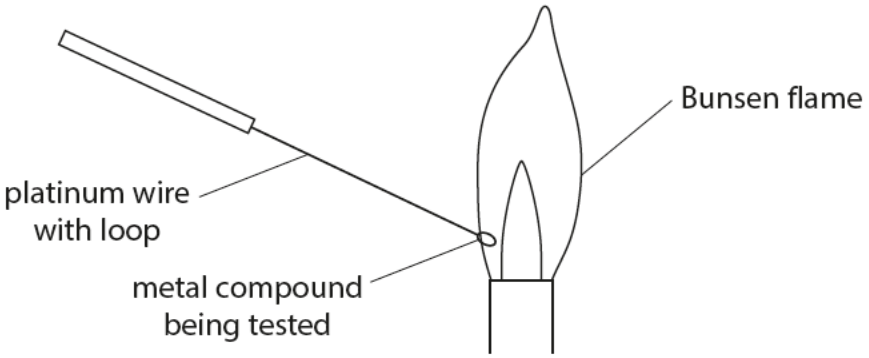
**1** A flame test is carried out on three metal compounds, X, Y and Z.

The diagram shows the apparatus used.




(a) (i) Suggest two reasons why platinum is a suitable metal to use as the wire in this test.

**(2)**

1 .....

.....

2 .....

.....

(ii) Why should the platinum wire be cleaned between each test?

**(1)**

.....

.....

(iii) Why is a luminous Bunsen flame not suitable for carrying out a flame test?

**(1)**

.....

.....

(b) The three metal compounds are also tested separately with three reagents.

The reagents used are

- aqueous acidified silver nitrate
- aqueous acidified barium chloride
- aqueous sodium hydroxide

The table shows the results of all the tests.

| Metal compound | Flame test | Aqueous acidified silver nitrate | Aqueous acidified barium chloride | Aqueous sodium hydroxide |
|---|---|---|---|---|
| X | yellow | white precipitate | no precipitate | no precipitate |
| Y | red | no precipitate | white precipitate | no precipitate |
| Z | no colour | no precipitate | no precipitate | green precipitate |

(i) Give the name of compound X and of compound Y.

**(4)**

compound X .....

compound Y .....

(ii) Identify the cation present in compound Z.

**(1)**

.....

(c) Describe a chemical test, other than heating, that could be used to show that compound Z contains carbonate ions.

**(3)**

test .....

.....

result .....

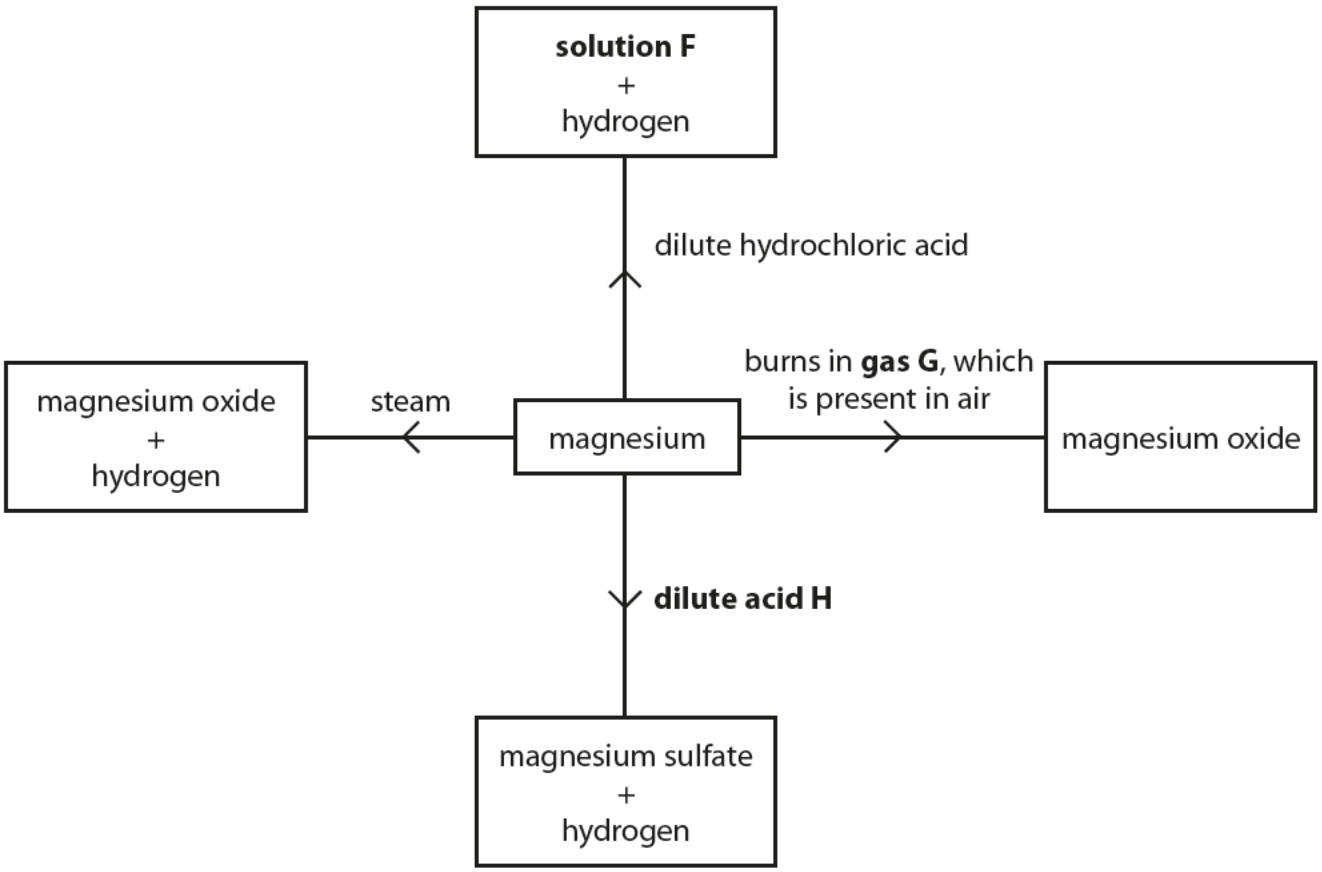
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**(Total for Question 1 = 12 marks)**

