Chemical Reactions – 2021 IGCSE 0620

1. Nov/2021/Paper_11,12&13/No.13

Solid copper(II) carbonate reacts with dilute sulfuric acid.

$$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + CO_2 + H_2O$$

The rate of the reaction can be changed by varying the conditions.

Which changes always increase the rate of this chemical reaction?

1 increasing the concentration of sulfuric acid

2 increasing the size of the pieces of copper(II) carbonate

3 increasing the temperature

4 increasing the volume of sulfuric acid

A 1, 3 and 4 **B** 1 and 3 only **C** 2 and 3 **D** 3 and 4 only

2. Nov/2021/Paper_11/No.14

Some changes are shown in the table.

In which rows are the changes described correctly?

	chemical change	physical change
1	rusting iron	melting ice
2	burning ethanol	evaporating ethanol
3	melting iron	evaporating ethanol
4	cracking hydrocarbons	burning methane

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

3. Nov/2021/Paper_11&21/No.15

X is a pink solid.

Y is a blue solid.

When X is heated, water is produced and the solid turns blue.

When water is added to Y, the solid turns pink.

What are X and Y?

	X	Y
A	anhydrous cobalt(II) chloride	hydrated cobalt(II) chloride
B	hydrated cobalt(II) chloride	anhydrous cobalt(II) chloride
C	anhydrous copper(II) sulfate	hydrated copper(II) sulfate
D	hydrated copper(II) sulfate	anhydrous copper(II) sulfate

4. Nov/2021/Paper_11/No.16

Carbon reacts with carbon dioxide as shown.

$$CO_2 + C \rightarrow 2CO$$

Which statement about this reaction is correct?

A Carbon dioxide and carbon are both oxidised.

B Carbon dioxide and carbon are both reduced.

C Carbon dioxide is reduced and carbon is oxidised.

D Carbon dioxide is oxidised and carbon is reduced.

5. Nov/2021/Paper_12/No.14

When a piece of marble is added to hydrochloric acid, bubbles of carbon dioxide gas are given off.

Which method is used to find the rate of the reaction?

A counting the number of gas bubbles formed

B measuring the diameter of the gas bubbles

C measuring the speed at which the gas bubbles rise upwards through the acid

D measuring the time taken for 10 cm^3 of gas to be collected

6. Nov/2021/Paper_12&22/No.15

Solid X is heated strongly.

The colour of the solid changes from blue to white.

What is solid X?

A anhydrous cobalt(II) chloride

B calcium carbonate

C hydrated copper(II) sulfate

D lead(II) bromide

7. Nov/2021/Paper_12/No.16

What happens to a chemical substance when it is reduced?

A It burns.

B It decomposes.

C It loses oxygen.

D It gains mass.

8. Nov/2021/Paper_13/No.14

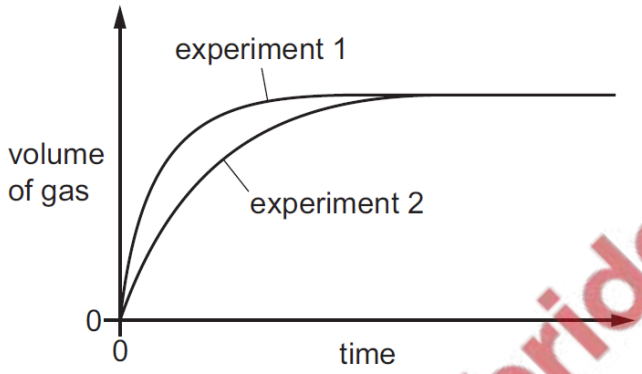
Magnesium carbonate and hydrochloric acid react to form a gas.

The volume of gas is measured at fixed time intervals.

In experiment 1, an excess of magnesium carbonate granules reacts with 100 cm^3 of hydrochloric acid.

The experiment is repeated but with one change. This is experiment 2.

The results are shown on the graph.



Which change is made?

A A catalyst is added.

B Magnesium carbonate powder is used.

C The hydrochloric acid is more concentrated.

D The temperature is lower.

9. Nov/2021/Paper_13/No.15

Which colour change is observed when water is added to anhydrous cobalt(II) chloride?

