Chemistry

FOR IGCSE

Final Revision

Paper 6

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Identification of Ions and Gases

Tests for Gases:

Gas	Formula	Tests
Ammonia	NH_3	Turns damp red litmus paper blue
Carbon dioxide	CO_2	Turns limewater milky
Oxygen	O_2	Relights a glowing splint
Hydrogen	H_2	'Pops' with a lighted splint
Chlorine	Cl_2	Bleaches damp litmus paper
Sulfur dioxide	SO_2	Turns acidified aqueous potassium dichromate(VI) from orange to green

Tests for Anions:

Anion	Test	Result
Carbonate (CO_3^{2-})	Add dilute acid	Effervescence, carbon dioxide produced
Chloride (Cl^-) (in solution)	Acidify with dilute nitric acid, then add aqueous silver nitrate	White ppt.
Bromide (Br^-) in solution	Acidify with dilute nitric acid, then add aqueous silver nitrate	Cream white ppt.
Iodide (I^-) (in solution)	Acidify with dilute nitric acid, then add aqueous silver nitrate	Yellow ppt.
Nitrate (NO^{3-}) (in solution)	Add aqueous sodium hydroxide, then aluminium foil; warm carefully	Ammonia produced
Sulfites SO_3^{2-}	with dilute acids	Sulfur dioxide gas is given off ▪ change purple aqueous potassium manganate(VII) to colourless
Sulfate (SO_4^{2-})	Acidify, then add aqueous barium nitrate	White ppt.

Tests for aqueous cations:

Cation	Effect of aqueous sodium hydroxide	Effect of aqueous ammonia
Aluminium (Al^{3+})	White ppt., soluble in excess giving a colourless solution	White ppt., insoluble in excess
Ammonium (NH_4^+)	Ammonia produced on warming	–
Calcium (Ca^{2+})	White ppt., insoluble in excess	No ppt. or very slight white ppt.
Copper (Cu^{2+})	Light blue ppt., insoluble in excess	Light blue ppt., soluble in excess, giving a dark blue solution
Iron(II) (Fe^{2+})	Green ppt., insoluble in excess	Green ppt., insoluble in excess
Iron(III) (Fe^{3+})	Red-brown ppt., insoluble in excess	Red-brown ppt., insoluble in excess
Chromium Cr^{3+}	Green ppt. soluble in excess	dark green solution forms
Zinc (Zn^{2+})	White ppt., soluble in excess, giving a colourless solution	White ppt., soluble in excess, giving a colourless solution

Cations: use of the flame test to identify

Lithium	**Crimson**
Sodium	**Yellow**
Potassium	**Lilac**
Copper(II)	**Green**

How to know

Observation	Conclusion	
Effervescence , turbid lime water milky	CO_2 gas	Carbonate CO_3^{2-}
Coloured salt	Transition element	
Blue ppt.	copper	
Formation of a gas makes pop sound	An active metal react with the acid	
A liquid changes blue cobalt chloride into purple	water	
Colour of copper oxide	black	
Colour of copper	Red / orange	

Any reactive metal reacts with water or acids and temperature rises

Oxidation of copper changes the color from **orange (red)** to **black**

Reduction of cooper oxide changes the color form **black to red**

Which indicator can be used when dilute nitric acid reacted with aqueous solutions of two different alkalis

phenolphthalein / litmus not pH or universal indicator

How can you test pure water (physical test)

1- boiling point; 100 °C;

Give a chemical test for water .

1- Test anhydrous copper(II) sulfate;
Result: turns blue

2- test: cobalt(II) chloride (paper);
result: turns pink

Starch in reactions contain iodine

turns blue and can be used as indicator

Suggest

1- Suggest one advantage of using a pipette to measure the volume of----------

more) accurate;

2- Suggest and explain one disadvantage of using a pipette to measure the volume of the hydrogen peroxide

Solution slow to run out of pipette;
difficult to know when to start timer
reaction does not start at once
inaccurate time measurement

3- Suggest one safety precaution when using chromium(VI).

fume cupboard / protective clothing, e.g. gloves or goggles;

4- **Suggest why a polystyrene cup was used in these experiments and not a copper can.**

polystyrene is an insulator / copper is a (good) conductor

5- Suggest and explain one improvement to increase the accuracy of the experiments.

insulate / lag tube / use a lid; to reduce heat losses;
OR use a pipette / burette; instead of measuring cylinder

6- Suggest why potassium was <u>not</u> used as one of the metals in to react with acids .

potassium is too reactive / dangerous;

7- Suggest how a sample of copper could be obtained from the solution of copper (II) nitrate. Explain your suggestion.