**2** The diagram shows some of the reactions of magnesium.




(a) Complete the table to give the identity of substances F, G and H.

**(3)**

| Substance | Identity |
|---|---|
| solution F | |
| gas G | |
| dilute acid H | |

(b) Write a chemical equation for the reaction between magnesium and steam.

**(1)**

.....

**(Total for Question 2 = 4 marks)**

**3** A student was asked by his teacher to perform a flame test on a solid.

He used this method.

- dip the tip of a clean platinum wire into hydrochloric acid and then into the solid
- adjust the air hole of the Bunsen burner to obtain a non-roaring, non-luminous Bunsen flame
- place the tip of the platinum wire into the edge of the flame
- observe the colour in the flame

(a) (i) Why is it important that the platinum wire is clean?

**(1)**

.....

.....

(ii) Why is it important to use a non-luminous flame?

**(1)**

.....

.....

(iii) What colour would be observed in the flame if the solid contained sodium ions?

**(1)**

.....

(b) Another student was given a pale violet solid. He was told that it contained two cations (positive ions) from this list

$Li^+$ $Ca^{2+}$ $Fe^{2+}$ $NH_4^+$ $Fe^{3+}$

He performed a flame test on the solid.

He then dissolved a small sample of the solid in water. A yellow solution was formed.

He added sodium hydroxide solution and then warmed the mixture.

The table shows his observations.

| Test | Observation |
|---|---|
| flame test | no positive result |
| add sodium hydroxide solution and warm | brown precipitate<br>a pungent-smelling gas was evolved<br>the gas turned damp red litmus paper blue |

(i) The flame test gave no positive result.

State the two cations from the list that are **not** present in the solid.

**(1)**

..... and .....

(ii) Identify the pungent-smelling gas given off and explain why the red litmus paper must be damp before it is used.

**(2)**

.....

.....

.....

.....

(iii) Identify the two cations present in the pale violet solid.

**(2)**

..... and .....

**(Total for Question 3 = 8 marks)**

**4** Some iron(II) sulfate ($FeSO_4$) is dissolved in water to make a solution.

(a) A reaction takes place when sodium hydroxide solution is added to a solution of iron(II) sulfate.

(i) Complete the word equation to show this reaction.

**(2)**

sodium hydroxide + iron(II) sulfate ⟶ +

(ii) State what you would observe in this reaction.

**(1)**

(b) Barium chloride is used to test for sulfate ions.

(i) Barium chloride solution is added to another solution of iron(II) sulfate. A white precipitate forms.

Identify the white precipitate.

**(1)**

(ii) In this test, another substance should be added to react with any carbonate ions that might be present.

Identify this other substance and state one observation that would be made if carbonate ions were present.

**(2)**

Other substance

Observation

(c) A compound with the formula $(NH_4)_2Fe(SO_4)_2$ gives the same results in the tests in parts (a) and (b) as iron(II) sulfate ($FeSO_4$).

