Chemical Reactions – 2021 IGCSE 0620

1. June/2021/Paper_11,12,13,21,22&23/No.14

When sulfur is heated it undergoes a .....1..... change as it melts.

Further heating causes the sulfur to undergo a .....2..... change and form sulfur dioxide.

Which words complete gaps 1 and 2?

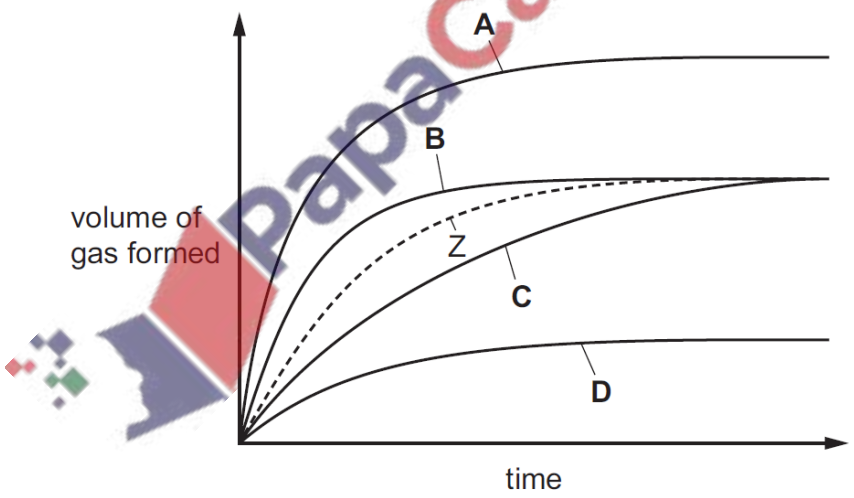
	1	2
A	chemical	chemical
B	chemical	physical
C	physical	chemical
D	physical	physical

2. June/2021/Paper_11/No.15

Zinc reacts with an acid to form a gas. The volume of gas produced is measured at intervals. The results are shown as curve Z.

The reaction is repeated in the presence of a catalyst.

Which curve shows the results for the catalysed reaction?



3. June/2021/Paper_11/No.16

Which statement is correct?

A When anhydrous copper(II) sulfate is heated its colour changes to a deeper blue.

B When hydrated copper(II) sulfate is heated its colour changes to a deeper blue.

C When water is added to blue cobalt(II) chloride paper it turns pink.

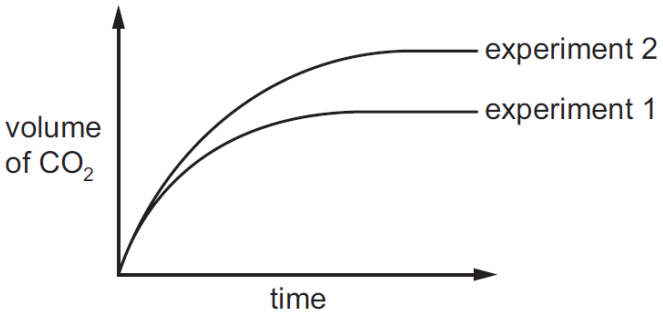
D When water is added to pink cobalt(II) chloride paper it turns blue.

4. June/2021/Paper_12&22/No.15,13

An excess of calcium carbonate reacts with dilute hydrochloric acid. The volume of carbon dioxide produced is measured at regular time intervals. The results are shown as experiment 1.

The experiment is repeated with only **one** change to the reaction conditions.

The results are shown as experiment 2.



Which change is made in experiment 2?

A The concentration of the acid is increased.

B The volume of acid is increased.

C The mass of calcium carbonate is increased.

D The calcium carbonate is powdered.

5. June/2021/Paper_12/No.16

The equation represents a reaction that can be reversed by changing the conditions.

$$\underset{\text{blue}}{\text{anhydrous cobalt(II) chloride}} + \text{water} \rightleftharpoons \underset{\text{pink}}{\text{hydrated cobalt(II) chloride}}$$

Which statement is correct?

A When anhydrous cobalt(II) chloride is heated, water vapour is produced.

B Blue cobalt(II) chloride paper turns pink when placed in water vapour.

C Anhydrous cobalt(II) chloride paper is pink and turns blue when placed in water.

D The colour changes from blue to pink when hydrated cobalt(II) chloride is heated.

6. June/2021/Paper_13/No.15

Copper(II) carbonate reacts with dilute sulfuric acid.