Add magnesium which is more reactive (magnesium displays copper)
displacement reaction

8- Suggest one way to improve the reliability of the results of these experiments

Repeat **and** average or compare results

9- Suggest the purpose of the cotton wool as a cover for a conical flask

Allow gas to escape **and** prevents loss of the liquid (acid or other)

10- Suggest how a sample of lead could be obtained from the solution of lead(II) nitrate.

Add magnesium which is more reactive (magnesium displays copper)
displacement reaction

11- Suggest why a stopper is not used in the top of the boiling tube.

pressure of gas build up and the tube may explode

1- State one source of error in the experiments. (titration by using measuring cylinder)Suggest an improvement to reduce this source of error.

source of error: heat losses / using a measuring cylinder
improvement: lag or insulate / use burette

2- State one safety precaution that should be taken when magnesium is burned in air.

Goggles / blue glass

3- **Explain one disadvantage of using a beaker instead of a conical flask.**
difficulty in swirling or shaking;

4- **Why would it be better to use an electrical heater instead of a Bunsen burner to heat the water and ethanol mixture?**
Ethanol is flammable

5- **Explain why the sketch graph is horizontal at the end (no change)**
reaction finished / no more gas given off

6- **Which liquid would collect first (vapour of ethanol or water)? Explain your answer.**
Ethanol has lower boiling point;

7- **Why must the level of the solvent be below the base-line during chromatography ?**
Bec. dyes dissolve in the solvent

8- **Why is the base-line not drawn in ink?**
ink is soluble .

Sources of errors and how can be improved

	source of error	improvement
1	heat losses	use a lid / lag the apparatus
2	use of a measuring cylinder	use a pipette/burette
3	wet cup in the second experiment	use new/another cup **OR** dry the cup
4	the solid absorbs water from the air	store in a sealed container / airtight container / desiccator
5	only done once	repeat **and** average
6	different masses of solids used / masses of solids not measured	use same mass of solid / weigh the solids

liquid	chemical test	result
pentene	Bromine water	
aqueous sodium iodide	Nitric acid followed by silver nitrate	
aqueous ammonia	Solutions of Copper salts	

Plan an experiment

1- Plan an experiment to obtain a sample of pure water from this salt (Nickel sulfate-6-water, $NiSO_4.6H_2O$, is a blue crystalline salt.

Method

1- heat the salt;
2- condenser shown on diagram;
3- drops of water / condensation;
4- colour change / blue solid becomes paler;

2- Plan an experiment to obtain pure crystals of potassium sulfate from sulfuric acid and potassium hydroxide solution.

Making the salt

any 4 from:

- known volume sulfuric acid;
- add named indicator;
- add potassium hydroxide solution to the acid until the indicator changes colour or is neutralised;
- measure the volume of potassium hydroxide solution added;
- repeat without indicator OR add (decolourising) charcoal;

Obtaining crystals

any 2 from:

- heat solution to crystallising point until half evaporated OR until crystals (start to) form
- leave to cool;
- filter to get crystals;
- dry crystals on filter paper

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

weigh calcium;
with lid / cover;
heat / burn;
allow air to enter / lift lid;
cool;
reweigh CaO;
reheat to constant mass;
calculate / find the difference;

4- Calcium carbonate is found in limestone and in marble. All carbonates react with hydrochloric acid to form chlorides. Calcium carbonate is insoluble in water but calcium chloride is water soluble. Most impurities in limestone and marble are insoluble. Plan an experiment to fi nd out which of limestone and marble contain most insoluble impurities. You are provided with common laboratory apparatus

equal weight/mass of limestone and marble //// crush
add excess hydrochloric acid and stir //// filter mixture
dry ///// reweigh
conclusion

5- Plan an investigation to find out which of two different Limes, calcium carbonate or calcium oxide, will neutralise more acid.