Describe how you could show that a solution of $(NH_4)_2Fe(SO_4)_2$ contains ammonium ions.

**(3)**

**(Total for Question 4 = 9 marks)**

**5** This question is about tests for some elements and compounds.

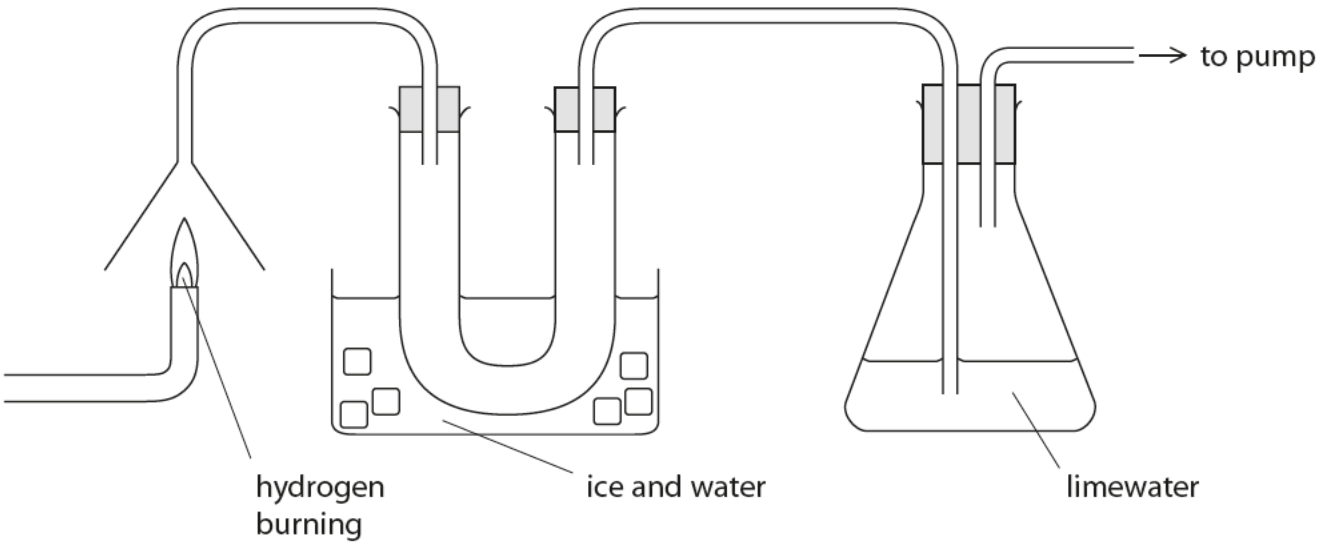
(a) What is the test for hydrogen?

**(1)**

.....

.....

(b) The diagram shows hydrogen burning in air, and how some of the gases passing through the apparatus are collected and tested.




A colourless liquid collects in the U-shaped tube and the limewater turns cloudy **very** slowly.

(i) Describe a **chemical** test to show that the colourless liquid contains water.

**(2)**

test .....

result .....

(ii) Describe a **physical** test to show that the colourless liquid is pure water.

**(2)**

test .....

result .....

(iii) A reaction involving carbon dioxide causes the cloudiness in the limewater.

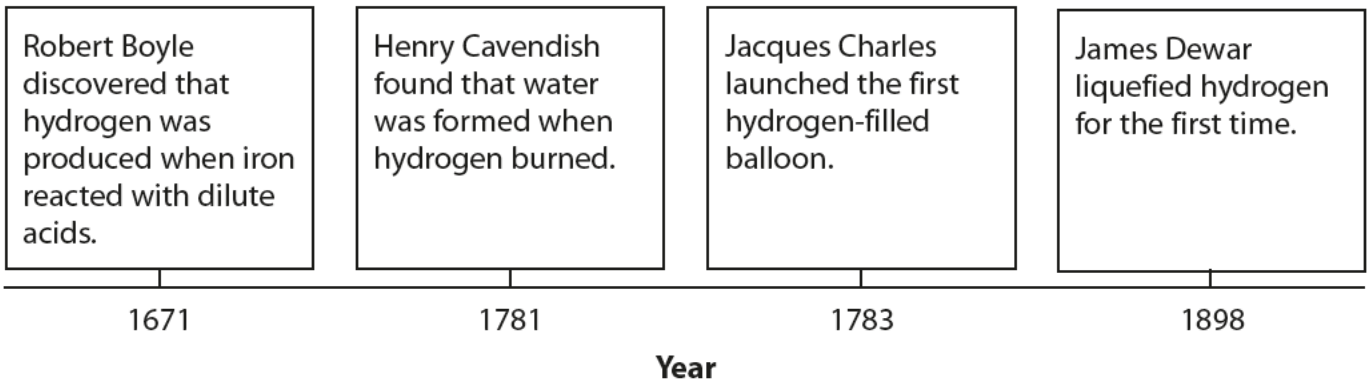
Place crosses (☒) in **two** boxes to show the correct statements about this reaction.