Which conditions produce the fastest rate of reaction?

	form of copper(II) carbonate	temperature of dilute sulfuric acid / °C
A	large lumps	37
B	large lumps	70
C	powder	37
D	powder	70

7. June/2021/Paper_13/No.16

Hydrated copper(II) sulfate is blue. When it is heated it forms white anhydrous copper(II) sulfate.

How is a sample of anhydrous copper(II) sulfate changed into hydrated copper(II) sulfate?

A Water is added.

B It is cooled down.

C It is heated up.

D Water is removed.

8. June/2021/Paper_13/No.17

Copper(II) oxide reacts with iron. The equation for the reaction is shown.

$$3CuO + 2Fe \rightarrow 3Cu + Fe_2O_3$$

Why can this reaction be described as the reduction of copper(II) oxide?

A Iron gains oxygen.

B The copper(II) oxide loses oxygen.

C The copper(II) oxide weighs less after the reaction than before.

D There are fewer substances on the right of the equation.

9. June/2021/Paper_21,22&23/No.15

Four statements about the effect of increasing temperature on a reaction are shown.

1 The activation energy becomes lower.

2 The particles move faster.

3 There are more collisions between reacting particles per second.

4 There are more collisions which have energy greater than the activation energy.

Which statements are correct?

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

10. June/2021/Paper_21,22&23/No.16

An example of a redox reaction is shown.

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

Which statement about the reaction is correct?

A Zn is the oxidising agent and it oxidises Cu^{2+}.

B Zn is the oxidising agent and it reduces Cu^{2+}.

C Zn is the reducing agent and it oxidises Cu^{2+}.

D Zn is the reducing agent and it reduces Cu^{2+}.

11. June/2021/Paper_21/No.17

Which statement about a reaction in equilibrium is correct?

A Both the forward and the backward reactions are proceeding at the same rate.

B Neither the forward nor the backward reaction is proceeding.

C The amount of product present is no longer affected by changes in temperature or pressure.

D The amount of product present is only affected by a change in pressure.

12. June/2021/Paper_23/No.32

The formulae of two compounds of manganese are MnO_2 and $KMnO_4$.

In these two compounds the oxidation state of potassium is +1 and the oxidation state of oxygen is –2.

What are the oxidation states of manganese in each of these two compounds?

	MnO_2	$KMnO_4$
A	+2	+3
B	+2	+7
C	+4	+3
D	+4	+7

13. March/2021/Paper_12/No.15

When zinc carbonate is mixed with dilute hydrochloric acid a change, M, takes place.

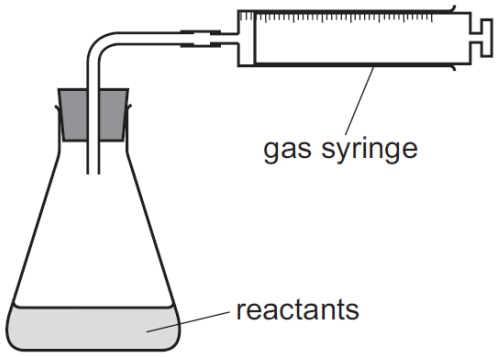
When carbon is heated with copper(II) oxide a change, N, takes place.

Which row describes changes M and N?

	M	N
A	chemical	chemical
B	chemical	physical
C	physical	chemical
D	physical	physical

14. March/2021/Paper_12/No.16

The apparatus shown is used to measure the rate of a reaction.



Which equation represents a reaction where the rate can be measured using this apparatus?

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

B $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

C $Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$

D $2Na(s) + Br_2(l) \rightarrow 2NaBr(s)$

15. March/2021/Paper_12&22/No.17

P is a hydrated metal salt with a blue colour. When P is heated, water is given off, leaving solid Q.

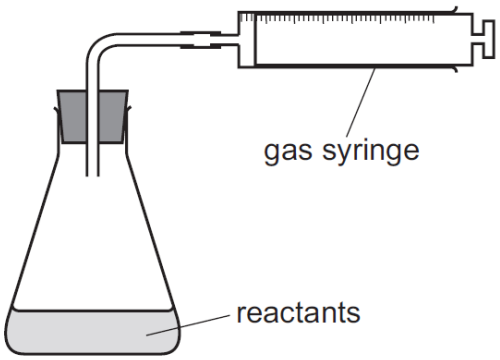
R is a hydrated metal salt with a pink colour. When R is heated, water is given off, leaving solid S.