A blue to pink

B pink to blue

C blue to white

D white to blue

10. Nov/2021/Paper_13/No.16

The equation for the extraction of iron from its ore is shown.

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

Which statement is correct?

A Iron is oxidised.

B Iron(III) oxide is oxidised.

C Carbon monoxide is oxidised.

D Carbon monoxide is reduced.

11. Nov/2021/Paper_21/No.13

Which statements about the effect of increasing the temperature on the rate of a reaction are correct?

1 It increases the rate of a reaction.

2 It increases the activation energy.

3 It increases the frequency of collisions.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

12. Nov/2021/Paper_21/No.14

Ammonia is made by reacting nitrogen with hydrogen.

The equation for the reaction is shown.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

Which changes in temperature and pressure decrease the yield of ammonia?

	temperature	pressure
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

13. Nov/2021/Paper_21,22&23/No.16

Iron(II) chloride solution reacts with chlorine gas.

The equation is shown.

$$2FeCl_2(aq) + Cl_2(g) \rightarrow 2FeCl_3(aq)$$

Which statements about this reaction are correct?

1 Fe^{2+} ions are reduced to Fe^{3+} ions.

2 Chlorine acts as a reducing agent.

3 Fe^{2+} ions each lose an electron.

4 Cl_2 molecules are reduced to Cl^- ions.

A 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

14. Nov/2021/Paper_22/No.12

Chlorine gas is bubbled into aqueous potassium iodide.

What is the ionic equation for the reaction that takes place?

A $Cl + I^- \rightarrow Cl^- + I$

B $Cl_2 + 2I^- \rightarrow Cl_2^- + I_2$

C $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$

D $Cl_2 + 2I^- \rightarrow 2Cl^- + 2I$

15. Nov/2021/Paper_22/No.20

The equation shown represents a reaction at equilibrium.

m and n represent the balancing numbers for the reactant and product respectively.

$$mP(g) \rightleftharpoons nQ(g)$$

A high temperature increases the concentration of Q.

A high pressure increases the concentration of Q.

Which statement about the reaction is correct?

A The forward reaction is exothermic and m is greater than n.

B The forward reaction is exothermic and m is less than n.

C The forward reaction is endothermic and m is greater than n.

D The forward reaction is endothermic and m is less than n.

16. Nov/2021/Paper_23/No.15

Sulfuric acid is manufactured using the Contact process. One of the reactions is shown.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.

statement 1	The equation has more molecules on the left-hand side than on the right-hand side.
statement 2	Using a higher pressure shifts the equilibrium to the left.
statement 3	Higher temperatures increase the rate of reaction.
statement 4	Increasing the temperature shifts the equilibrium to the right.

Which alternative is correct?

A Statement 1 is correct and explains statement 2.

B Statement 1 and statement 3 are correct.

C Statement 2 and statement 4 are correct.

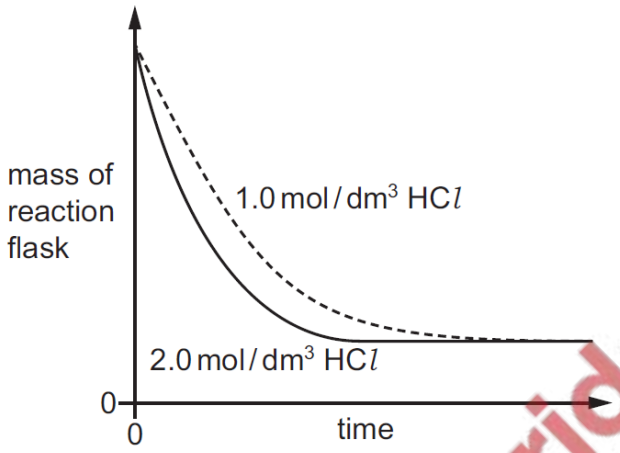
D Statement 3 is correct and explains statement 4.

17. Nov/2021/Paper_23/No.17

Excess dilute hydrochloric acid is added to equal masses of powdered calcium carbonate in two separate experiments.

Two different concentrations of hydrochloric acid are used. The temperature in both experiments is the same.

The results show the change in mass of the reaction flask measured over time.