method adding Agri Lime to acid

add weighed amount of known mass of Agri Lime **Q**
to a known volume of acid
with a named indicator added to the acid
until the indicator changes colour
note the mass of Agri Lime **Q** added
repeat with Agri Lime **R**
conclusion, e.g. 'the experiment using the smaller amount of Agri Lime is better'

OR

method adding acid to Agri Lime

use weighed amount / known mass of Agri Lime **Q**
add acid to it gradually / from a burette
with a named indicator added to the acid
until the indicator changes colour
note volume of acid added
repeat with Agri Lime **R**
conclusion, e.g. 'the experiment using the larger volume of acid is better'

6- Some cleaning products are mixtures (solid sodium carbonate melts at 585, liquid ethanol boils at 78, and limonene boils at 176) .
Use these information to plan an experiment to obtain a sample of each substance from a mixture of the three substances.

Method 1

1 heat the mixture 2 using a Bunsen
3 in a suitable container (flask)
4 ethanol boils / evaporates first / at 78 °C
5 limonene boils next / at 176 °C (and collects / condenses)
6 use of the term (fractional) distillation
7 use of a condenser 8 sodium carbonate residue left

Method 2 (assuming sodium carbonate does not dissolve

1 filter (to obtain sodium carbonate) 2 heat the filtrate
3 using a Bunsen / electric heater / oil bath
4 in a suitable container (flask / boiling tube / test-tube)
5 ethanol boils / evaporates first / at 78 °C
7 limonene boils next / at 176 °C (and collects / condenses) / is the residue
7 use of the term (fractional) distillation 8 //use of a condenser

7- 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.

• Measured volume of dilute hydrochloric acid
• Use of suitable container (test tube or beaker)
• Measure initial temperature of acid • Add known mass of solid C
• Measure final temperature of mixture then Calculate temperature change
• Repeat with (same mass / moles of) solid D
And
• Bigger temperature change is bigger energy change
• Temperature increase is exothermic / temperature decrease is endothermic process

8- 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.

Method 1

- Coat a glass slide (or any suitable inert material)
- With same amount / thickness of paint
- (leave to) dry
- Add controlled amount / drops of propanone
- Until paint / coating removed
- Count drops / measure volume
- Repeat with ethyl ethanoate
- Comparison / conclusion

Method 2

- Weigh slides
- Add equal mass of paint to both
- Leave to dry
- Immerse each slide in 2 containers with each of solvents
- Fixed volume of solvent / excess solvent
- For set time interval / time
- Dry and reweigh slides / to dissolve
- Conclusion e.g. solvent causing greater mass loss is better or shortest time to dissolve is better

9- 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.

any **6** from one method:

evaporation

- measured volume of water
- using measuring cylinder / pipette / burette
- heat to 40 °C / heat to >40 °C
- add KCl until no more dissolves / add excess KCl
- stir
- filter mixture (if heated to >40 °C then need to cool and filter)
- evaporate filtrate to dryness
- weigh solid

mass not used

- measured volume of water
- using measuring cylinder / pipette / burette
- heat to 40 °C
- add KCl until no more dissolves
- stir
- weigh KCl not added
- weigh KCl before adding any to water – only awarded if weighed mass not used after
- difference in mass of KCl is mass dissolved

mass undissolved

- measured volume of water
- using measuring cylinder / pipette / burette
- heat to 40 °C
- stir
- filter
- weigh residue (do not award if residue washed)
- add weighed (excess) KCl to water – only awarded if mass of residue measured
- mass KCl dissolved = initial mass – final mass

10- **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.**

any **6** from:

- hydrochloric acid in burette
- measured volume of barium hydroxide solution
- in named container (conical) flask
- litmus solution or methyl orange indicator (ignore Universal Indicator) OR pH meter
- add acid gradually and slowly
- until colour changes or endpoint
- note volume added / initial and final volumes
- calculation (using volumes and concentration of the acid)

11- **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.**

any 6 from:

- cut leaves into small pieces
- grind / crush with sand / ethanol
- using pestle/mortar
- decant and filter liquid
- use chromatography
- apply extract to paper (in correct location)
- description of separating colours

