Types of Chemical reactions – 2021/20 GCSE Gateway Chemistry Combined Science A

1. Nov/2021/Paper_J250/03/No.13

A student investigates how the pH of dilute hydrochloric acid changes as sodium hydroxide solution is added to it.

Fig. 13.1 shows the equipment the student uses.

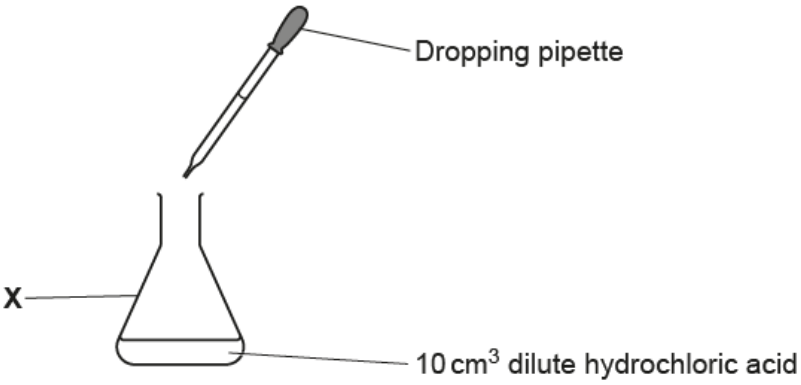


Fig. 13.1

The student:

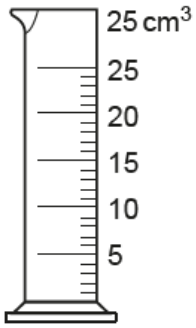
- Adds 10 cm^3 dilute hydrochloric acid to **X**.
- Adds 0.5 cm^3 of the sodium hydroxide solution to the dilute hydrochloric acid.
- Swirls the mixture and measures its pH with a pH probe.
- Repeats adding 0.5 cm^3 of the sodium hydroxide solution each time until 10 cm^3 of the sodium hydroxide solution has been added.

(a) What is the name of the piece of equipment labelled **X**?

..... **[1]**

(b) **Fig. 13.2** shows two pieces of equipment which could be used to measure 0.5 cm^3 of the sodium hydroxide solution.

Dropping pipette



Measuring cylinder

Fig. 13.2

Why did the student use the dropping pipette instead of the measuring cylinder?

