Chemical reactions – 2021 O Level

1. Nov/2021/Paper_11/No.5

A compound X, when heated with an aqueous solution of compound Y, produces a gas that turns red litmus blue.

1 Y could be potassium hydroxide.

2 X is an acid.

3 X could be an ammonium salt.

4 X could be sodium nitrate.

Which statements are correct?

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

2. Nov/2021/Paper_11/No.19

Which statements about oxidation and reduction are correct?

1 Reduction can involve the loss of oxygen.

2 Oxidation can involve the loss of hydrogen.

3 Reduction can involve the loss of electrons.

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

3. Nov/2021/Paper_11/No.20

Aqueous ammonium nitrite, NH_4NO_2, decomposes when heated.

$$NH_4NO_2(aq) \rightarrow N_2(g) + 2H_2O(l)$$

In this salt, the anion is .....1..... .

The nitrogen atoms in the .....2..... ion are oxidised during the reaction.

Which formulae correctly complete gaps 1 and 2?

	1	2
A	NH_4^+	NH_4^+
B	NH_4^+	NO_2^-
C	NO_2^-	NH_4^+
D	NO_2^-	NO_2^-

4. Nov/2021/Paper_11/No.21

Elements X and Y react together in a reversible reaction to form XY_2.

$$X + 2Y \rightleftharpoons XY_2$$

1.0 mol of X is mixed with 1.0 mol of Y and the mixture is left to react until an equilibrium position is reached.

Which statements about this reaction are correct?

1 After the equilibrium position has been reached, the reaction stops.

2 At equilibrium there is more than 0.5 mol of X present.

3 At equilibrium there is less than 1.0 mol of XY_2 present.

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

5. Nov/2021/Paper_12/No.18

The equation shows the reaction for the manufacture of ammonia.

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

Which change will decrease the activation energy of the reaction?

A addition of a catalyst

B decrease in temperature

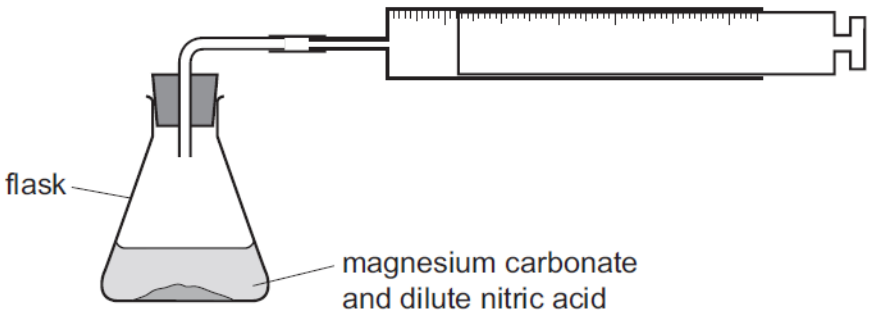
C increase in concentration

D increase in pressure

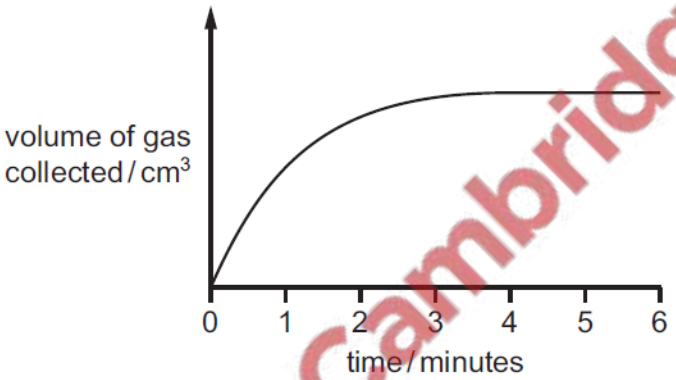
6. Nov/2021/Paper_12/No.19

The apparatus shows a method of following the rate of the reaction between magnesium carbonate, $MgCO_3$, and dilute nitric acid, HNO_3.

$$MgCO_3(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$



The graph shows the volume of gas collected against time.



Three statements are made about the experiment.

