4 Some cleaning products are mixtures. The three substances present in a cleaning product are listed in the table.

substance	state at room temperature	physical property
sodium carbonate	solid	melts at 858 °C
ethanol	liquid	boils at 78 °C
limonene	liquid	boils at 176 °C

Use the information in the table to plan an experiment to obtain a sample of each substance from a mixture of the three substances.

You are provided with a mixture of the three substances and common laboratory apparatus.

filter the mixture to get sodium carbonate. wash and dry between filter paper.
heat the filtrate in distillation flask with a fractionating column and condenser
attached to it using a bunsen burner. place the thermometer in the fractionating
column. ethanol start to boil. ethanol is condensed. ethanol is collected first in the
beaker because it have lower boiling point, temperature stay constant until all
ethanol is collected. stop heating when the temperature starts to rise again.
limonene is remained in the distillation flask.

4 When solid **C** and solid **D** separately react with dilute hydrochloric acid, one reaction is exothermic and one reaction is endothermic.

Plan an investigation to determine:

- which reaction is exothermic and which reaction is endothermic
- which energy change is greater.

You are provided with solid **C** and solid **D**, dilute hydrochloric acid and common laboratory apparatus.

put 50cm3 of hydrochloric in beaker using a graduated pipette. measure the initial temperature of HCl t0. measure 30g of solid C using a balance. add 30g of solid C into the HCl stir using the beaker. after 120s record the temperature of solution in beaker, record the temperature t1. temperature change = t1-t0, record temperature change. repeat using same mass of solid D, same volume of hydrochloric acid, same concentration of hydrochloric acid, same initial temperature of hydrochloric acid. compare the temperature change for both. if temperature change in negative then the reaction is endothermic, if the temperature change is positive then the reaction is exothermic. compare the magnitude of the temperature change one with greater temperature change gives greater energy change.

[6]

[Total: 6]

4 Propanone and ethyl ethanoate are both solvents which can be used to remove paint.

Plan an investigation to determine which of these **two** solvents is better to use to remove paint.

You are provided with glass slides, paint, the two solvents and common laboratory apparatus.

paint the top surface of a glass slide completely. let the paint dry. using a burette place 0.5cm3 of propanone on the glass slide. gently rub the glass slide using a piece of cotton. add another 0.5cm3 drop of propanone on the glass slide and rub until all the paint is removed using the same cotton piece. count/record the number of drops of propanone needed to remove the paint completely. repeat and average the number of drops. repeat with ethyl ethanoate. use the same paint, same thickness of layer of paint on the slide, same type of paint, same colour of paint, same concentration of ethyl ethanoate/solvent. same size of glass slide. repeat and average. the one with the least amount of drops required is the best solvent.

[6]

[Total: 6]

4 Some trees have purple leaves. The purple colour is a mixture of coloured pigments.

Plan an experiment to extract and separate the coloured pigments present in the purple leaves.

You are provided with some purple leaves, sand, ethanol and common laboratory apparatus.
You may draw a diagram to help you answer the question.

crush the leaves in a using a mortal and pestle with sand. filter the mixture to extract the dye. draw a baseline in pencil on a chromatography paper. put few drops of dye on the baseline. put a suitable solvent like water or ethanol in a chromatography tank. put the paper in a chromatography tank. wait for the solvent level to reach top of the page. remove the paper. colored pigment are separated. it colour not visible then use locating agent.

4 Aqueous solutions of barium hydroxide are alkaline.
Plan an investigation to find the concentration of an aqueous solution of barium hydroxide.

You are provided with an aqueous solution of barium hydroxide, dilute hydrochloric acid of known concentration and common laboratory apparatus.

put known (25cm3) volume of barium hydroxide in a conical flask. add 5cm3 of phenolphthalein indicator. fill a burette with dilute hydrochloric acid. record the initial volume of dilute hydrochloric acid in the burette. put drop by drop dilute hydrochloric acid from the burette into the conical flask. stir after each portion of acid is added. keep adding until the colour has just changed. record the volume of acid needed. repeat without indicator. record the volume of acid and average. use the equation - $Ba(OH)2 + 2HCl \Rightarrow BaCl2 + 2H2O$. use mole = concentration * volume (in dm3) to find number of moles of HCl needed to neutralize barium hydroxide. use the ratio. to find the number of moles of barium hydroxide. half the moles of HCl gives moles of barium hydroxide. use concentration = mole/volume (in dm3) to calculate the volume of barium hydroxide.

