Name : _____( )  Date: _____
Class: Sec 4 ( )

## Practice on Planning Questions

**1** A white solid mixture contains mainly zinc sulfate with lead(II) sulfate as an impurity.

Plan an experiment to find out the percentage purity of the zinc sulfate in the mixture.
You should include details of the method and any apparatus used.

1. Weigh the mixture of white solids using an electronic weighing balance. Record its mass.
2. Add **excess** water to the mixture and stir to dissolve the zinc sulfate.
3. Filter the mixture to obtain insoluble lead(II) sulfate as the residue.
4. Wash the residue with a little amount of distilled water.
5. Dry the residue between pieces of filter paper.
6. Weigh the pure, dry lead(II) sulfate. Record the mass.

Results
Subtract the mass of lead(II) sulfate from the mass of impure mixture to find the mass of pure dry zinc sulfate.

% purity of $ZnSO_4$ = $\frac{mass\ of\ pure\ zinc\ sulfate}{mass\ of\ impure\ zinc\ sulfate}$ x 100%

Note: Alternatively, use the filtrate (zinc sulfate solution) and perform crystallisation (4 steps – **H**ere **C**omes **F**at **D**onkey)
Heat the solution until it is saturated. Cool the hot solution. Filter out the mixture.
Dry the crystals between pieces of filter paper.
(Do not wash because zinc sulfate is a soluble salt)

**2** Malachite is a naturally occurring form of copper(II) carbonate. Outline how a sample of the metal can 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. Jun 2010

Method 1

Use the mortar and pestle to crush large lumps of malachite to obtain malachite powder.

$CuCO_3 \rightarrow CuO + CO_2$
$CuO + C \rightarrow Cu + CO_2$

Add carbon powder to the crushed malachite.

Heat the mixture of malachite and carbon in a crucible strongly until the pink solid copper is obtained.

On heating, the copper(II) carbonate to decompose to form copper(II) oxide which will then be reduced by the carbon to form copper.

Method 2

Use the mortar and pestle to crush large lumps of malachite to obtain malachite powder.

Add dilute sulfuric acid into the malachite to obtain copper(II) sulfate solution.

Electrolyse the copper(II) sulfate solution using copper cathode and graphite anode.

Copper will be formed on the copper cathode.

**3** Petrol is a liquid fuel obtained from petroleum (crude oil).

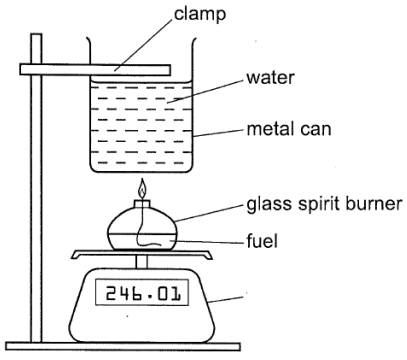
Bioethanol is a liquid fuel made from the fermentation of carbohydrates obtained from plants such as sugar cane.

Plan an experiment to investigate which of these two fuels produces more energy.

You may draw a picture to help you answer the question. Jun 2011

1. Set up the apparatus as shown in the diagram below.
2. Weigh a fixed mass of petrol using an electronic weighing balance.
3. Measure 50 $cm^3$ (or fixed volume) of water using a measuring cylinder and pour it into a beaker.
4. Use a thermometer to measure the initial temperature of the water.
5. Burn the petrol and use the flame to heat up the water.
6. Measure the final temperature of the water when all the petrol is burnt away.
7. Find the temperature change in the water.
8. Repeat the experiment with the same mass of bioethanol and same volume of water.

The fuel that gives the larger rise in temperature of the water produces more heat energy.




Note: You cannot burn petrol or bioethanol directly and measure the temperature of the petrol/bioethanol because they are flammable.

**4** 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 investigate if these inhibitors prevent the corrosion of steel and which of these inhibitors is the most effective. Jun 2012

Measure 3 portions of x $cm^3$ of water using a measuring cylinder and place it in three different test tubes.

Add the same volume of the corrosion inhibitors R, S and T and place each into a test tube of the water.

Place an iron nail of the same size and mass into each of the test tube and leave it for one day.

Observe and record the time that the nail starts to rust in each test tube.

The test tube with the nail that takes the longest time to start rusting contains the most effective inhibitor.

**5** 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 and distilled water.

Plan an investigation to find out which sample of water causes iron to rust the fastest. Nov 2010

Method 1

Measure x $cm^3$ of tap water, sea water and distilled water using a measuring cylinder and place it in three different test tubes.