12- **Indigestion pain is caused by too much acid in your stomach. The acid is hydrochloric acid. Indigestion tablets contain a base which neutralises the acid. You are provided with two different brands of indigestion tablets, Painremuve and Indcure. Plan an investigation to compare which of these brands of tablet is the most effective. You areprovided with dilute hydrochloric acid and common laboratory apparatus.**

Use same volume of hydrochloric acid
use of named measuring apparatus
addition of named indicator
add tablets
until the colour changes / pH =7
take measurement e.g. number of tablets
repeat with other tablet
compare / conclusion e.g. brand that uses fewer tablets is most effective
allow: other correct methods including loss of mass and collection of gas

13- **Growwell and Plantstrong are two different granular fertilisers. Fertilisers improve the growth of plants. A farmer decides to buy one of these fertilisers to improve the soil on his land. Plan an investigation to fi nd out which of these fertilisers would be best for the farmer to buy, and use, to grow beans on his land.**

known mass of each fertiliser
add to same amount of soil
add bean add water
leave for specified time
observe plant growth
compare between the effect of each one
/conclusion max 7

General Questions

1) What is the purpose of ice or cold water?

To cool down the gas so that it condenses and turns into a liquid.

2) When the gas collecting tube is upside down, give a property of this gas.

It is less dense than air.

3) Why is a pencil used in drawing the origin line in chromatography?

If pen was used, it will dissolve giving colours and so, the experiment won't be accurate.

4) When using ethanol, give a better apparatus arrangement, and why?

Cover apparatus with a lid, because ethanol is volatile.

5) In the tests and observation tables, when in the first row, they tell you that upon heating condensation occurred, there will be a question asking what does this show about the solid?

It is hydrated.

6) When copper is used in the test, and the answer is four marks, the best answer is:

light blue precipitate (ppt) which is soluble in excess to form dark blue solution.

7) Why is this experiment done in a fume cupboard?

It releases harmful gases that are poisonous. It is toxic.

8) Which result appears to be inaccurate?

It is the point not appearing on the drawn graph, you read it's x-axis and write it with a reason indicating that it doesn't occur in the graph.

9) Why should the solid be crushed?

It increases surface area for a faster rate of reaction.

10) Why is the experiment made in a well-ventilated room?

To prevent the burning of the substance.

11) Explain the term (decant).

Filter/Pour the liquid leaving the solid alone.

12) Why is concentrated sulphuric acid not used to dry ammonia?

Because it will react with the base ammonia, which is neutralization reaction.

13) Why should samples be taken from different parts of the field?

To get more accurate results.

14) Suggest why it is important to know the pH of the soil.

To see which is the best place for growing, and wht kind of base to use for neutralizing it.

15) What is necessary for rusting?

Water (humidity) and oxygen (air).

16) Suggest why in an experiment for rusting the water level increases.

Oxygen is used up, and water is used to take its place.

17) For electrolysis, state the observations.

The bulb will light - A metal is formed on the cathode - Fizz of gases produced.

18) Suggest a suitable material for electrodes.

Graphite - Carbon - Steel.

19) when copper oxide is reacted with hydrogen, what is the colour change?

Black to brown, because copper oxide is reduced to copper.

20) How can you distinguish between water and ethanol?

Use cobalt chloride paper, it turns from pink to blue with water, but there will be no change with ethanol.

21) How can you distinguish between sulpharic acid and aqueous sodium sulphate?

There are three tests, you can use a metal carbonate in which carbon dioxide will be produced with sulpharic acid but there'd will be no change with sodium sulphate. You can add a metal, in which hydrogen is produced with sulpharic acid, but no change in sodium sulphate. Finally, you could use an indicator like litmus paper, it will change to red with sulpharic acid, but there will be no change with sodium sulphate..

22) how can you distinguish between hydrochloric acid and nitric acid?

Add silver nitrate, in which white ppt will be formed with hydrochloric acid, but there will be no reaction with nitric acid.

23) What is the purpose of the mineral wool?

To absorb and hold the liquid.

24) When there is a delivery tube involved in a question, what precaution should be taken in the experiment when the heat is removed?

Remove the delivery tube from water to prevent suck-back.

25) As reactants are heated,

the particles gain energy, move faster, and their kinetic energy increases therefore there will be more collisions and rate increases

26) How can you distinguish between alkanes and alkane?