1 The mass of the flask and its contents decreases as time increases.

2 The rate of the reaction decreases as time increases.

3 The reaction has finished after four minutes.

Which statements are correct?

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

7. Nov/2021/Paper_12/No.21

Which statement is correct for all reversible reactions that have reached dynamic equilibrium?

A Introduction of a catalyst changes the position of the equilibrium.

B The number of moles of products equals the number of moles of reactants.

C The rate of the forward reaction equals the rate of the reverse reaction.

D When the reaction reaches the position of equilibrium the reaction stops.

8. Nov/2021/Paper_12/No.25

Ammonia is made by a reversible reaction.

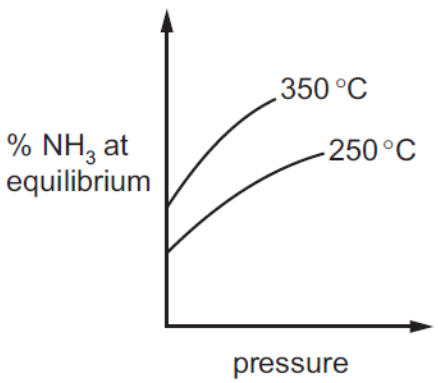
$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ/mol$$

A chemist investigates how the percentage of ammonia at equilibrium changes with pressure.

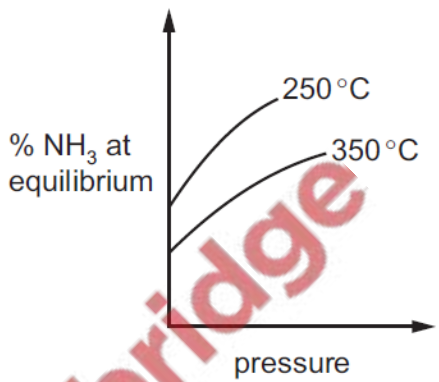
The experiment is carried out both at 250 °C and at 350 °C.

Which graph shows the chemist's results?

A



B



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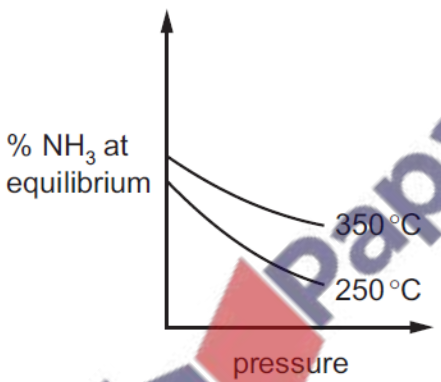
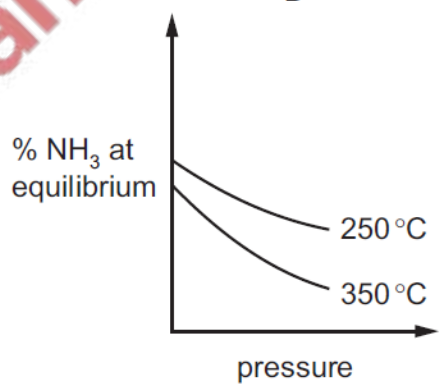


D



9. Nov/2021/Paper_12/No.20

Aqueous bromine is added to aqueous sodium chloride.

Which statement is correct?

A Bromine is oxidised and chloride ions are reduced.

B Bromine is reduced and chloride ions are oxidised.

C Neither oxidation nor reduction takes place.

