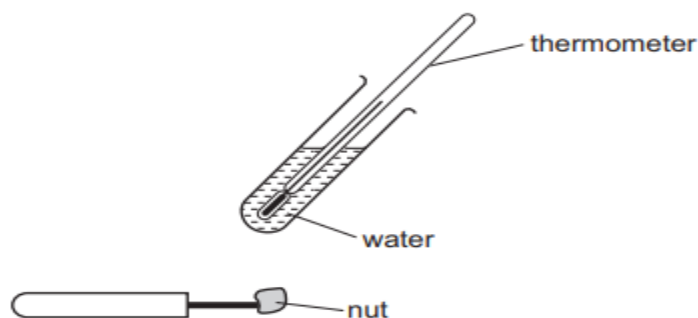


Steps:

- Add the first fuel (diesel) to spirit burner
- Measure the Initial temperature of water
- Start burn for certain time
- Stop the reaction, Then Measure the Final temperature of water
- Repeat experiment using the second fuel (biodiesel)
- For fair comparison, use same volume of fuel/same volume of water/same time interval/same distance between tube and burner/same initial temperature
- Fuel with greater temperature difference produce more energy.

Q2:

Nuts contain oil. Nuts can be burned to produce energy. The apparatus shown can be used to compare the energy produced by burning different nuts.



Plan an investigation to show which of three different types of nut produce the most energy. You are provided with peanuts, brazil nuts and hazelnuts.

Steps:

- Hold the test tube of water with stand & Put the peanuts below it
- Measure the Initial temperature of water
- Start burning for certain time
- Stop the reaction, then Measure the Final temperature of water
- Repeat the experiment with the other nuts (Brazil & hazel nuts)
- For fair comparison, use same mass of nuts / same volume of water/ same distance between test tube and the nuts/ same initial temperature
- Nuts with greater difference in temperature produce more energy.

Q3: Coal is a fossil fuel. When heated strongly, sulfur dioxide gas is one of the products formed.

Sulfur dioxide changes the colour of acidified potassium manganate(VII) from purple to colourless.

Plan an investigation to show which of the **two** different types of coal produces the most sulfur dioxide when heated. You are provided with one lump of each type of coal.

Steps:

- Use equal mass of coal , Crush it with mortar & pestle
- Put the coal in fume cupboard and start heating
- Pass it through potassium manganate(VII)
- Then Measure Time taken for purple to become colourless
- Repeat experiment with the second type of coal using same mass and same surface area
- Coal with less time taken for colour to disappear produce most Sulfur dioxide .

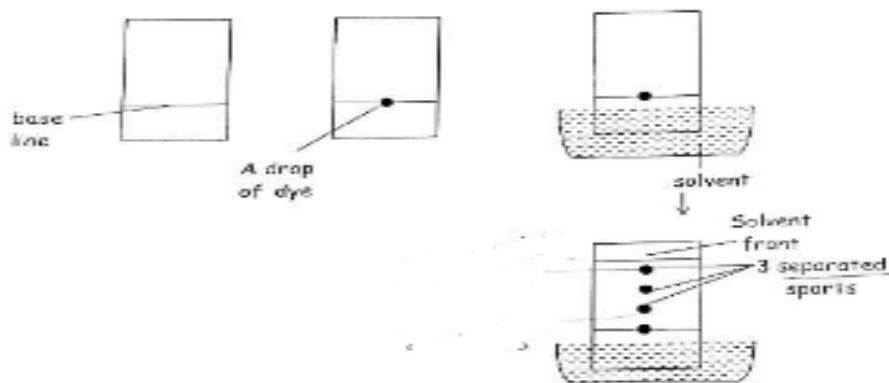
2. Separation methods:

Q1: Leaves from trees contain a mixture of coloured pigments which are not soluble in water. student was given these two instructions to investigate the pigments in the leaves.

1. Crush some leaves to extract the coloured pigments.
2. Use the liquid extract to find the number of coloured pigments in the leaves.