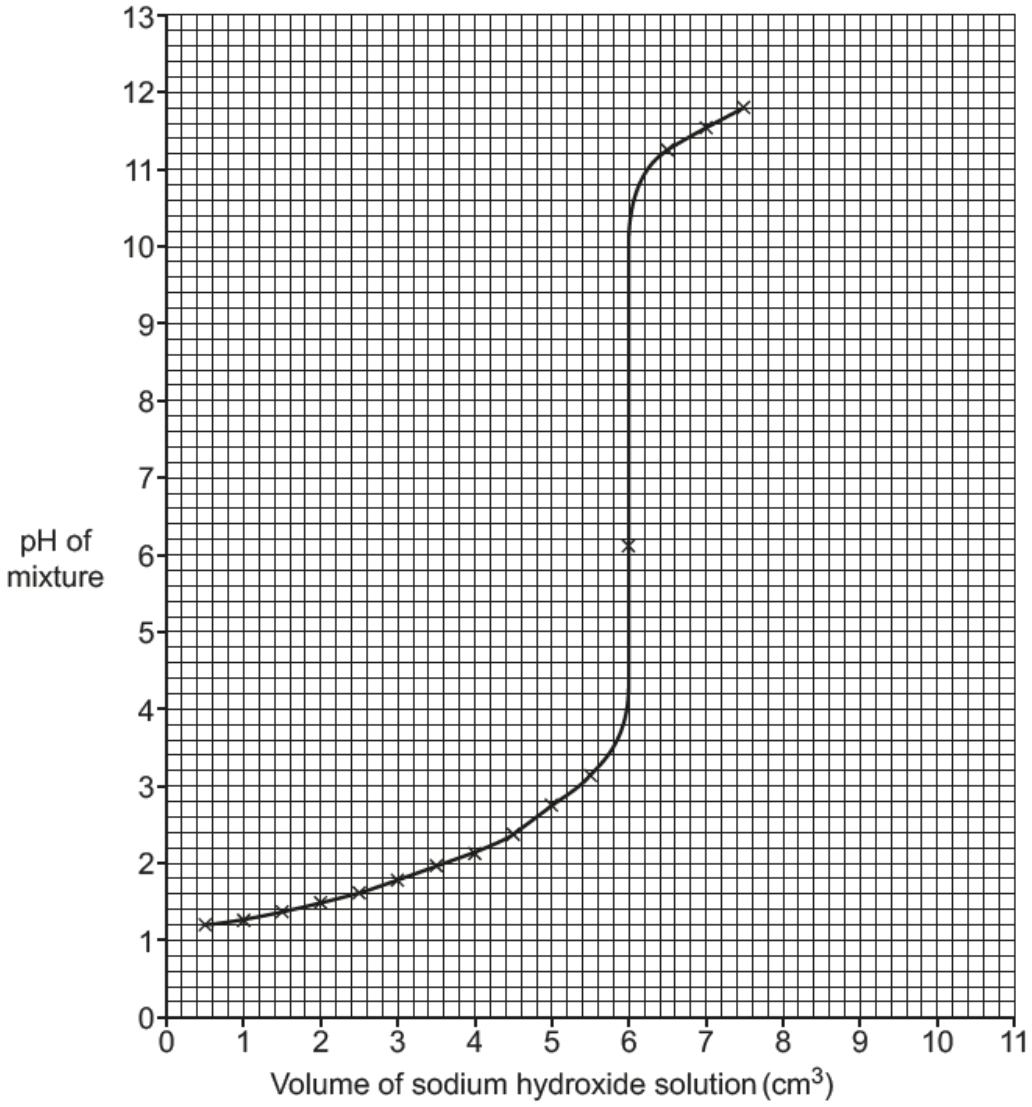
..... **[1]**

(c) The student plots a graph of some of their results.

Look at the table. It shows the rest of the student's results.

Volume of sodium hydroxide solution (cm^3)	8.0	8.5	9.0	9.5	10.0
pH of mixture	12.1	12.3	12.4	12.5	12.5

Plot the results on the graph and draw a line of best fit.



[3]

(d) The dilute hydrochloric acid is exactly neutralised when the pH of the mixture is 7.

Use the graph to work out the **volume of sodium hydroxide solution** needed to exactly neutralise the dilute hydrochloric acid.

Volume of sodium hydroxide solution = ... cm^3 **[1]**

(e) The dilute hydrochloric acid is neutralised by the sodium hydroxide solution.

Complete the sentence using the words shown. You may use each word once, more than once or not at all.

hydrogen ions **hydroxide ions** **water molecules**

The ..... in the dilute hydrochloric acid react with

the ..... in the sodium hydroxide solution to

make ..... . **[2]**

2. Nov/2020/Paper_J250/03/No.4

Which particle in a solution of dilute hydrochloric acid, HC*l*, makes it acidic?

A Cl^-

B H^+

C H_2O

D OH^-

Your answer ☐ **[1]**

3. Nov/2020/Paper_J250/03/No.9

Iron can be made from the reaction of iron(III) oxide with carbon monoxide.

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

What is the **reducing agent** in this reaction?

A CO

B CO_2

C Fe

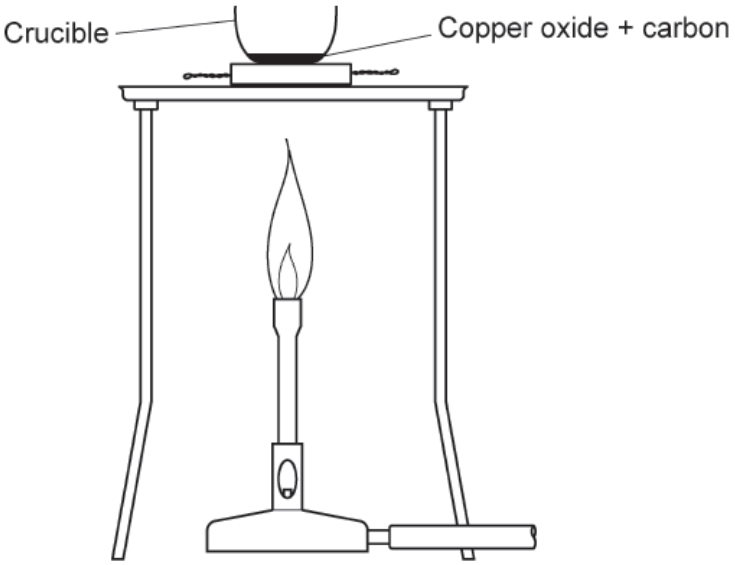
D Fe_2O_3

Your answer ☐ **[1]**

4. Nov/2020/Paper_J250/04/No.13

In an experiment a student heats copper oxide and carbon to produce copper.