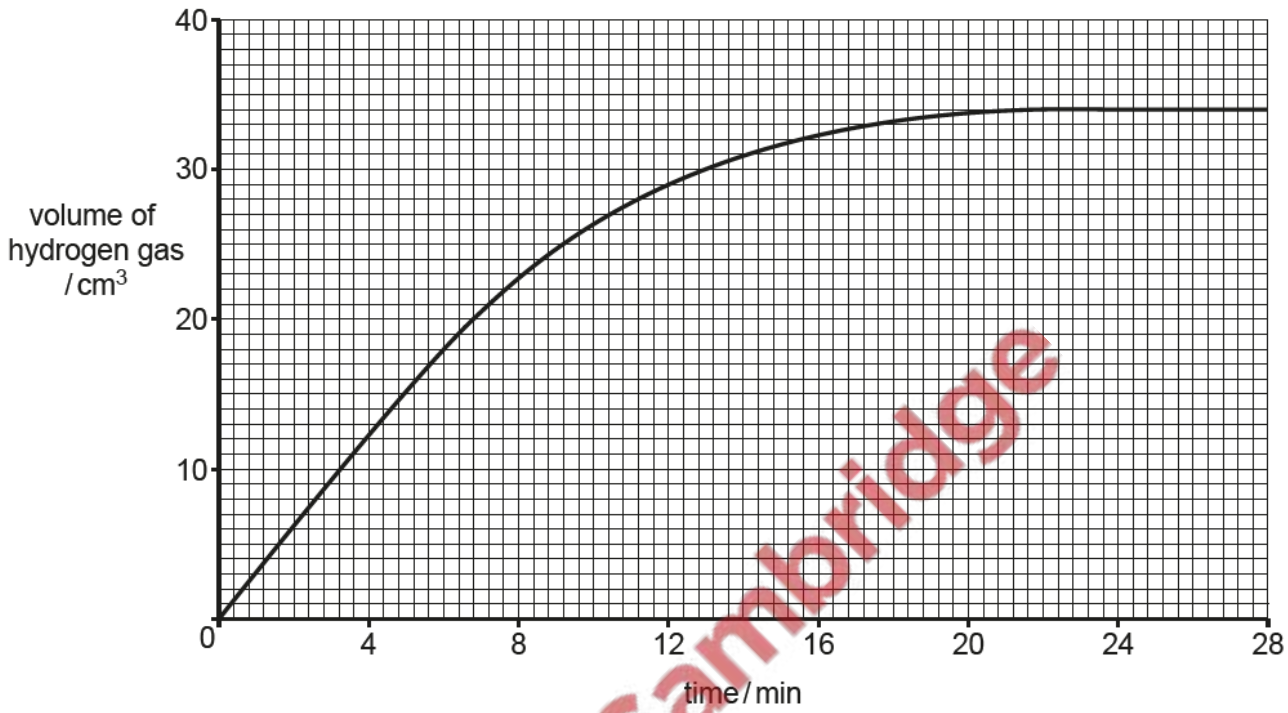
D Sodium ions are oxidised.

10. Nov/2021/Paper_21/No.3

Iron powder reacts with dilute sulfuric acid.

$$Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$$

(a) The graph shows the volume of hydrogen gas produced at 20 °C as the reaction proceeds.



(i) State how long it takes from the start of the experiment to collect 18 cm^3 of hydrogen gas.

..... [1]

(ii) The experiment is repeated at 30 °C.

All other conditions are the same.

Draw a line **on the grid** to show how the volume of hydrogen gas produced changes with time when the reaction is done at 30 °C. [2]

(b) **(i)** Describe and explain, using ideas about collisions between particles, how the rate of the reaction changes when the temperature of the reaction mixture is increased.

All other conditions are the same.

.....

.....

.....

..... [2]

(ii) Describe and explain, using ideas about collisions between particles, how the rate of the reaction changes when larger pieces of iron are used.

All other conditions are the same.

.....

.....

.....

..... [2]

(c) Calculate the maximum volume, in dm^3, of hydrogen formed when 3.36 g of iron react with excess dilute sulfuric acid at room temperature and pressure.
Give your answer to **three** significant figures.

maximum volume = ... dm^3 [2]

(d) Concentrated sulfuric acid is an oxidising agent.

Describe a test for oxidising agents.

test .....

observations .....

.....