Place an iron nail of the same size and mass into each of the test tube and leave it for one day.

Take out each nail and dap dry with filter paper gently.

Weigh each rusted nail.

The water with the heaviest nail causes iron to rust the fastest.

Method 2

Measure x $cm^3$ of tap water, sea water and distilled water using a measuring cylinder and place it in three different test tubes.

Place an iron nail of the same size and mass into each of the test tube and leave it for one day.

Observe and record the time that the nail starts to rust in each test tube.

The test tube with the nail that takes the shortest time to start rusting contains the water that causes iron to rust the fastest.

**6** Seawater contains sodium chloride and other salts.

Plan an experiment to find the mass of salts in 1 $dm^3$ of seawater.

You will be provided with a small bottle of seawater.
You should include details of the method and any apparatus used. Nov 2011

Measure 1 $dm^3$ of seawater using a measuring cylinder.

Weigh an empty evaporating dish.

Pour the seawater into the evaporating dish.

Heat the seawater to dryness to evaporate away all the water.

The salt will be left inside the evaporating dish.

Weigh the salt and the evaporating dish.

Find the mass of salt and that will give the mass of salt in 1 $dm^3$ of seawater.

**7** Kleen Up is a colourless liquid used to clean work surfaces and glass windows. Kleen Up contains ammonia solution which is a weak alkali.

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. Nov 2011

Pipette 25.0 $cm^3$ of Kleen Up and place it in a conical flask.

Add methyl orange as an indicator.

Place dilute nitric acid of known concentration in the burette.

Titrate the Kleen Up with dilute hydrochloric acid from the burette until one drop of the acid causes a change in the methyl orange from yellow to orange ~~red.~~

Repeat the titration until 2 consistent readings are obtained.

Use the volume of solutions and concentration of dilute hydrochloric acid to calculate the concentration of aqueous ammonia in Kleen Up.

**8** Calcium carbonate is found in limestone and marble. All carbonates react with hydrochloric acid to from chlorides. Calcium carbonate is insoluble in water but calcium chloride is soluble in water.

Most impurities in limestone and marble are insoluble.

Plan an experiment to find out whether limestone or marble contain more insoluble impurities.

You are provided with common laboratory apparatus. Nov 2012

Weigh a fixed mass of limestone.

Crush it with pestle and mortar and add excess dilute hydrochloric acid until no more bubbling occurs / reaction is complete.

Filter the mixture to obtain the insoluble impurity as residue.

Wash the residue with deionised water and dap dry with filter paper.

Weigh the completely dry residue.

Repeat the experiment with the same mass of marble.

Compare the mass of insoluble residue to determine whether limestone or marble has more insoluble impurities.

**9** Coal is a fossil fuel. When heated strongly, sulfur dioxide gas is one of the products formed. Sulfur dioxide changes aqueous acidified potassium manganate(VII) from purple to colourless.

Plan an investigation to show which of two different types of coal produces more sulfur dioxide gas when heated. Nov 2012

Use a weighing balance to measure x g of one type of coal.

Use a pestle and mortar to crush the coal.

Heat the coal in a test tube in a fume cupboard and bubble the sulfur dioxide gas into a known volume of acidified potassium manganate(VII) solution.

Measure the time taken for the purple acidified potassium manganate(VII) solution to turn colourless.

Repeat the experiment with the same mass of the other type of coal and same volume of acidified potassium manganate(VII) solution.

Compare the time taken by the sulfur dioxide gas to decolourise the purple acidified potassium manganate(VII) solution.

**10** You are provided with 2 bottles of white solids whose label has fallen off. One bottle contains sodium carbonate and another contains sodium hydrogencarbonate.

Plan an investigation to identify the 2 white solids.

**Concept : $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$**
**$Na_2CO_3$ is a stable carbonate and cannot decompose on heating.**

**Use of acid will not work because both carbonates will give carbon dioxide.**

**$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$**
**$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$**

*Heating of metal carbonates/hydrogencarbonates produces the same products.
Heating of metal hydrogen carbonates does not give hydrogen gas.
There are only 3 ways to produce hydrogen in the laboratory besides electrolysis of water or cracking of oil.
Metal + water/steam/acid

Place a spatulaful of white solid and put it in a dry test-tube.

Set up the apparatus as shown in the diagram.

Heat the test-tube of solid using a Bunsen burner and observe if white precipitate is observed in the test-tube containing limewater.

If white precipitate is observed, then the test-tube contains sodium hydrogen carbonate. If no precipitate is observed in the limewater, then it must be Calcium carbonate.

solid