[6]

4 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 cm^3 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.

add 100cm3 of water in a beaker using a pipette. use a electric heater to heat the water to 40 deg C. use a spatula to add small portions of KCl. keep stirring using a glass rod... keep adding until no more dissolves. filter the excess. evaporate filtrate to dryness ..... measure the mass of the salt left. repeat and average the mass of KCl. .....

4 Magnesium reacts with dilute sulfuric acid at room temperature to form hydrogen gas.

Plan an experiment to find the rate of reaction between magnesium ribbon and dilute sulfuric acid.

In your answer:

- include a diagram
- indicate how you could use the results obtained to find the rate of reaction.

You are provided with common laboratory apparatus, magnesium ribbon and dilute sulfuric acid.

place magnesium ribbon in test tube. place test tube inside an beaker. put dilute sulfuric acid in the beaker. close the beaker and attach a gas syringe as shown in the diagram. now carefully shake the beaker so that magnesium gets out of test tube and fall in sulfuric acid and react. once the reaction starts immediately start the stop watch. use the gas syring to note the volume of hydrogen produced at equal intervals of 10s. measure the time until volume of hydrogen produced no longer increases. divide the voulme of hydrogen/time taken(in seconds) to get the rate of reaction.

4 Potassium nitrate and ammonium chloride are two salts. The energy change when they each dissolve in water is endothermic.

Plan an experiment to show which of these two salts produces the larger endothermic energy change per gram.

Your answer should include:

- any measurements you would take and record
- how the results could be used to draw a conclusion.

You are provided with potassium nitrate and ammonium chloride, distilled water and common laboratory apparatus.

in a conical flask add known volume of water. place a thermometer in the flask. measure the initial temperature of water using the thermometer. add 10 g of potassium nitrate. stir. record the final temperature reading on the thermometer. repeat using 10g/same mass of ammonium chloride. use the same volume of water. same initial temperature. calculate and record the temperature change for both. energy change per gram = temperature change/mass. salt with the highest temperature change produces largest endothermic energy per gram. salt with lowest temperature change produces smallest endothermic energy per gram.

4 The table gives some information about the properties of three substances found in a hand cream.

substance	reaction with dilute nitric acid
polystyrene beads	no reaction
calcium carbonate	reacts and dissolves
sodium fluoride	dissolves

Use the information in the table to plan an experiment to obtain a pure, dry sample of polystyrene beads from this mixture of substances.

You are provided with a mixture of the three substances and common laboratory apparatus.

place the mixture in a beaker. add excess of dilute nitric acid in the beaker until all the reactants have dissolved. filter the solution. wash the residue under running water. dry the residue between filter paper.

4 Iodine dissolves in two different solvents: ethanol and hexane.

Plan an experiment to find out in which solvent iodine is the most soluble at room temperature.

You are provided with iodine, the two solvents and common laboratory apparatus.

put known volume of ethanol in a beaker. measure a large sample mass of iodine. add excess of iodine in the beaker. stir. filter the excess. wash under water and dry between filter paper. mix with the initial sample. re weigh the sample. calculate change in mass of sample to get mass of iodine used. repeat using same volume of hexane at same room temperature. the one with the largest change in mass is the solvent in which iodine is most soluble at room temperature.

4 Calcium carbonate, calcium hydroxide and calcium oxide can be used to neutralise the acid in soil.

Plan an investigation to find out which of these calcium compounds neutralises acid most effectively.

You are provided with the three calcium compounds, dilute hydrochloric acid and common laboratory apparatus and chemicals.

fill a burette with hydrochloric acid till 0 mark. measure the calcium compound. add it in a conical flask. add thymolphthalein indicator into the conical flask. gradually add small portions of acid from the burette into the flask. swirl after adding each portion. keep adding the colour has just changed to colourless. record the volume of hydrochloric acid needed. repeat for other calcium compound. using the same mass of compound and same concentration of HCl. the which can neutralise the largest volume of HCl is most effective in neutralising acid.