Describe an experiment to carry out instruction

A space has been left below if you want to draw a diagram to help answer the question.



Steps:

- Crush the leaves with mortar and pestle
- Draw base line with pencil in chromatography paper
- Using glass rod add drop of sample on base line
- Place the chromatography paper on solvent (ethanol) level below base line
- Leave it for certain time
- Colours spot start to appear on chromatography paper

Q2: A sample of furniture cleaner contains aqueous sodium chloride, aqueous ammonia and sand.

Plan an investigation to obtain a sample of

(i) pure water from the mixture,

Steps:

- By Simple Distillation
- Boils the mixture
- Then condense the vapour & collect the liquid

(ii) pure sand from the mixture.

Steps:

- By Filtration
- Sand in residue
- Wash the residue & dry between two filter papers

4. How to determine:

Q1: The Concentration:-

Plan an experiment to determine the concentration of ammonia in Kleen Up. You are provided with aqueous nitric acid of known concentration and common laboratory apparatus.

Steps:

- Add 25 cm³ of Kleen Up in flask
- Add nitric acid to the burette
- Add indicator to conical flask
- Start adding acid to the flask until indicator change colour to neutral
- Record volume of acid used
- Then calculate the concentration:

No of moles of Ammonia = No of moles of nitric acid

$$C \times V = C \times V$$

Q2: The percentage :

Copper(II) oxide and carbon are both black solids. Copper(II) oxide reacts with dilute sulfuric acid to form aqueous copper(II) sulfate. Carbon does not react with dilute sulfuric acid. You are given a mixture of copper(II) oxide and carbon and access to dilute sulfuric acid. Plan an experiment to investigate the percentage of copper(II) oxide in the mixture.

Steps:

- Weight the mixture (100g)
- Add excess sulfuric acid
- Warm and stir
- Filter , wash and dry the residue (carbon) between filter paper
- Then the mass of residue
- Calculate the percentage :

$$100 - \text{carbon mass}$$

Q3: The Maximum Mass:

Calcium burns in air to form calcium oxide. The reaction is vigorous and some of the calcium oxide can be lost as smoke.

Plan an investigation to determine the maximum mass of oxygen that combines to form calcium oxide when 2g of calcium granules are burnt in air.

You are provided with common laboratory apparatus and calcium granules.

Steps:

- Use mortar and pestle to crush calcium granules to increase surface area
- Add the powdered calcium to crucible covered with lid to prevent lost of calcium oxide smoke
- Start heating, calcium oxide is produced
- Stop the reaction and use balance to measure calcium oxide mass
- Then re-heat till constant mass and re-measure to make sure all calcium converted to calcium oxide
- Finally, subtract 2g from calcium oxide final mass result and the rest will be the mass of oxygen

Q4: The Solubility :-

Potassium chloride is a salt that dissolves in water.

The solubility of a salt is the mass in grams of the salt that dissolves in 100 cm³ of water at a particular temperature.

Plan an investigation to determine the solubility of potassium chloride in water at 40 °C.

You are provided with potassium chloride and common laboratory apparatus.

Steps:

- Measure 100 cm³ of water using measuring cylinder
- Heat to 40°C
- Add potassium chloride until no more dissolves
- Stir
- Filter the mixture
- Evaporate filtrate to dryness
- Weigh the solid using balance.

7. How to prepare an indicator :

Q1: Acid base indicators

Indicators are used to identify acids and bases.

Indicators can be obtained from berries and other fruits.

(a) Plan an experiment to obtain an aqueous solution of an indicator from some berries.

Steps :

- Crush the berries with pestle and mortar
- Add water and mix
- Then filter off , the filtrate is the solution of an indicator

Q2: (b) Plan an experiment to use the indicator solution to show that it is an effective indicator.