Look at the diagram of the equipment she uses.



(a) Complete the word equation for the reaction.

copper oxide + carbon → copper + ... **[1]**

(b) In the reaction copper ions in the copper oxide are **reduced**.

Explain why.

.....

..... **[1]**

(c) The student measures the mass of copper made in the experiment.

She repeated the experiment four times.

Look at the table of her results.

Experiment	1	2	3	4
Mass of copper oxide (g)	2.4	2.4	2.4	2.4
Mass of copper (g)	1.7	1.7	0.8	1.6

(i) Look at the mass of copper made in **Experiment 3**.

Suggest why the result of **Experiment 3** is different and why it should **not** be used to calculate the mean.

.....

.....

.....

..... **[2]**

(ii) Calculate the **mean** mass of copper formed. Do **not** include the result of **Experiment 3** in your calculation.

Give your answer to **2** significant figures.

Mean mass of copper = ... g **[3]**

(d) Another student repeats the experiment with magnesium oxide and carbon.

There was **no** reaction.

Explain why.

.....

..... **[1]**

5. Nov/2021/Paper_J250/09/No.6

Which equation shows the ionisation of a **weak acid**?

A $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$

B $HCOOH(aq) \rightleftharpoons HCOO^-(aq) + H^+(aq)$

C $NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$

D $NH_4OH(aq) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

Your answer ☐ **[1]**

6. Nov/2021/Paper_J250/09/No.8

Look at the ionic equation.

$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$

Which species is **reduced**?

A Cu(s)

B $Cu^{2+}(aq)$

C Mg(s)

D $Mg^{2+}(aq)$

Your answer ☐ **[1]**

7. Nov/2021/Paper_J250/09/No.9

A solution has a hydrogen ion concentration of 1×10^{-6} mol/dm^3. The solution has a pH of 6.

What is the hydrogen ion concentration of a solution with a pH of 3?

A 1×10^{-9} mol/dm^3

B 1×10^{-6} mol/dm^3

C 1×10^{-3} mol/dm^3

D 1×10^{-1} mol/dm^3

Your answer ☐ **[1]**

8. Nov/2020/Paper_J250/09/No.1

Iron can be made from the reaction of iron(III) oxide with carbon monoxide.

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

What is the **reducing agent** in this reaction?

A CO

B CO_2

C Fe

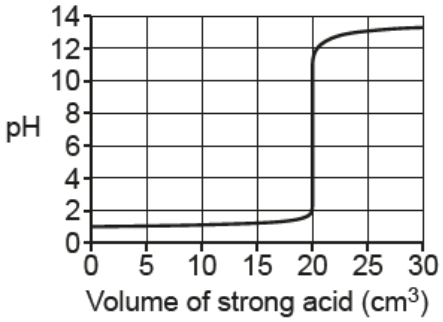
D Fe_2O_3

Your answer ☐ **[1]**

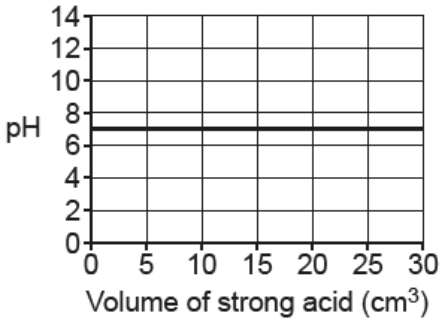
9. Nov/2020/Paper_J250/09/No.8

Which curve shows how the pH of a strong alkali changes when a strong acid is added?