Why is the rate of reaction for the 1.0 mol / dm³ hydrochloric acid slower?

	collision energy	collision rate
A	lower	higher
B	lower	lower
C	same as for 2.0 mol / dm³	higher
D	same as for 2.0 mol / dm³	lower

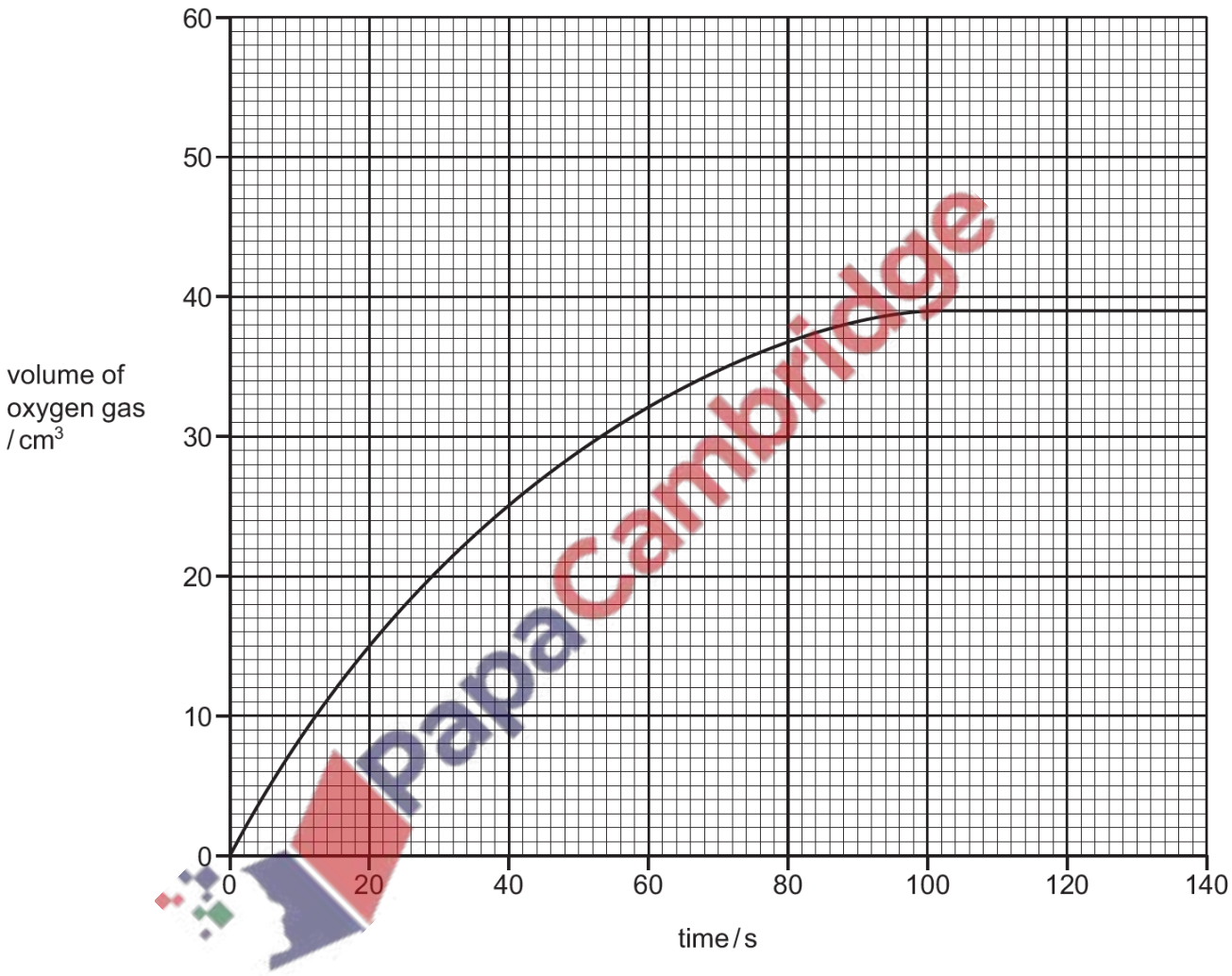
18. Nov/2021/Paper_31/No.8

The rate of decomposition of aqueous hydrogen peroxide, H_2O_2, is increased by an enzyme.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

The rate of reaction is found by measuring the volume of oxygen gas given off as the reaction proceeds.