[2]

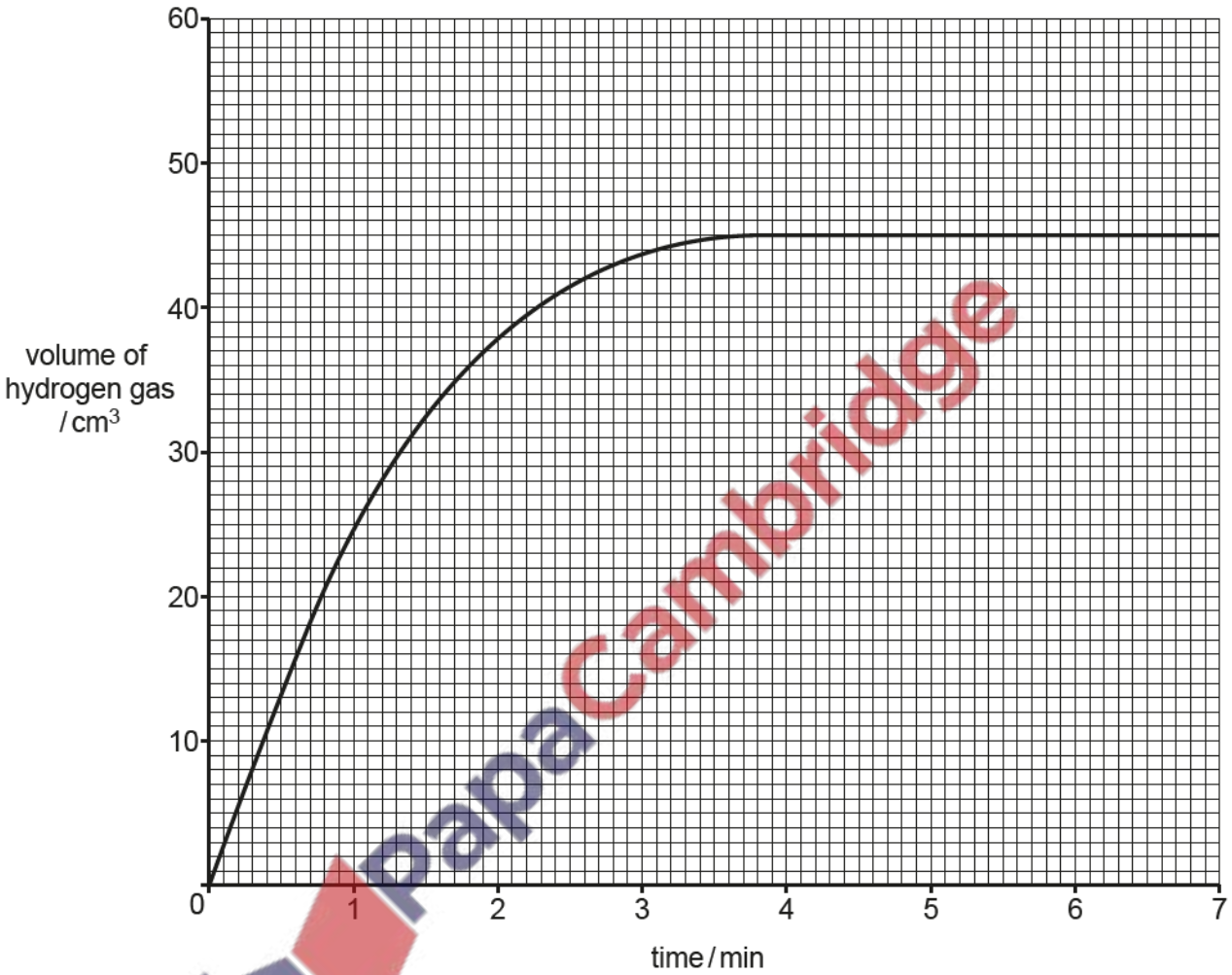
[Total: 11]

11. Nov/2021/Paper_22/No.3

Magnesium ribbon reacts with dilute hydrochloric acid.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(a) The graph shows the volume of hydrogen gas produced at 20 °C as the reaction proceeds. The magnesium is in excess.



The experiment is repeated using a lower concentration of hydrochloric acid.

The volume of acid used and all other conditions are the same.

Draw a line **on the grid** to show how the volume of hydrogen gas produced changes with time when the reaction is done with a lower concentration of hydrochloric acid. [2]

(b) **(i)** Describe and explain, using ideas about collisions between particles, how the rate of the reaction changes when magnesium powder is used instead of magnesium ribbon.

All other conditions are the same.

.....

.....

.....

..... [2]

(ii) Describe and explain, using ideas about collisions between particles, how the rate of the reaction changes when the temperature of the reaction mixture is decreased.