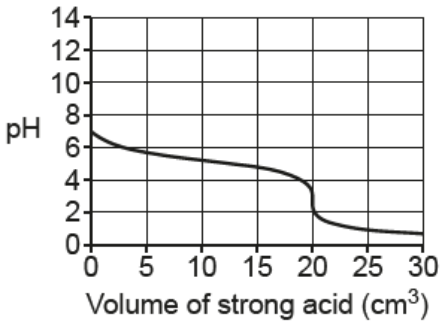
A



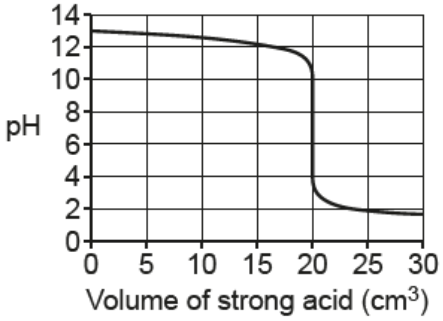
B



C



D

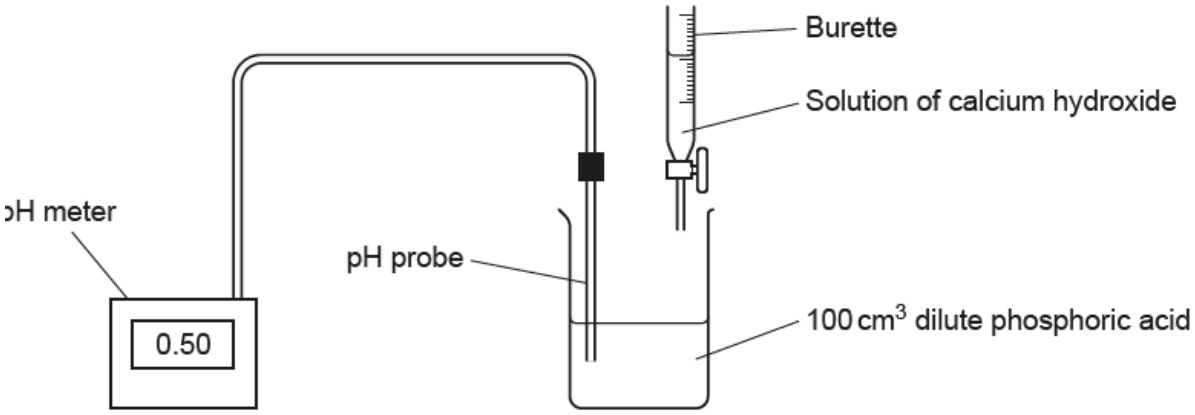


Your answer ☐ **[1]**

10. Nov/2020/Paper_J250/09/No.16

Phosphoric acid, H_3PO_4, is a strong acid.

A student investigates how the pH of a solution of dilute phosphoric acid changes when a solution of calcium hydroxide is slowly added to it from a burette.



The student then calculates the concentration of hydrogen ions as the pH changes.

Table 16.1 shows the results of her experiment.

pH of solution formed	Concentration of hydrogen ions as the pH changes (mol/dm^3)
0.50	0.320
1.00	0.100
1.50	0.032
2.00	0.010

Table 16.1

(a) Explain why phosphoric acid is described as a **strong** acid.

.....

..... **[1]**

(b) Explain why the solution of phosphoric acid used is described as **dilute**.

.....

..... **[1]**

(c) Complete the **balanced symbol** equation for the reaction between phosphoric acid and calcium hydroxide.

$$\text{.....}H_3PO_4 + \text{.....}Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + \text{.....}H_2O$$

[2]

(d) Look at **Table 16.1**.

Describe how the pH of the solution formed changes as the concentration of the hydrogen ions in the solution changes by a factor of 10.

Use data from **Table 16.1** in your answer.

.....

.....

.....

..... **[2]**

(e) The reaction between phosphoric acid and calcium hydroxide is a neutralisation reaction.

Write the **balanced ionic equation** for neutralisation.

Include state symbols.

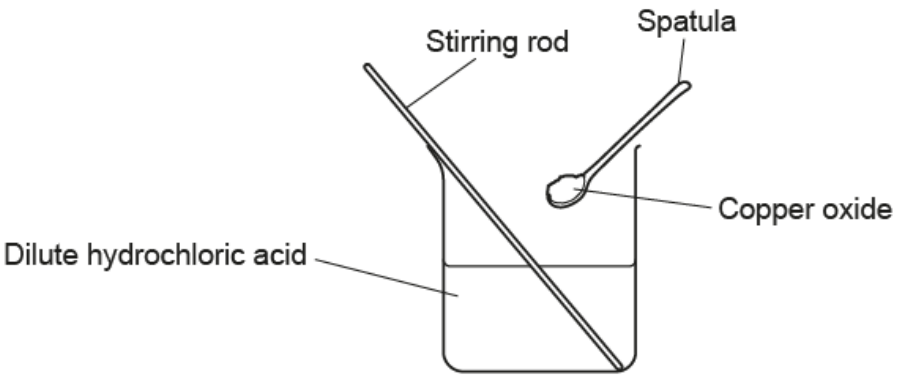
..... **[2]**

11. Nov/2020/Paper_J250/09/No.14

A student investigates how to make a sample of a pure salt.