Which row gives the name of P and the colour of S?

	name of P	colour of S
A	hydrated cobalt(II) chloride	blue
B	hydrated cobalt(II) chloride	white
C	hydrated copper(II) sulfate	blue
D	hydrated copper(II) sulfate	white

16. March/2021/Paper_22/No.16

The apparatus shown is used to measure the rate of a reaction.



Which equation represents a reaction where the rate can be measured using this apparatus?

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

B $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

C $Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$

D $2Na(s) + Br_2(l) \rightarrow 2NaBr(s)$

17. March/2021/Paper_22/No.18

Magnesium reacts with copper(II) oxide to give magnesium oxide and copper.

Which substance is the oxidising agent in this reaction?

A copper

B copper(II) oxide

C magnesium

D magnesium oxide

18. June/2021/Paper_31/No.5

(a) Calcium oxide is made by the thermal decomposition of calcium carbonate.

(i) State the meaning of the term *thermal decomposition*.

.....

..... [2]

(ii) Describe a test for calcium ions.

test .....

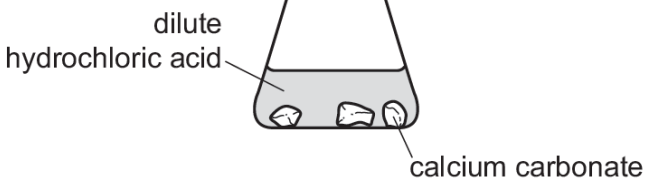
observations .....

[2]

(b) Carbon dioxide is produced when dilute hydrochloric acid reacts with calcium carbonate.

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

(i) Complete the diagram to show how to measure the volume of carbon dioxide produced during this reaction.



[2]

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

- The concentration of hydrochloric acid is decreased.

All other conditions stay the same.

.....

- The temperature is increased.

All other conditions stay the same.

.....

[2]

(c) Carbon dioxide is also formed when the hydrocarbon C_3H_8 is completely combusted.

(i) State the meaning of the term *hydrocarbon*.

.....

..... [2]

(ii) The hydrocarbon C_3H_8 is called propane.

Name the homologous series that propane belongs to.

..... [1]

(iii) Name two substances formed by the incomplete combustion of propane.

..... and ..... [2]

[Total: 13]

19. June/2021/Paper_32/No.5

(a) Calcium carbonate is heated in a closed container.

$$CaCO_3 \rightleftharpoons CaO + CO_2$$

(i) State the name of a rock which is mainly calcium carbonate.

..... [1]

(ii) State the meaning of the symbol $\rightleftharpoons$.

..... [1]

(iii) CaO is lime. Lime is used for neutralising acidic industrial waste.

Give one **other** use of lime.

..... [1]

(iv) Describe a test for carbon dioxide.

test .....

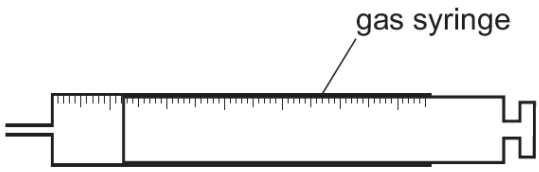
observations .....

[2]

(b) Carbon dioxide is produced when dilute hydrochloric acid reacts with calcium carbonate.

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

(i) Complete the diagram to show the apparatus used to investigate the volume of carbon dioxide produced during this reaction.



[2]

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

- The temperature is decreased.

All other conditions stay the same.

.....

- Calcium carbonate powder is used instead of large pieces of calcium carbonate.

All other conditions stay the same.

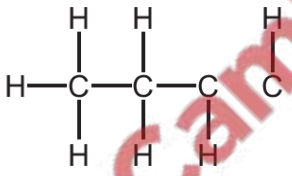
.....

[2]

(c) Carbon dioxide is also formed when the hydrocarbon C_4H_8 is completely combusted.

(i) The hydrocarbon C_4H_8 is an alkene.

Complete the structure of this alkene by adding the missing bonds and atom.



[2]

(ii) The incomplete combustion of C_4H_8 produces carbon monoxide.

State the meaning of the term *incomplete combustion*.

.....