All other conditions are the same.

.....

.....

.....

..... [2]

(c) Calculate the maximum volume, in dm^3, of hydrogen formed when 1.68 g of magnesium react with excess dilute hydrochloric acid at room temperature and pressure.
Give your answer to **three** significant figures.

volume = ... dm^3 [2]

(d) Magnesium is a good reducing agent.

Describe a test for reducing agents.

test .....

observations .....

.....

[2]

[Total: 10]

12. Jun/2021/Paper_11/No.18

Which changes will speed up a chemical reaction?

1 decreasing the pressure in a reaction between gases

2 increasing the size of the solid particles in a reaction involving solids

3 increasing the temperature of any reaction

4 increasing the concentration of a solution

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

13. Jun/2021/Paper_11/No.19

Magnesium reacts with dilute sulfuric acid.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

Two experiments are carried out at 25 °C.

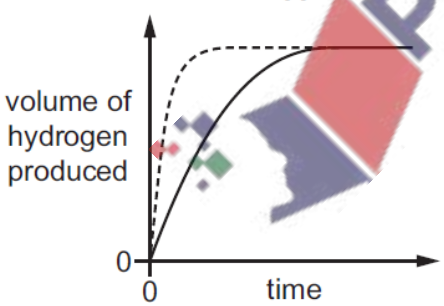
experiment 1 24.0 g of powdered magnesium is reacted with 100 cm^3 of 1.0 mol/dm^3 sulfuric acid.

experiment 2 24.0 g of powdered magnesium is reacted with 50 cm^3 of 2.0 mol/dm^3 sulfuric acid.

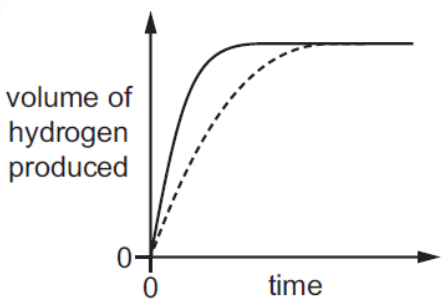
During each experiment the volume of hydrogen produced is measured. The results are plotted on a graph.

Which graph is correct?

A



B

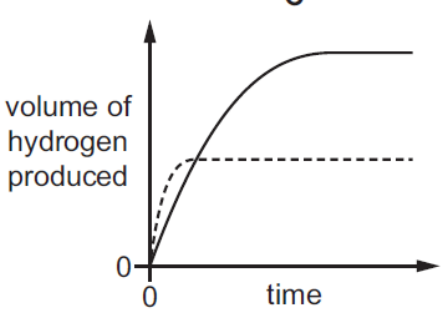


key

experiment 1

experiment 2

C



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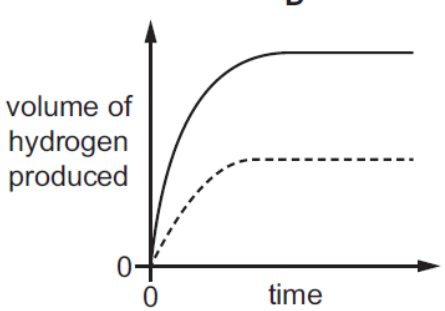


14. Jun/2021/Paper_11/No.21

The Haber process converts nitrogen and hydrogen into ammonia.

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

Which row is correct?

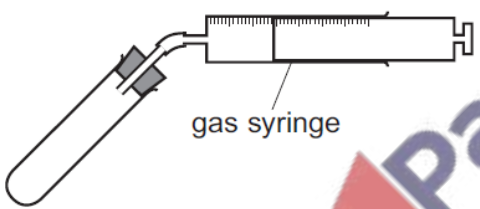
	change in condition	position of equilibrium
A	pressure is increased	moves to the left
B	pressure is reduced	no change
C	catalyst present	moves to the right
D	catalyst present	no change

15. Jun/2021/Paper_12/No.1

The formula of magnesium oxide can be investigated by using the fact that when magnesium is heated it reacts with oxygen to form magnesium oxide.

Which apparatus is used for this investigation?