4 Azurite is an ore of copper which contains copper(II) carbonate. Azurite contains no other metal ions.

Plan an experiment to show how a sample of copper could be obtained from large lumps of azurite.

Your answer should include:

- descriptions of the reactions involved
- the expected observations.

You are provided with a large lump of azurite and common laboratory chemicals and apparatus.

crush large lumps of azurite using a mortal and pestle. heat the azurite with carbon in a crucible using a bunsen burner to obtain copper. redox reaction reaction takes place. brown solid forms.

4 A toothpaste contains:

- sodium fluoride
- calcium carbonate
- silica
- mint flavouring.

Sodium fluoride and the mint flavouring are soluble in water.
Calcium carbonate and silica are insoluble in water.
Calcium carbonate reacts with dilute hydrochloric acid to form the soluble salt calcium chloride.

Plan an investigation to find the percentage by mass of silica in the toothpaste.

In your answer you should include how you will calculate the percentage by mass of silica in the toothpaste.

You have access to normal laboratory apparatus.

measure the mass of silica using a balance m1. add water to the toothpaste in a beaker. stir. add excess dilute hydrochloric acid into the beaker. stir. filter the solution. wash the residue under running water and dry the residue between filter paper. measure the mass of the residue m2. repeat and average the mass.

% by mass of silica = m1-m2/m1 *100

4 Brass is a mixture of two metals, copper and zinc.

Copper does not react with dilute sulfuric acid. Zinc reacts with hot dilute sulfuric acid to form the soluble salt zinc sulfate.

Plan an investigation to find the percentage by mass of zinc in a sample of brass.
In your answer you should include how to calculate the percentage by mass of zinc.

You have access to normal laboratory apparatus.

measure the mass of brass using a balance(m1). place it in a beaker. add excess of hot dilute sulfuric acid in the beaker. place the beaker in a water bath. stir the solution. solid copper will form. wait until no more solid forms. filter the copper from the beaker. wash copper under water, dry between filter paper, and weight it using a balance(m2). % by mass of zinc = ((m1-m2)/m1)*100. repeat with same mass of brass and average.

4 A mixture contains three solid compounds:

- copper(II) sulfate
- cetyl alcohol
- silicon dioxide.

The table gives some information on the solubility of these three solids.

name of compound	solubility in water	solubility in propanone
copper(II) sulfate	soluble	insoluble
cetyl alcohol	insoluble	soluble
silicon dioxide	insoluble	insoluble

Plan a method to obtain a pure sample of each of the three solids, copper(II) sulfate, cetyl alcohol and silicon dioxide, from the mixture.

You have access to normal laboratory apparatus.

add water to the mixture in a beaker. stir. filter silicon dioxide and cetyl alcohol. wash under running water and dry between filter paper, keep the residue aside for sometime. heat the filtrate to evaporate water. precipitate of copper will start to form. heat until no more precipitate is produced. filter the precipitate. wash under running water and dry between filter paper - copper sulfate. to the residue add propanone. filter silicon dioxide. wash under running water and dry between filter paper - silicon dioxide. heat the filtrate to evaporate propanone. precipitate of cetyl alcohol will start to form. heat until no more precipitate is produced. filter the precipitate. wash under running water and dry between filter paper - cetyl alcohol

..... [6]

4 Stayclean and Brightwhite are two brands of washing powder. Both contain sodium carbonate. Sodium carbonate is soluble in water and reacts with dilute sulfuric acid to produce carbon dioxide gas.

Plan an investigation to determine which of the two washing powders, Stayclean or Brightwhite, contains the greatest percentage of sodium carbonate.

You are provided with samples of the two washing powders and common laboratory apparatus and chemicals.

take same mass of both washing powders. add stay clean washing powder in a conical flask. add excess of sulfuric acid. measure the mass at the start of the reaction. then measure the mass at the end. calculate the change in mass repeat for bright white washing powder using the same mass and surface area of powder. the one with the largest change in mass has the highest percentage of sodium carbonate.

4 Many window-cleaning products contain aqueous ammonia. Aqueous ammonia is an alkali that reacts with dilute acids.

Plan an investigation to find which of two window-cleaning products contains the most concentrated aqueous ammonia. Include in your plan:

- the method you will use
- how your results will be used to determine which window-cleaning product contains the most concentrated aqueous ammonia.