Use bromine water, in which the alkene will decolourise it to colorless, but nothing happens with an alkane,

27) how can you distinguish between chlorine and sodium chloride?

Add litmus paper, it will bleach with chlorine, but nothing happens to it with sodium chloride.

28) How can you distinguish between copper sulphate and copper carbonate?

Acidify with hydrochloric acid, and add barium chloride, there will be white ppt with sulphate, but no white ppt with carbonate. OR just add hydrochloric acid, in which nothing happens with sulphate, but a fizz or effervescence of carbon dioxide will occur with carbonate.

29) When a measuring cylinder is used, and they ask for a change in apparatus

to get more reliable results, you should say that a biuret can be used instead as it is more accurate.

30) volume of reagent used

decreases if it is more concentrated.

31) In an experiment observation of pH value, and they ask what type of acid/base is used,

your answer should be weather weak or strong. A strong acid lies between pH values of 0 and 2, and a weak one lies between 3 and 6. 7 is neutral. A weak base lies between 8 and 11, while a strong one lies between 12 and 14.

32) A concentrated acid is an acid that contains

a large number of H+, hydrogen ions. Vice versa with dilute acid.

33) A concentrated base is a base that contains a large number of OH-'

hydroxide ions. Vice versa with dilute base.

34) a strong acid is one that ionizes completely giving H^+ in solutions.

Vice versa with a weak one..

35) A strong base is one that ionizes completely giving OH- in solutions.

Vice versa with a weak one..

36) Concentrated:

is a solution that contains a large number of solute or little amount of water is involved.

37) How can you make crystals?

1)heat till point of crystallization.
2) leave to cool gradually.
3) filter, dry and collect the crystals!

38) How can you detect the point of crystallization?

Place a stirring rod in the solution and see the formation of the first crystals on it.

39) When you crush,

you use a pestle and mortar. And increase surface area

40) Grass is ground with ethanol rather than water

because chlorophyll is more soluble in ethanol.

41) Colour of rusty iron fillings

is brown (orange and red)

42) unreacted reactant

is called excess.

43) you can speed up the drying process by using

a fan or by increasing temperature or by using a hair-drier if you have one) , NOT a catalyst.

44) The action of a lie big condenser

is to change steam to water.

45) to check for the purity for a collected solvent,

test it's melting or boiling point.

46) The chromatogram needs to be sprayed with locating agent is amino acids are investigated
because they are colorless.

47) If water contained salt,
this will have no effect on rusting, however if a bigger substance is being rusted, it will be slower.

48) Hydrated copper sulphate will turn from blue to white
upon heating.

49) saturated: no mo solute can be dissolved in a solvent
at a constant temperature..

50) An excess amount of reactant is used
to make sure all the other reactant will be used.

51) Sometimes, crystals are dried using filter paper instead of heating
to prevent the complete loss of water from crystals, and to prevent crystals from breaking.

52) how could you know which reactant is in excess?
At the end of the reaction, the excess reactant will be visible.

53) excess means
more than what is needed.

54) When lead bromide is used,
you can use a fume cupboard or use goggles, lab coat, gloves,,, because it is toxic.

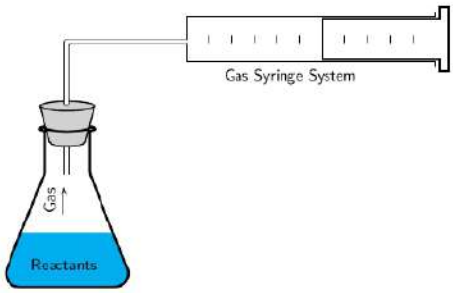
55) To separate two different solutions with different boiling point,
use fractional distillation.

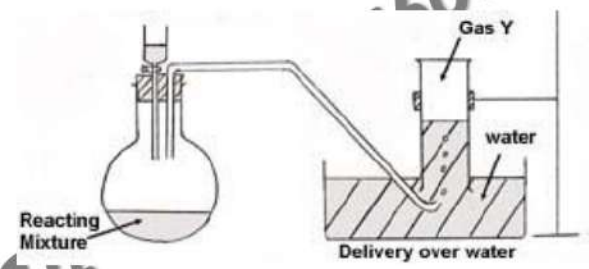
56) Fire will be produced if alcohol is touched with lighted splint, therefore a water bath should be used when heating it.
Lagging or cloth can be used to control temperature for accurate results.