The results are shown on the graph.



(a) (i) Deduce the volume of oxygen gas released when the reaction is complete.

volume = ... cm^3 [1]

(ii) Deduce the volume of oxygen gas produced 50 seconds from the start of the reaction.

volume = ... cm^3 [1]

(b) The experiment was repeated using hydrogen peroxide of a higher concentration.

All other conditions stayed the same.

Draw a line **on the grid** to show how the volume of oxygen changes with time when hydrogen peroxide of a higher concentration is used. [2]

(c) Describe the effect each of the following has on the rate of decomposition of hydrogen peroxide.

- The reaction is carried out at a lower temperature.

All other conditions stay the same.

.....

- The reaction is carried out without an enzyme.

All other conditions stay the same.

.....

[2]

(d) Some metal oxides catalyse the decomposition of hydrogen peroxide.

The table shows the time taken to produce 20 cm^3 of oxygen gas using three different metal oxide powders as catalysts.

All other conditions stay the same.

metal oxide	time taken to produce 20 cm^3 of oxygen gas / s
iron(III) oxide	26
lead(IV) oxide	12
manganese(IV) oxide	15

(i) Put the three oxides in order of their ability to catalyse the reaction.
Put the **best** catalyst first.

best catalyst ⟶ worst catalyst

[1]

(ii) The experiments with the metal oxide catalysts used powdered oxide.

Describe the effect on the rate of decomposition of hydrogen peroxide when large pieces of catalyst are used instead of powdered catalyst.

All other conditions stay the same.

..... [1]

[Total: 8]

