# Introducing Chemical reactions – 2021/20 GCSE Gateway Chemistry A

**1.** Nov/2021/Paper_J248/01/No.16

A student investigates the reaction between acids and metals.

**Table 16.1** shows the names and formulae of the acids and metals the student investigates.

| Name | Formula |
|---|---|
| Zinc | Zn |
| Magnesium | ..... |
| Nitric acid | $HNO_3$ |
| Hydrochloric acid | ..... |

**Table 16.1**

**(a)** Complete **Table 16.1**. **[2]**

**(b)** Zinc reacts with nitric acid. Look at the balanced symbol equation for the reaction.

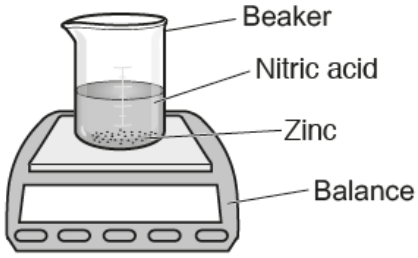
$Zn(s) + 2HNO_3(aq) \longrightarrow Zn(NO_3)_2(aq) + H_2(g)$

What physical state does (aq) represent?

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

**(c)** The student investigates the reaction between zinc metal and nitric acid.

The diagram shows the apparatus the student uses.



**(i)** The student uses the balance to record the change in mass during the reaction.

The mass **decreases**. Explain why.

.....

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

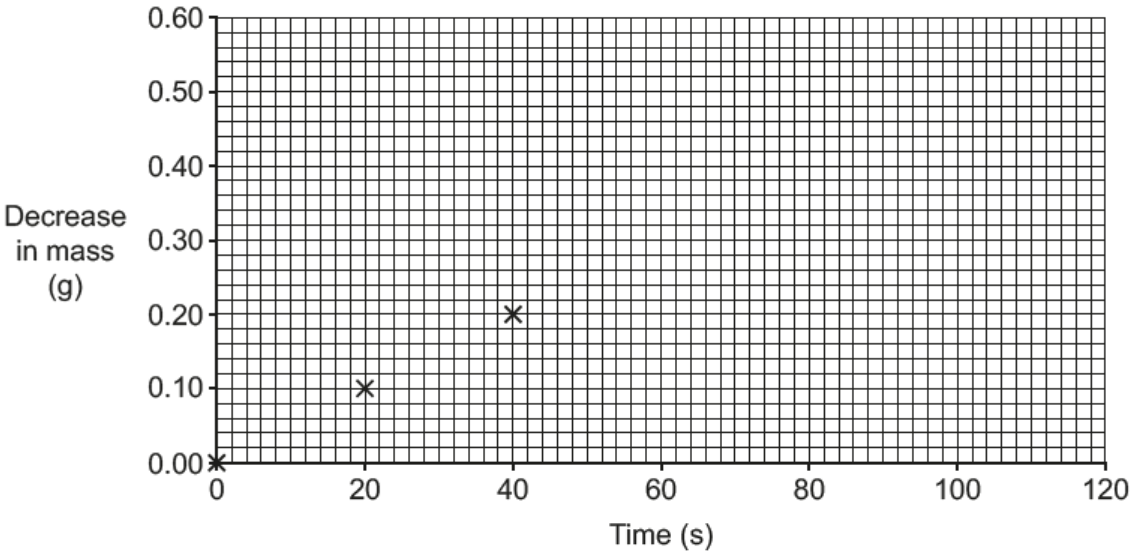
**(ii)** **Table 16.2** shows the student's results.

| Time (s) | Decrease in mass (g) |
|---|---|
| 0 | 0.00 |
| 20 | 0.10 |
| 40 | 0.20 |
| 80 | 0.40 |
| 100 | 0.50 |
| 120 | 0.60 |

**Table 16.2**

Plot the results from **Table 16.2** on the graph and draw a line of best fit.

The first three points have been plotted for you.




**[2]**

**(iii)** Use your graph to estimate the **decrease in mass** at 60 seconds.

Decrease in mass = ..... g **[1]**

**(d)** The student does four experiments.

They record the decrease in mass after 120 seconds.

**Table 16.3** shows their results.

| | **Experiment 1** | **Experiment 2** | **Experiment 3** | **Experiment 4** |
|---|---|---|---|---|
| **Decrease in mass after 120 seconds (g)** | 0.60 | 0.69 | 0.62 | 0.59 |

**Table 16.3**

**(i)** The student notices that one of the results is anomalous.

Put a (ring) around the anomalous result in **Table 16.3**. **[1]**

**(ii)** Calculate the **mean** decrease in mass of the experiments in **Table 16.3**. You should **not** include the anomalous result.

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

Mean decrease in mass = ..... g **[3]**

**2.** Nov/2021/Paper_J248/02/No.10

Copper carbonate, $CuCO_3$, decomposes when heated. Copper oxide, CuO, and carbon dioxide gas are made.

$CuCO_3 \rightarrow CuO + CO_2$

12.4 g of copper carbonate decomposes to make 8.0 g of copper oxide.

How much carbon dioxide gas is made?