Steps :

- Add the indicator to hydrochloric acid
- Add the indicator to sodium hydroxide
- Colours must be different for each solution

11. Differentiate between 2 solutions :

Q1: Type of the solutions

Hair bleach

A solution of hydrogen peroxide can be used to bleach hair. Hairdressers buy '20 volume' hydrogen peroxide. One volume of this solution breaks down to form 20 volumes of oxygen. For example 10 cm^3 of 20 volume hydrogen peroxide will break down to produce 200 cm^3 of oxygen.

Old solutions of hydrogen peroxide will produce less oxygen than expected.

Plan an experiment to find out which of two solutions of hydrogen peroxide, **H** and **J**, is new and which is old. You are provided with common laboratory apparatus and the catalyst manganese(IV) oxide which speeds up the break down of hydrogen peroxide.

Steps :

- Add $x\text{ cm}^3$ of solution **H** to boiling tube
- Add manganese(IV) oxide
- Connect gas syringe to collect the gas
- Start heating for certain time
- Measure total volume of gas produced
- Repeat the experiment with solution **J** using same volume of hydrogen peroxide and same mass of manganese(IV) oxide
- Finally, the solution that produces large volume of oxygen gas is the new one.

Q2: Strength of the solution:

Oven cleaners contain an aqueous solution of sodium hydroxide.

Plan an investigation to show which of two different oven cleaners, **C** and **D**, contains the more concentrated solution of sodium hydroxide.

You are provided with common laboratory apparatus and chemicals.

Steps :

- Add 25 cm^3 of hydrochloric acid to a clean conical flask
- Add few drops of methyl orange indicator into the conical flask
- Fill the burette with oven cleaner **C** and note the starting volume
- Start titration until the colour change
- Then stop adding oven cleaner **C** and note the volume added
- Repeat the experiment using same volume of oven cleaner **B** and same volume and concentration of HCl

- The oven cleaner that use less volume to neutralize acid is the more concentrated one

8.Reactivity Series:

Q1:

You are provided with samples of three metals, tin, zinc and silver.

Plan an investigation to show the order of reactivity of these three metals.
You are provided with common laboratory apparatus and dilute acids.

Steps:

- Use 10 cm³ of hydrochloric acid in test tube .
- Add zinc metal .
- Count the number of bubbles
- Repeat experiment with silver and tin using same mass and surface area of metals .
- The metal with the highest bubbles is the most reactive.

2.Catalyst:

Q1:

A catalyst is a substance that speeds up the rate of a chemical reaction and remains unchanged at the end of the reaction.

Hydrogen peroxide solution, H₂O₂, breaks down to form oxygen. This decomposition is very slow if a catalyst is not used.

Plan an investigation to show that copper(II) oxide is a suitable catalyst for this reaction.
You can use aqueous hydrogen peroxide and common laboratory apparatus.

Step 1 Show that copper(II) oxide catalyses the decomposition of hydrogen peroxide and measure the rate of the reaction.

Steps:

- Use same volume and concentration of hydrogen peroxide.
- Add copper oxide to hydrogen peroxide.
- Measure the volume of gas produced per unit time using a gas syringe.
- Then compare that to the volume of gas produced from hydrogen peroxide without adding copper oxide.
- Compare volume of gas produced

Q2:

Step 2 Show that the copper(II) oxide is unchanged at the end of the decomposition.

Steps:

- Weigh the copper oxide before adding to the hydrogen peroxide.
- After the reaction is done, filter the copper oxide from the solution.
- Dry it using an oven (or between two filter papers)
- Weigh its mass
- Compare the final mass with the initial mass.

10. Electroplating:

Q1:

Metal rings can be coated with a layer of copper using electricity.

Plan an experiment to electroplate a small metal ring with copper.

You are provided with common laboratory apparatus, a copper rod, copper(II) sulfate crystals, water and a small metal ring.

Include a labelled diagram in your answer.

Steps:

- Prepare a copper sulfate solution.
- Set up a circuit and a source of electricity.
- Clean the ring using sand paper .
- Place the ring at the cathode.
- Place the copper rod in the anode.
- Switch on electricity.
- Make sure the ring is being rotated.
- Remove the ring after electroplating and wash it.