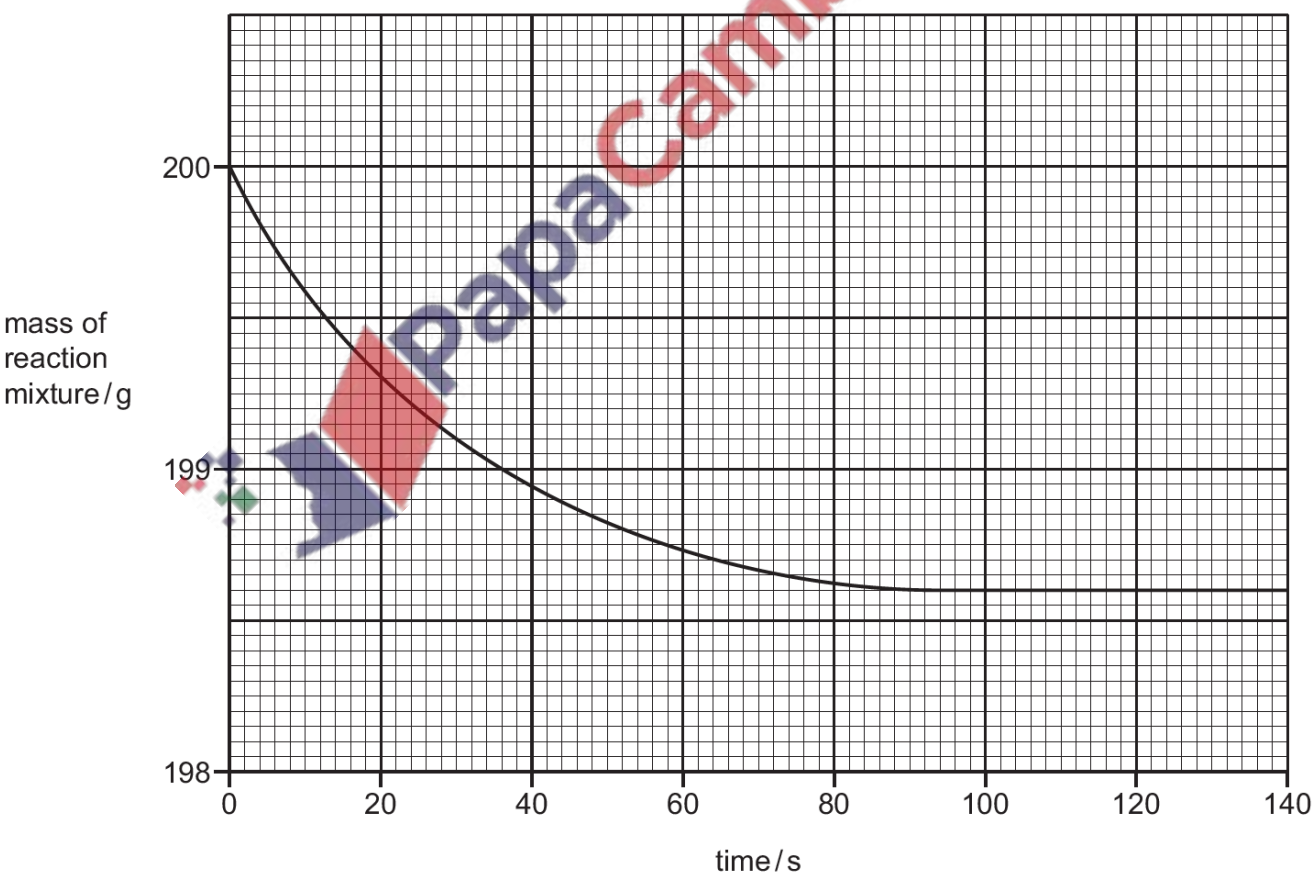
19. Nov/2021/Paper_32/No.8

A student investigated the reaction of small pieces of calcium carbonate with dilute hydrochloric acid. The hydrochloric acid was in excess.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

The rate of reaction is found by measuring the decrease in the mass of the reaction mixture with time.

The results are shown on the graph.



(a) Deduce the time taken from the beginning of the experiment for the mass of the reaction mixture to decrease by 1.0 g.

time = ... s [1]

(b) The experiment was repeated using dilute hydrochloric acid of a higher concentration.

All other conditions stayed the same.

Draw a line **on the grid** to show how the mass of the reaction mixture changes with time using acid of a higher concentration. [2]

(c) Describe the effect each of the following has on the rate of reaction of calcium carbonate with hydrochloric acid.

All other conditions stay the same.

- The reaction is carried out at a higher temperature.

.....

- The reaction is carried out using large pieces of calcium carbonate instead of small pieces of calcium carbonate.

.....

[2]

(d) When 0.44 g of calcium carbonate is used, 100 cm^3 of carbon dioxide gas is formed.

Calculate the mass of calcium carbonate needed to produce 25 cm^3 of carbon dioxide gas.

mass of calcium carbonate = ... g [1]

(e) The table compares the reaction of four metals with dilute hydrochloric acid.

metal	observations
iron	bubbles produced slowly
magnesium	bubbles produced very rapidly
nickel	bubbles produced very slowly
silver	no bubbles produced

Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

[Total: 8]