1



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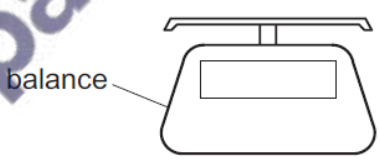

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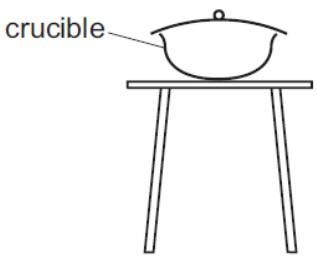


A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

16. Jun/2021/Paper_12/No.18

Aqueous sodium thiosulfate reacts with hydrochloric acid. The rate of the reaction increases if the concentration of both reactants is increased.

Nitrogen gas reacts with hydrogen gas. The rate of the reaction increases if the pressure in the reaction vessel is increased.

Which row correctly explains why the given change increases the rate of the reaction?

	aqueous sodium thiosulfate + hydrochloric acid	nitrogen + hydrogen
A	higher frequency of collisions between particles	higher frequency of collisions between particles
B	higher frequency of collisions between particles	the activation energy is decreased
C	the activation energy is decreased	higher frequency of collisions between particles
D	the activation energy is decreased	the activation energy is decreased

17. Jun/2021/Paper_12/No.22

Which row shows the pH values for 0.1 mol/dm^3 solutions of ammonia, hydrochloric acid, sodium chloride and sodium hydroxide?

	pH values			
	NH_3	HCl	$NaCl$	NaOH
A	1	7	13	11
B	7	1	11	13
C	11	1	7	13
D	13	11	7	1

18. Jun/2021/Paper_12/No.19

Magnesium reacts with dilute sulfuric acid.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

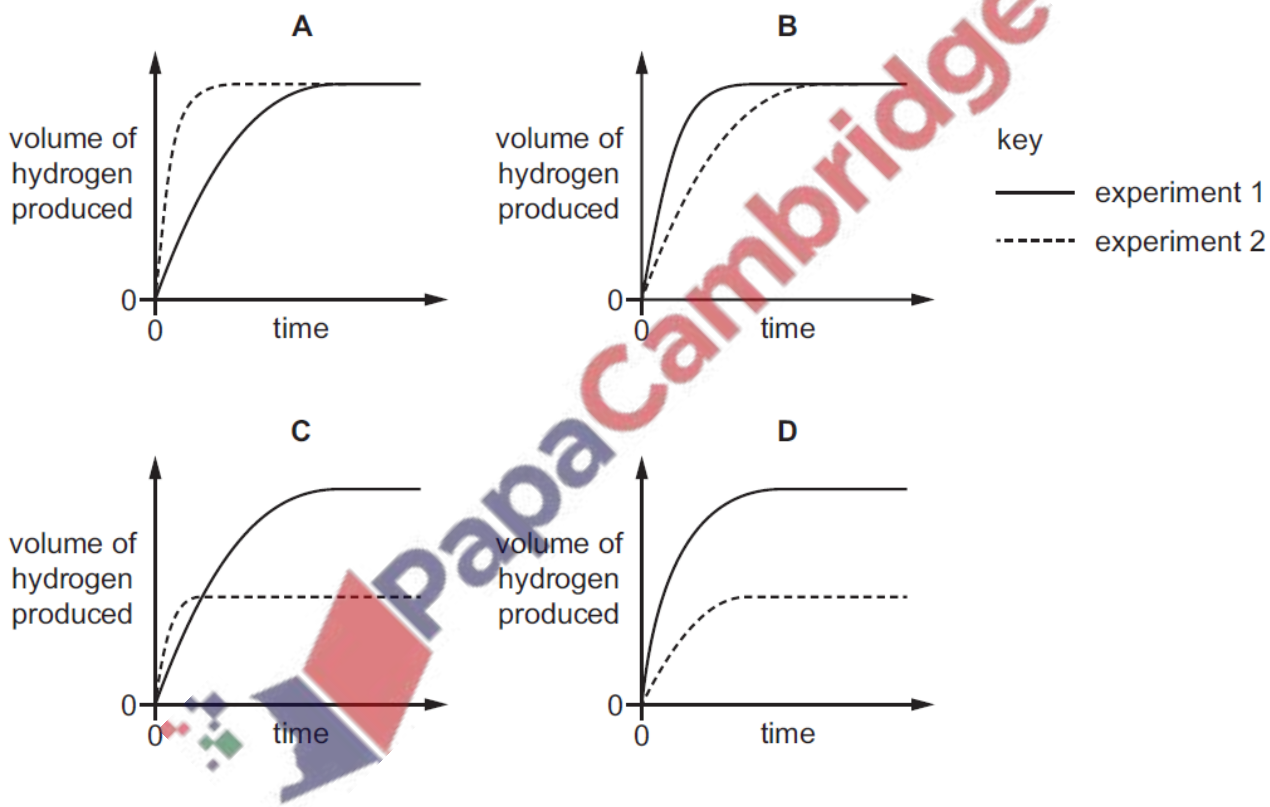
Two experiments are carried out at 25 °C.