..... [1]

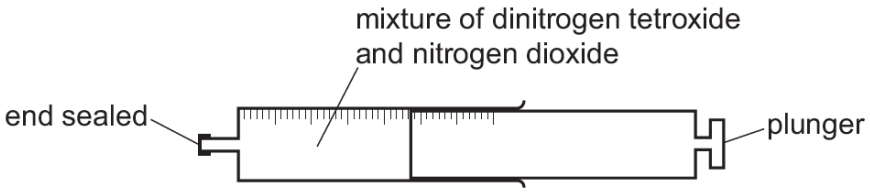
[Total: 12]

20. June/2021/Paper_41/No.4

Dinitrogen tetroxide, N_2O_4, decomposes into nitrogen dioxide, NO_2. The reaction is reversible.

$$\underset{\text{colourless gas}}{N_2O_4(g)} \rightleftharpoons \underset{\text{brown gas}}{2NO_2(g)}$$

A gas syringe containing a mixture of dinitrogen tetroxide and nitrogen dioxide gases was sealed and heated. After reaching equilibrium the mixture was a pale brown colour.



(a) State what is meant by the term *equilibrium*.

.....

.....

..... [2]

(b) The plunger of the gas syringe is pushed in. The temperature does not change. The mixture initially turns darker brown. After a few seconds the mixture turns lighter brown because the equilibrium shifts to the left.

$$\underset{\text{colourless gas}}{N_2O_4(g)} \rightleftharpoons \underset{\text{brown gas}}{2NO_2(g)}$$

(i) Explain why the mixture initially turns darker brown.

..... [1]

(ii) Explain why the position of equilibrium shifts to the left.

..... [1]

(c) The forward reaction is endothermic.

(i) State what happens to the position of equilibrium when the temperature of the mixture is increased.

..... [1]

(ii) State what happens to the rate of the forward reaction and the rate of the backward reaction when the temperature of the mixture is increased.

rate of the forward reaction .....

rate of the backward reaction .....

[2]

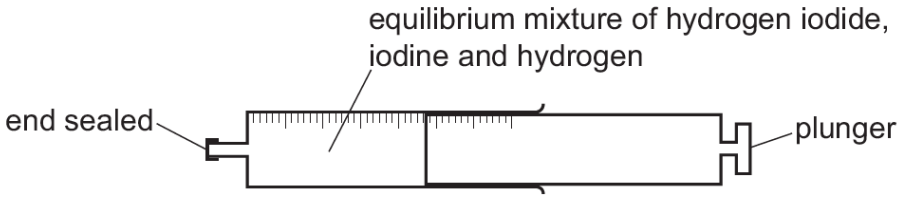
[Total: 7]

21. June/2021/Paper_43/No.4

Hydrogen iodide, HI, decomposes into iodine and hydrogen. The reaction is reversible.

$$\underset{\text{colourless gas}}{2HI(g)} \rightleftharpoons \underset{\text{purple gas}}{I_2(g)} + \underset{\text{colourless gas}}{H_2(g)}$$

A gas syringe containing a mixture of hydrogen iodide, iodine and hydrogen gases was sealed. After reaching equilibrium the mixture was a pale purple colour.



(a) State what is meant by the term *equilibrium*.

.....

.....

..... [2]

(b) The plunger of the gas syringe is pushed in. The position of equilibrium does not change. The colour of the gaseous mixture turns darker purple.

The temperature remains constant.

$$\underset{\text{colourless gas}}{2HI(g)} \rightleftharpoons \underset{\text{purple gas}}{I_2(g)} + \underset{\text{colourless gas}}{H_2(g)}$$

(i) Explain why the position of equilibrium does **not** change.

..... [1]

(ii) Suggest why the colour of the gaseous mixture turns darker purple even though the position of equilibrium does not change.

..... [1]

(c) The forward reaction is endothermic.

(i) State what happens to the position of equilibrium when the temperature is decreased.

.....

..... [1]

(ii) State what happens to the rate of the forward reaction and the rate of the backward reaction when the temperature of the mixture is decreased.

rate of the forward reaction .....

rate of the backward reaction .....