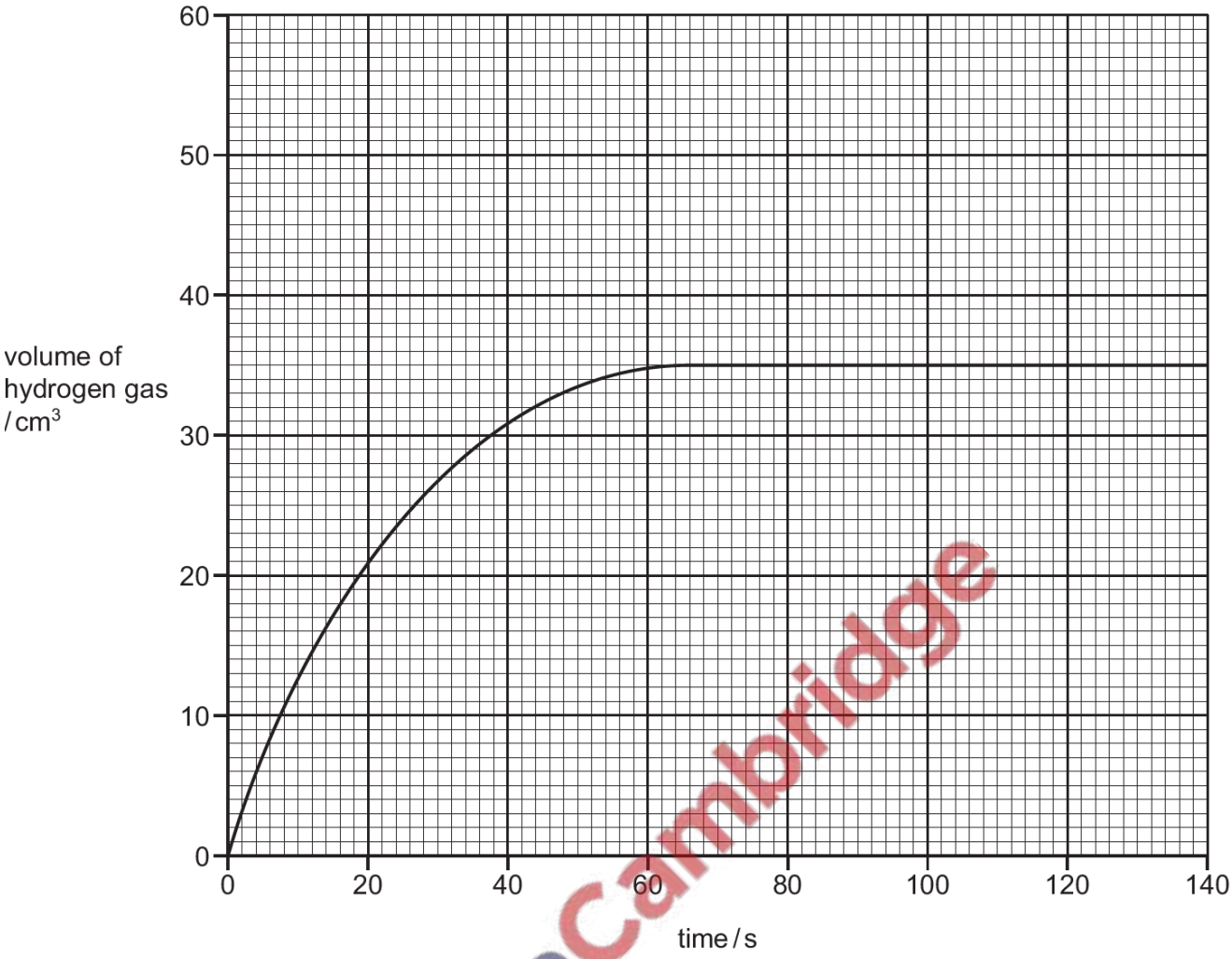
20. Nov/2021/Paper_33/No.8

A student investigated the reaction of small pieces of zinc with dilute hydrochloric acid. The hydrochloric acid was in excess.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

The rate of reaction is found by measuring the increase in volume of hydrogen gas with time.

The results are shown on the graph.



(a) Deduce the time taken from the beginning of the experiment to collect 30 cm^3 of hydrogen gas.

time = ... s [1]

(b) The experiment was repeated using dilute hydrochloric acid of a higher concentration.

All other conditions stayed the same.

Draw a line **on the grid** to show how the volume of hydrogen gas changes with time. [2]

(c) Describe the effect each of the following has on the rate of reaction of zinc with dilute hydrochloric acid.

All other conditions stay the same.

- The reaction is carried out at a lower temperature.

.....

- The reaction is carried out using zinc powder instead of small pieces of zinc.

.....

[2]

(d) When 0.065 g of zinc is used, 24 cm^3 of hydrogen gas is formed.

Calculate the mass of zinc needed to produce 96 cm^3 of hydrogen gas.

mass of zinc = ... g [1]

(e) Aqueous ammonia is added to aqueous zinc chloride.

Describe the observations when a few drops of aqueous ammonia are added and when excess aqueous ammonia is added.

a few drops of aqueous ammonia .....

excess aqueous ammonia .....

[2]

[Total: 8]

21. Nov/2021/Paper_43/No.6

A student investigates the decomposition of hydrogen peroxide in the presence of a catalyst of manganese(IV) oxide.