experiment 1 24.0 g of powdered magnesium is reacted with 100 cm^3 of 1.0 mol/dm^3 sulfuric acid.

experiment 2 24.0 g of powdered magnesium is reacted with 50 cm^3 of 2.0 mol/dm^3 sulfuric acid.

During each experiment the volume of hydrogen produced is measured. The results are plotted on a graph.

Which graph is correct?



19. Jun/2021/Paper_21/No.7

Aqueous ammonium nitrite, $NH_4NO_2(aq)$, decomposes when heated, as shown.

$$NH_4NO_2(aq) \rightarrow N_2(g) + 2H_2O(l)$$

(a) A 25.0 cm^3 sample of 0.150 mol/dm^3 $NH_4NO_2(aq)$ is heated.

Calculate the maximum volume, in dm^3, of nitrogen formed, measured at room temperature and pressure.

volume of nitrogen ..... dm^3 [2]

(b) The concentration of $NH_4NO_2(aq)$ is decreased.

The temperature of the reaction remains constant.

State and explain how the rate of reaction changes.

.....

.....

.....

.....

..... [3]

(c) NH_4NO_2 contains the ammonium ion, NH_4^+, and the nitrite ion.

A mixture of aqueous calcium hydroxide and $NH_4NO_2(s)$ is warmed.

Calcium nitrite, water and a gas are formed. The gas turns damp red litmus paper blue.

Construct the equation for this reaction.

..... [3]

(d) $NH_4NO_2(aq)$ is added to a sample of aqueous potassium iodide.

A brown solution is formed.

(i) Name the brown solution.

..... [1]

(ii) Name the type of reaction that causes this brown solution to form.

..... [1]

[Total: 10]

20. Jun/2021/Paper_22/No.7

Sulfamic acid, NH_2SO_3H, is a white crystalline solid.

It reacts with aqueous sodium nitrite to make nitrogen gas, as shown in the equation.

$$NH_2SO_3H(s) + NaNO_2(aq) \rightarrow N_2(g) + H_2O(l) + NaHSO_4(aq)$$

(a) An excess of sulfamic acid reacts with a 20.0 cm^3 sample of 0.150 mol/dm^3 $NaNO_2(aq)$.

Calculate the maximum volume, in dm^3, of nitrogen formed, measured at room temperature and pressure.

volume of nitrogen ..... dm^3 [2]

(b) The rate of this reaction can be determined by measuring the volume of nitrogen formed every second.

Draw a labelled diagram of the assembled apparatus that can be used to make, collect and measure the volume of nitrogen formed in this reaction.

[2]

(c) The concentration of $NaNO_2(aq)$ is increased.

The temperature of the reaction remains constant.

State and explain how the rate of reaction changes.

.....

.....

.....

.....

..... [3]

(d) Sulfamic acid forms salts called sulfamates that contain the anion $NH_2SO_3^-$.

Magnesium carbonate, $MgCO_3$, is added to a sample of $NH_2SO_3H(aq)$.

Magnesium sulfamate, water and a gas are formed. The gas turns limewater milky.

Construct the equation for this reaction.

..... [3]

[Total: 10]