[2]

[Total: 7]

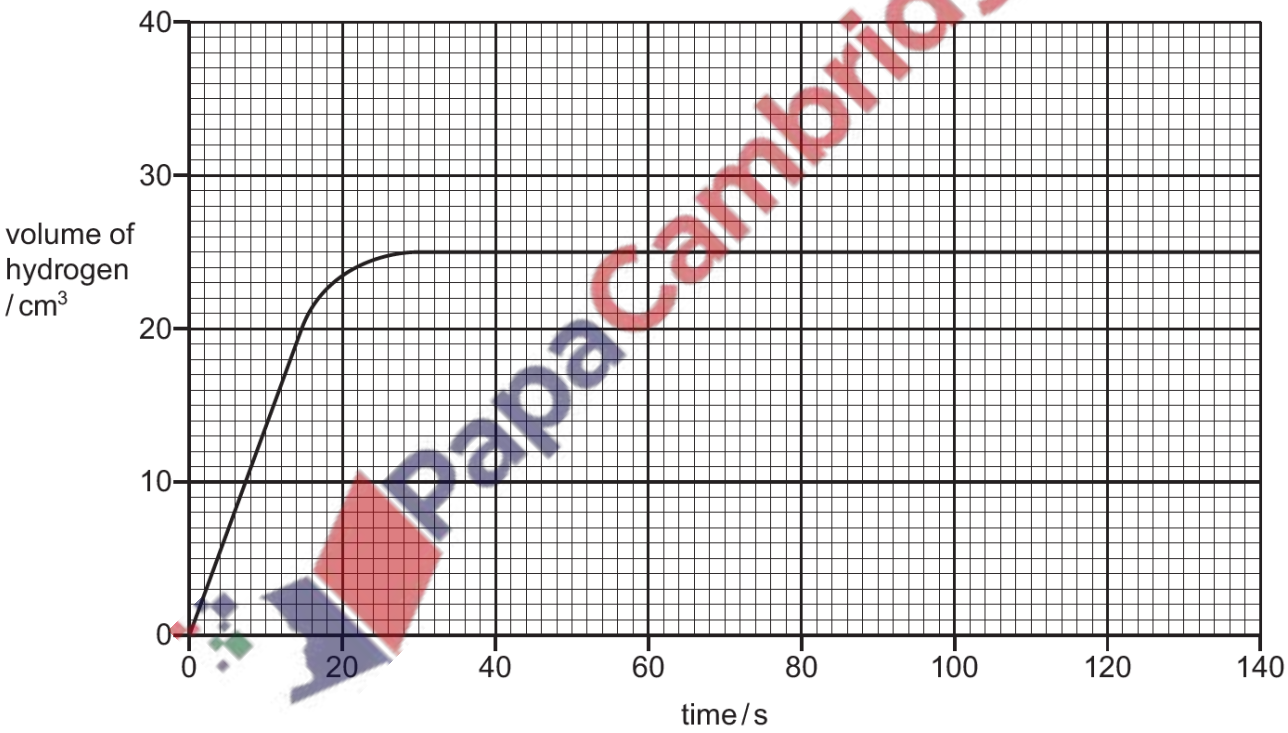
22. March/2021/Paper_32/No.4

A student investigates the reaction of magnesium powder with dilute hydrochloric acid. The magnesium is in excess.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

The rate of reaction can be found by measuring the increase in volume of hydrogen with time.

The results are shown on the graph.



(a) Deduce the time taken for the reaction to finish.

time taken = ... s [1]

(b) The experiment is repeated using dilute hydrochloric acid of a lower concentration.

Draw a line **on the grid** to show how the volume of hydrogen changes with time using dilute hydrochloric acid of a lower concentration.

All other conditions stay the same. [2]

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

- The temperature is increased.

  All other conditions stay the same.

  .....

- Magnesium ribbon is used instead of magnesium powder.

  All other conditions stay the same.

  .....

[2]

(d) Hydrochloric acid reacts with calcium carbonate.

Name the products of this reaction and give the observations.

products .....

.....

observations .....

.....

[4]

[Total: 9]

23. March/2021/Paper_42/No.3

This question is about ammonia.

(a) Nitrogen reacts with hydrogen to form ammonia in an industrial process.

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

(i) Name this industrial process.

..... [1]

(ii) State the meaning of the symbol $\rightleftharpoons$.

..... [1]

(iii) State the conditions used in this industrial process. Include units.

temperature .....

pressure .....

[2]

(iv) Name the catalyst used in this industrial process.

..... [1]

(v) If the pressure is increased, the yield of ammonia increases.

Explain why, in terms of equilibrium.

.....

.....

..... [2]

(vi) If the temperature is increased, the rate of reaction increases.

Explain why, in terms of particles.

.....

.....

.....

.....

..... [3]

(b) Ammonia reacts with sulfuric acid to make a compound which is used as a fertiliser.

Write the chemical equation for the reaction between ammonia and sulfuric acid.

..... [2]

[Total: 12]