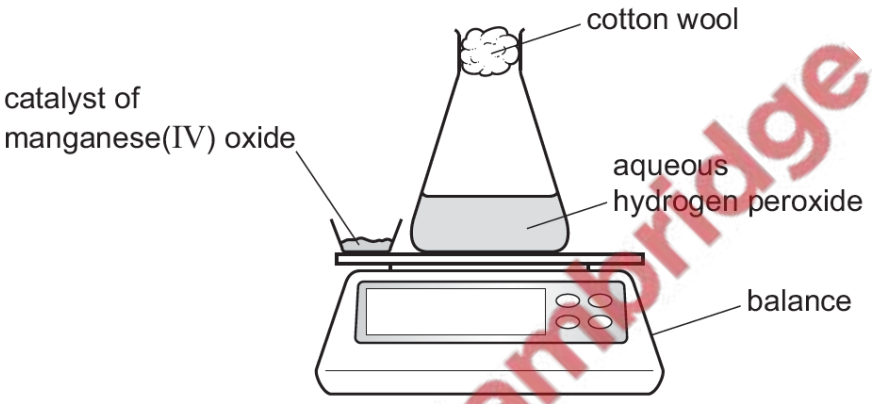
$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

(a) State the meaning of the term *catalyst*.

.....

..... [2]

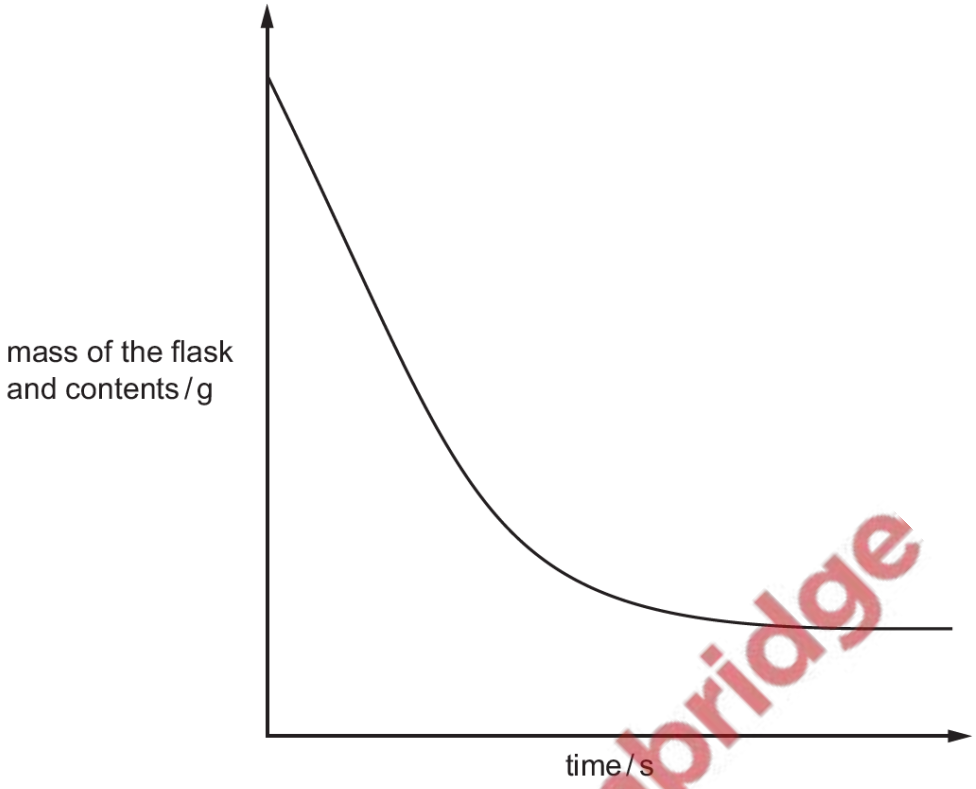
(b) The diagram shows the equipment the student uses.



The student uses this method:

- the catalyst is added to the aqueous hydrogen peroxide
- the stop-clock is started
- the mass of the flask and contents is recorded at regular time intervals.

A graph of the mass of the flask and contents against time is shown.



(i) Suggest why the mass of the flask and contents decreases as time increases.

..... [1]

(ii) Describe what happens to the rate of the reaction as time increases.

.....

..... [2]

(c) The student repeats the experiment at a higher temperature. All other conditions stay the same. The rate of reaction increases.

(i) Explain, in terms of collisions between particles, why the rate of reaction increases at a higher temperature.

.....

.....

.....

..... [3]

(ii) Draw a line on the graph in **(b)** for the experiment at a higher temperature. [2]

[Total: 10]