The volume of burette from 0-50
The volume of pipette from 0 to 10
The volume of measuring cylinder (different volumes) from 0 –(50/ 100/200/250)

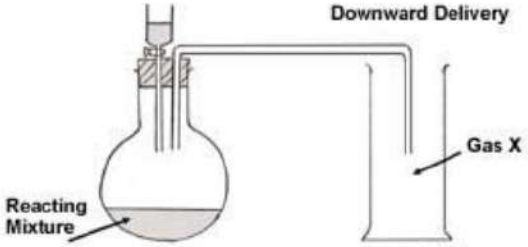
indicator	Acid	Neutral	base
litmus	red	purple	blue
Phenolphthalein	colorless	colorless	Purple / pink
Methyl red	Red	yellow	yellow
Methyl orange	pink	yellow	yellow

Collecting Gases

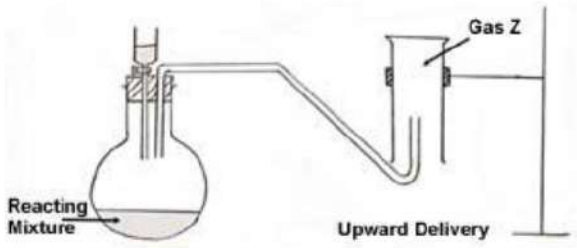




A gas does not dissolve in water or slightly soluble in water

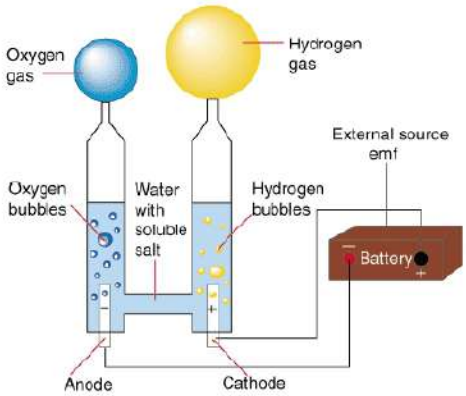


A gas is heavier than air

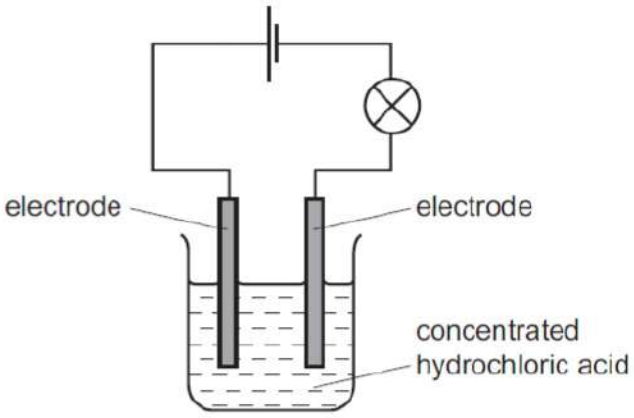


a gas is lighter than air

what is the mistake ????



Electricity was passed through a solution of concentrated hydrochloric acid using the apparatus shown.



(a) Give **two** expected observations.

1. .....
2. ..... [2]

(b) Suggest a suitable material for the electrodes.

..... [1]

(c) A lighted splint placed in a test-tube of the gas collected at the negative electrode gave a pop sound. The identity of the gas was

..... [1]

(d) State **two** safety precautions that must be followed when carrying out this experiment.

1. .....
2. ..... [2]

Ions	Solubility of salts	Solubility Exceptions
sodium (Na), potassium (K) and ammonium (NH_4^+)	all soluble	none
nitrates (NO_3^-)	all soluble	none
chlorides (Cl^-) and iodides (I^-)	most soluble	silver (Ag^+), lead (Pb^{2+}), mercury (Hg_2^{2+})
sulfates (SO_4^{2-})	most soluble	Ag^+, Pb^{2+}, calcium Ca^{2+}, strontium (Sr^{2+}) and barium (Ba^{2+})
carbonates (CO_3^{2-})	most insoluble	Group 1A, NH_4^+ soluble
hydroxide (OH^-)	most insoluble	Group 1A, NH_4^+ soluble

Common Laboratory Equipment