His method is shown in **Fig. 14.1**.

Stage 1 React an excess of copper oxide with 50 cm^3 dilute hydrochloric acid.



Stage 2 Heat the solution from Stage 1.

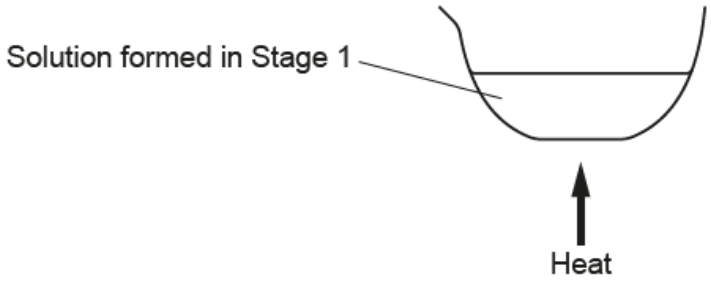


Fig. 14.1

(a) Copper oxide is an **insoluble** compound that neutralises dilute hydrochloric acid.

Name the type of insoluble compound that neutralises an acid to form a salt and water.

..... **[1]**

(b) Dilute hydrochloric acid is a **hazardous** chemical.

Describe **one** safety precaution the student should take when using dilute hydrochloric acid.

..... **[1]**

(c) Stage 1 uses an **excess** of copper oxide.

Give a reason why.

.....

..... **[1]**

(d) The equation shows the reaction between copper oxide, CuO, and dilute hydrochloric acid, HCl.

$$CuO + 2HCl \longrightarrow CuCl_2 + H_2O$$

The student adds 0.500 g of copper oxide to the 50 cm^3 of dilute hydrochloric acid.

The 50 cm^3 contains 2.50×10^{-3} moles of hydrochloric acid.

(i) Calculate the number of moles of copper oxide, CuO, in 0.500 g.

Give your answer to **3** significant figures.

Number of moles of copper oxide = ... mol **[3]**

(ii) Use your answer to **(d)(i)** and the balanced symbol equation to explain why the copper oxide is in excess.

.....

.....

..... **[2]**

(e) Another student thinks that the method in **Fig. 14.1** will not make pure copper chloride.

(i) Explain why this student is correct.

.....

..... **[1]**

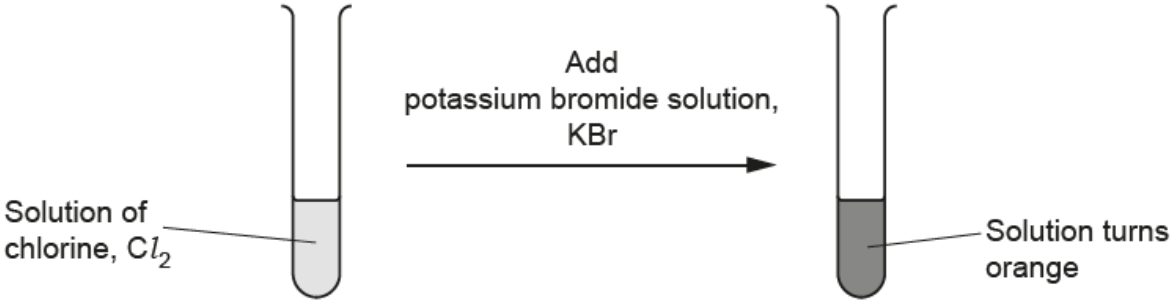
(ii) Describe how the method in **Fig. 14.1** can be improved to make **pure** copper chloride.

.....

..... **[1]**

12. Nov/2020/Paper_J250/10/No.18

The diagram shows what happens when a small amount of potassium bromide solution, KBr, is added to a solution of chlorine, Cl_2.



(a) Write the **balanced symbol** equation for the reaction between potassium bromide, KBr, and chlorine, Cl_2.

..... **[2]**

(b) Write down the name of the chemical which makes the solution orange.

..... **[1]**

(c) **(i)** Write the **half equation** for the formation of chloride ions, Cl^-, from chlorine, Cl_2.

..... **[1]**

(ii) In this reaction is chlorine oxidised or reduced?

Explain your answer.

.....

..... **[1]**

(d) Explain why chlorine is **more** reactive than bromine.

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.....

.....

.....

.....

..... **[3]**