You are provided with an aqueous solution of the two window-cleaning products, dilute hydrochloric acid of known concentration and common laboratory apparatus.

take equal volume of each window-cleaning product in two separate conical flask using pipette.

add equal volume of phenolphthalein. using a burette add same concentration of HCl in both

until the colour has just changed. record the volume of HCl used. repeat without indicator.

the product which required the most amount of acid to change colour has the highest

concentration of ammonia. wear eye protection/goggles/gloves/lab coat. repeat and take

average for more reliable results.

4 Cobalt, manganese and nickel are metals. They react with dilute hydrochloric acid to form hydrogen gas.

Plan an investigation to find the order of reactivity of these three metals.

You are provided with:

- samples of each metal
- dilute hydrochloric acid
- common laboratory apparatus.

Your plan must make it clear how your investigation will be a fair test and how you will use your results to place the metals in order of reactivity.

take equal mass and same surface area pieces of one metal. put it in a test tube. add known volume and known concentration of HCl in conical flask. put the test tube containing the metal in the flask. put a bung in the flask. connect it to a gas syringe. shake the flask so that the metal falls out of tube into the flask. start the stopwatch collect the hydrogen gas. record the volume of gas produced after 3minutes. repeat and take average value. repeat for the rest two metals using the same mass and surface area of metal. use the same apparatus. collect the volume of hydrogen for all of them. the metal which produces the biggest amount of hydrogen in 3 min is the most reactive. the one which produces the least hydrogen is least reactive.

4 Catalysts are substances which increase the rate of a reaction but are unchanged at the end of the reaction.

Aqueous hydrogen peroxide decomposes slowly to form water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Copper(II) oxide is an insoluble solid.

Plan an investigation to find out if copper(II) oxide is a catalyst for the decomposition of hydrogen peroxide. You must include how your results will tell you if copper(II) oxide is a catalyst. You have access to copper(II) oxide, aqueous hydrogen peroxide and all normal laboratory apparatus.

add known volume hydrogen peroxide in a conical flask. add 10g of copper oxide to it. measure the volume of gas produced in 20minutes. filter copper oxide. weight copper oxide. if weight is same then it is catalyst. repeat the investigation without copper oxide. if smaller volume of gas is produced without copper oxide then copper oxide is a catalyst.

4 Cobalt is a metal. Cobalt is between copper and iron in the reactivity series. The mineral spherocobaltite contains the compound cobalt(II) carbonate and no other metal ions. Cobalt(II) carbonate is insoluble in water and reacts with dilute acids to form an aqueous solution of a salt.

Describe how you would obtain a sample of cobalt metal starting with a large lump of spherocobaltite. You have access to all normal laboratory apparatus and chemicals.

crush into powder using mortal and pestle. heat it with carbon in a crucible. cobalt is formed.

crush into powder using mortal and pestle. add dilute hydrochloric acid to it.

perform electrolysis of the solution using inert carbon electrodes. cobalt forms at the negative electrode/cathode.

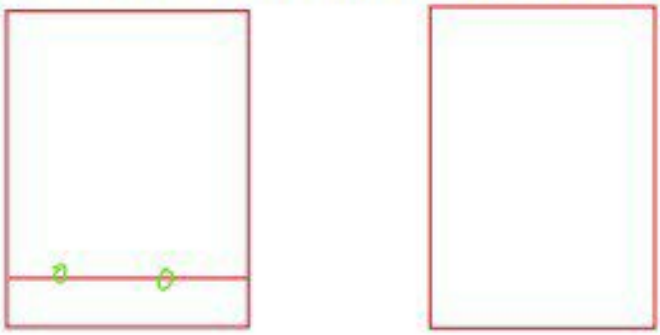
crush into powder using mortal and pestle. add dilute hydrochloric acid to it. add metal more reactive than cobalt example iron. cobalt is formed.

4 Tartrazine is used as a yellow food colouring.

Plan an investigation to find out if a yellow sweet contains tartrazine. Explain how your results will tell you if the sweet contains tartrazine.

You have access to all normal laboratory materials, a yellow sweet and a sample of tartrazine.