**(2)**

- ☐ carbon dioxide forms when the hydrogen burns
- ☐ carbon dioxide from the air reacts to cause the cloudiness
- ☐ the cloudiness is caused by the formation of calcium hydroxide
- ☐ the cloudiness is caused by the formation of a white precipitate
- ☐ the reaction in the limewater is an example of oxidation

**(Total for Question 5 = 7 marks)**

**6** A student found this information about hydrogen.




(a) (i) The student repeated Boyle's experiment using iron and dilute sulfuric acid.

State **two** observations that he could have made.

**(2)**

1 .....

.....

2 .....

.....

(ii) Complete the word equation for this reaction.

**(1)**

iron + sulfuric acid → ..... + .....

(b) Balance the equation for the complete combustion of hydrogen.

**(1)**

..... $H_2$ + ..... $O_2$ → ..... $H_2O$

(c) To show that the liquid produced by burning hydrogen was pure water, a student carried out a chemical test and a physical test.

(i) The chemical test involved adding a few drops of the liquid to a sample of anhydrous copper(II) sulfate.

State the colour change observed.

**(2)**

Initial colour .....

Final colour .....

(ii) Place a cross ☒ in one box to show the formula of the compound formed in this chemical test.

**(1)**

☐ **A** $Cu(OH)_2$

☐ **B** $CuSO_4$

☐ **C** $CuSO_4.H_2O$

☐ **D** $CuSO_4.5H_2O$

(iii) The physical test involved measuring a property of the liquid.

State a suitable physical property and give the value for pure water.

**(2)**

Physical property .....

Value .....

(d) (i) Suggest what property of hydrogen makes it suitable for filling balloons.

**(1)**

.....

(ii) Helium is now used instead of hydrogen to fill balloons.

State the property of helium that makes it more suitable than hydrogen for filling balloons.

**(1)**

.....

(e) Write an equation, including state symbols, to show the process that occurs when hydrogen is liquefied.

**(1)**

.....

**(Total for Question 6 = 12 marks)**

7 Ammonium chloride contains oppositely charged ions.

(a) State the formula of each ion.

**(2)**

Positive ion .....

Negative ion .....

(b) (i) Describe a chemical test to show that a substance contains ammonium ions.

**(3)**

.....

.....

.....

.....

.....

.....

(ii) Describe a chemical test to show that a substance contains chloride ions.

**(3)**

.....

.....

.....

.....

.....

.....

(c) Ammonium chloride decomposes when heated:

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

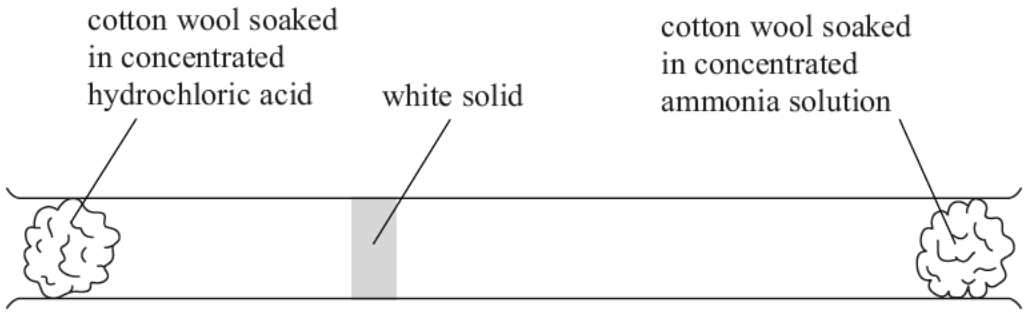
What does the $\rightleftharpoons$ symbol indicate about the reaction?

**(1)**

.....

.....

(d) The reaction between ammonia and hydrogen chloride can be used to illustrate diffusion with the following apparatus.




After a few minutes, a white solid appears inside the tube.

(i) Identify the white solid.

**(1)**

.....

(ii) What does the diagram show about the speed of the ammonia molecules compared to the speed of the hydrogen chloride molecules?

**(1)**

.....

.....

(e) State the main hazard when using concentrated hydrochloric acid in the experiment in (d).

Suggest **one** precaution you could use to minimise this hazard.

**(2)**

Hazard .....

Precaution .....

.....

**(Total for Question 7 13 marks)**