**A** 1.55 g

**B** 4.4 g

**C** 8.0 g

**D** 20.4 g

Your answer ☐ **[1]**

**3.** Nov/2021/Paper_J248/02/No.12

Sodium reacts with fluorine to form sodium fluoride.

What is the correctly **balanced symbol** equation for this reaction?

**A** $Na + F \rightarrow NaF$

**B** $Na + F_2 \rightarrow NaF_2$

**C** $2Na + F \rightarrow Na_2F$

**D** $2Na + F_2 \rightarrow 2NaF$

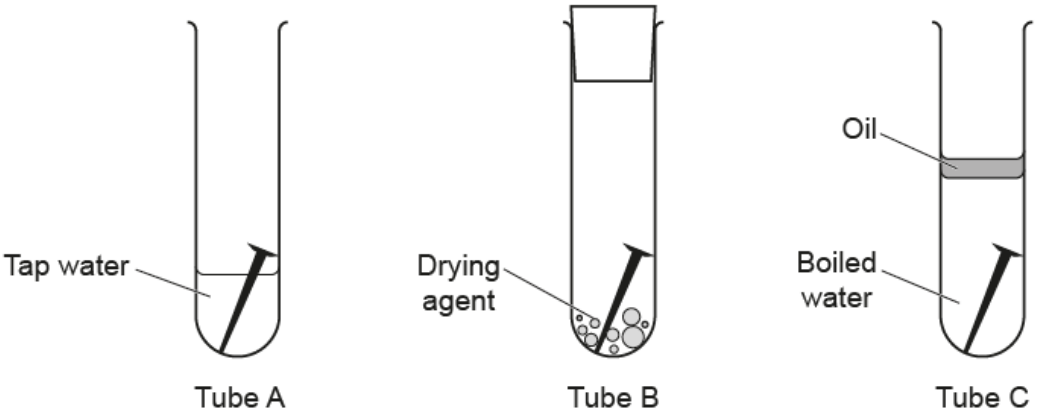
Your answer ☐ **[1]**

**4.** Nov/2021/Paper_J248/02/No.21(c)

**(c)** Iron corrodes. This is called rusting.

A student does an experiment to find out what conditions are needed to cause an iron nail to rust.

Look at the diagram of their experiment.




They leave the tubes for one week.

Predict in which tube the iron nail will rust.

Explain your answer.

Tube .....

Explanation .....

.....

.....

.....

..... **[4]**

**5.** Nov/2020/Paper_J248/01/No.3

Look at the balanced symbol equation.

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

What does the symbol **(s)** represent in the balanced symbol equation?

**A** Solid

**B** Solute

**C** Solution

**D** Substance

Your answer ☐ **[1]**

**6.** Nov/2020/Paper_J248/01/No.9

Ethanol, $C_2H_5OH$, burns in oxygen. Carbon dioxide and water are made.

Which equation for this reaction is correctly balanced?

**A** $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$

**B** $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

**C** $C_2H_5OH + 2O_2 \rightarrow 3CO_2 + 2H_2O$

**D** $2C_2H_5OH + 7O_2 \rightarrow 4CO_2 + 6H_2O$

Your answer ☐ **[1]**

**7.** Nov/2020/Paper_J248/01/No.13

Oxygen reacts with 1.20 g of carbon. 4.40 g of carbon dioxide forms.

$C + O_2 \rightarrow CO_2$

What mass of oxygen is used in this reaction?

**A** 0.80 g

**B** 1.60 g

**C** 3.20 g

**D** 5.60 g

Your answer ☐ **[1]**

**8.** Nov/2020/Paper_J248/01/No.14

The symbol of an aluminium ion is $Al^{3+}$.

The symbol of an oxide ion is $O^{2-}$.

What is the formula of aluminium oxide?

**A** $AlO$

**B** $Al_2O$

**C** $Al_3O_2$

**D** $Al_2O_3$

Your answer ☐ **[1]**

**9.** Nov/2020/Paper_J248/02/No.14

A student investigates the decomposition of hydrogen peroxide.

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

0.2 g of oxygen gas is produced in the reaction.

The student uses 0.5 g of manganese(IV) oxide as a catalyst in the reaction.

How much manganese(IV) oxide remains at the end of the reaction?

**A** 0.2 g

**B** 0.3 g

**C** 0.5 g

**D** 0.7 g

Your answer ☐ **[1]**

**10.** Nov/2021/Paper_J248/03/No.9

Sodium reacts with hydrochloric acid to give sodium chloride and hydrogen gas.

What is the **balanced** symbol equation for this reaction?

**A** $Na + HCl \longrightarrow NaCl + H$

**B** $Na + HCl \longrightarrow NaCl + H_2$

**C** $2Na + 2HCl \longrightarrow 2NaCl + H_2$

**D** $2Na + 2HCl \longrightarrow 2NaCl + 2H$

Your answer ☐ **[1]**

**11.** Nov/2021/Paper_J248/03/No.12

Magnesium reacts with oxygen. Magnesium oxide is made.

The balanced symbol equation is shown.

$2Mg + O_2 \longrightarrow 2MgO$

Calculate how much magnesium is needed to make 10.0 g of magnesium oxide.