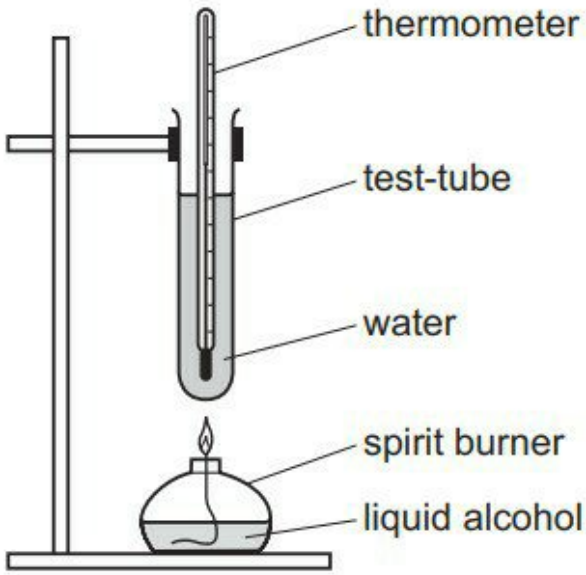
You may draw a labelled diagram as part of your answer.



crush and grind the yellow sweet using a mortal and pestle. add some water. stir. filter the solution. throw the residue and keep the filtrate. on a chromatography paper, draw a base line in pencil as in the diagram. put one drop of the filtrate and one drop of tartrazine on the base line as shown in the figure. place the chromatography in a chromatography tank filled with suitable solvent like water. keep the solvent level below the baseline. leave the apparatus for some time. when the solvent level have react almost top remove the chromatography paper from the chromatography tank. colours will have been separated. if the coloured spots are not visible then use a locating agent. conclusion- measure the distance moved by the tartrazine drop and the yellow sweet drop (there might be more than one spots in sweet). if the distance by any yellow sweet drop is the same distance moved by the tartrazine spot then the sweet contain tartrazine, if not it does not contain tartrazine. repeat the experiment twice more.

[6]

4 The energy given out when different liquid alcohols are burned can be compared using the apparatus shown.



Describe how the apparatus shown can be used to compare the amount of energy given out by three different liquid alcohols, ethanol, propanol and butanol. Your answer should include how the results can be used to determine which fuel gives out the most energy.

take known volume of ethanol in a spirit burner. place under the measuring cylinder as shown. record the initial temperature of water (t1). light the spirit for about 2 minutes. after 2 minutes turn/blow off the spirit and immediately record the final temperature of water (t2). t2-t1 gives the temperature increase. repeat with the same volume and same concentration of propanol and then butanol. use same volume of water for all. keep the distance of the flame to the base of the tube the same. conclusion - the fule with the highest temperature increase gives the most energy.

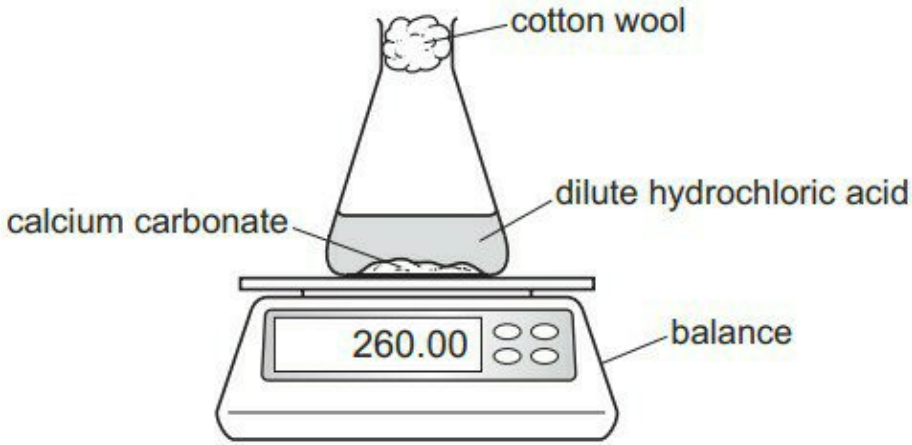
4 The mineral epsomite contains hydrated magnesium sulfate. When epsomite is heated strongly, it loses water and eventually becomes anhydrous magnesium sulfate.