**A** 4.0 g

**B** 6.0 g

**C** 10.0 g

**D** 16.6 g

Your answer ☐ **[1]**

**12.** Nov/2021/Paper_J248/03/No.18(a, c, d)

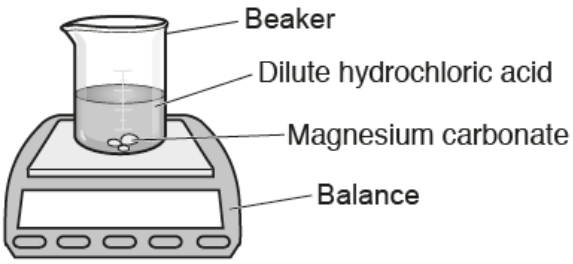
All chemical reactions follow the law of conservation of mass.

**(a)** State the law of conservation of mass.

.....

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

**(c)** The student sets the experiment up on a balance as shown in the diagram.




**(i)** Explain why the mass on the balance **decreases** as the reaction occurs.

Use ideas about the particle model in your answer.

.....

.....

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

**(ii)** The particle model is not a perfect representation of the three states of matter.

Describe **two** limitations of the particle model.

1 .....

.....

2 .....

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

**(d)** The student wants to produce a pure, dry sample of magnesium chloride, $MgCl_2$, at the end of the reaction.

The student suggests a method:

1. Filter the remaining solid out of the reaction mixture in the beaker.
2. Wash the solid with distilled water.
3. Allow the water to evaporate to leave pure solid.

The student's method does **not** produce a pure, dry sample of magnesium chloride, $MgCl_2$.

**(i)** Explain why the student's method does **not** work.

.....

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

**(ii)** Suggest **two** ways the method could be changed to produce a pure, dry sample of magnesium chloride, $MgCl_2$.

1 .....

.....

2 .....

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

**13.** Nov/2021/Paper_J248/03/No.22(a, b)

Hydrogen sulfide, $H_2S$, reacts with oxygen, $O_2$, to form sulfur dioxide, $SO_2$, and water.

The balanced symbol equation is shown.

$2H_2S(g) + 3O_2(g) \longrightarrow 2SO_2(g) + 2H_2O(l)$

**(a)** A scientist sets up the reaction so that hydrogen sulfide is the limiting reactant.

**(i)** Explain what is meant by the term **limiting reactant**.

.....

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

**(ii)** Explain what effect a limiting reactant has on a reaction.

.....

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

**(b)** Calculate the mass of sulfur dioxide made from 102.3 g of hydrogen sulfide.

(The relative atomic mass, $A_r$, of H is 1.0, of O is 16.0 and of S is 32.1).

**14.** Nov/2020/Paper_J248/03/No.3

Magnesium reacts with chlorine. Magnesium chloride is made.

What is the balanced symbol equation for this reaction?

**A** $Mg + Cl \longrightarrow MgCl$

**B** $Mg + Cl_2 \longrightarrow MgCl_2$

**C** $2Mg + Cl_2 \longrightarrow 2MgCl$

**D** $2Mg + Cl_2 \longrightarrow Mg_2Cl_2$

Your answer ☐ **[1]**

**15.** Nov/2020/Paper_J248/03/No.10

Avogadro's constant has a value of $6.02 \times 10^{23}$.

What is the number of atoms in 0.5 mol of water?

**A** $2.00 \times 10^{23}$

**B** $3.01 \times 10^{23}$

**C** $6.02 \times 10^{23}$

**D** $9.03 \times 10^{23}$

Your answer ☐ **[1]**

**16.** Nov/2020/Paper_J248/04/No.1

A student investigates the decomposition of hydrogen peroxide.

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

0.2 g of oxygen gas is produced in the reaction.

The student uses 0.5 g of manganese(IV) oxide as a catalyst in the reaction.

How much manganese(IV) oxide remains at the end of the reaction?

**A** 0.2 g

**B** 0.3 g

**C** 0.5 g

**D** 0.7 g

Your answer ☐ **[1]**

**17.** Nov/2020/Paper_J248/04/No.17(c)

**(c)** Ammonium nitrate, $NH_4NO_3$, is another fertiliser made from ammonia.

Ammonium nitrate is made by reacting ammonia with nitric acid.

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

**(i)** Calculate the mass of **ammonium nitrate** that could be made from 25.5 tonnes of ammonia.

$A_r$: H = 1.0, N = 14.0, O = 16.0

Mass of ammonium nitrate = ..... tonnes **[3]**

**(ii)** A student makes some ammonium nitrate in the laboratory.

He predicts that he should make 12.5 g of ammonium nitrate.

His percentage yield is 80%.

Calculate the **actual mass** of ammonium nitrate that the student makes.

Actual mass of ammonium nitrate = ..... g **[2]**

**18.** Nov/2020/Paper_J248/04/No.18(a)

Sodium is in Group 1 of the Periodic Table.

**(a)** Sodium reacts with water to make sodium hydroxide, NaOH, and hydrogen.

Write the **balanced symbol** equation for the reaction between sodium and water.

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