Plan an investigation to find the percentage by mass of water in a sample of epsomite. Your plan should include how you would calculate the percentage by mass of water in epsomite.
You have access to common laboratory apparatus.

put 100g(m1) of epsomite in crucible use a balance to measure 100g of epsomite. put the beaker of a tripod stand and heat strongly. heat until all the water has evaporated. to check if all the water has evaporated - heat and weight until mass is constant. once all the water has been evaporated weigh the epsomite - m2. m2 -m1=mw, gives mass of water in 100g of epsomite. mw/100 *100 gives the percentage by mass of water in 100g of epsomite.

wear goggle, gloves, lab coat and tie hairs if needed.

4 Dilute hydrochloric acid reacts with calcium carbonate to make carbon dioxide gas. The apparatus shown in the diagram can be used to follow the progress of the reaction. The carbon dioxide gas leaves the flask causing the mass shown on the balance to decrease.



Plan an investigation, using the apparatus shown in the diagram, to find out how the temperature of the dilute hydrochloric acid affects the rate of the reaction. Your plan should include how your results will show how the temperature of the dilute hydrochloric acid affects the rate of the reaction.

You are provided with dilute hydrochloric acid, calcium carbonate and common laboratory apparatus.

insulate a conical flask heat dilute hydrochloric acid to 70degC. immediately pour into conical flask, put it on balance add calcium carbonate. put the cotton wool at the mouth of the flask . start the stop watch record the initial mass of the apparatus at time=0s. record mass measurement at equal intervals of 20s. in a table write down the temperature of HCl, initial vol, initial temp, and temp at different intervals. plot a graph. repeat using same volume and same concentration of HCl at 60deg C. use same mass of calcium carbonate with the same surface area. use same thickness and same type of insulation. repeat and take average. use tong. wear gloves, goggles and lab coat. the steepest line in the graph gives fastest rate of reaction.

4 When solution **A** and solution **B** are mixed they react slowly to form iodine.
Starch solution is added to the mixture to act as an indicator.
When a certain amount of iodine is made there is a sudden colour change to blue-black.

Plan an investigation to find the effect of temperature on the rate of the reaction between solution **A** and solution **B**.

You are provided with solution **A**, solution **B**, starch solution and common laboratory apparatus.

use at least 3 different temperatures. use thermostatically controlled water baths to maintain desired temperature. equilibrate a water bath at desired temperature. add known volume of solution A and B in a test tube. immediately place the test tube in water bath and add known volume of starch solution and start the stop watch. stop the stop watch when there is a sudden colour change to blue-black. record the time taken for colour change to be observed. repeat for other temperatures using the same volume of A and same volume of B and same volume of starch and same size of test tube. plot a temperature(x-axis) against time taken(y-axis) graph. compare the results to see if change in temperature produces the rate of reaction between solution of A and solution B. is time taken is small/short then rate of reaction is high. if time taken is more then rate of reaction is slow/low.

4 A sample of muddy river water contains water, dissolved solids and insoluble solid mud.

Plan an investigation to find the concentration of dissolved solids, in g/dm^3, in the river water.

In your answer state how you will work out the concentration of the dissolved solids in g/dm^3.

You are provided with a small sample (less than $1\,dm^3$) of muddy river water and common laboratory apparatus.
($1\,dm^3 = 1000\,cm^3$)

measure 0.5dm3 or 500cm3 of sample using a measuring cylinder. filter the sample using a filter paper and funnel. remove the residue. place the filtrate in a beaker. heat the beaker using a bunsen burner until all the water is boiled. dissolved solids will become become solids again. remove the solids from the beaker. dry between filter paper. measure the mass of this solid m. m/0.5dm3 is the concentration in half dm3. multiply m by 2 to get concentration in dm3. 2m/dm3. repeat the experiment and average the mass.

4 The diagram shows some coffee beans.

Caffeine occurs naturally in coffee beans. Caffeine is a white crystalline solid. It is very soluble in hot water but much less soluble in cold water.

Plan an investigation to obtain a pure crystalline sample of caffeine from coffee beans.

Assume that all other soluble substances in coffee beans are very soluble in both hot and cold water.

You are provided with coffee beans and common laboratory apparatus.

crush and grind the coffee beans. put the powder in hot water. mix/stir the solution. heat the water till crystallisation point/ until saturated. let the solution cool. crystals of caffeine forms. filter the crystals. wash under running cold water. dry between filter paper.