Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0) Higher

Resource Set Topic J: Groups in the periodic table

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

2

(b) Describe what you would **see** if damp, blue litmus paper is placed into chlorine gas.

(2)

The damp blue litmus paper turns red, then white

2

(d) When the gas hydrogen chloride, HCl, is dissolved in water, a solution forms. Blue litmus paper dipped in this solution turns red.

State why the litmus paper turns red.

(1)

hydrochloric acid is formed when HCl is dissolved in water

3

(b) Sodium reacts with water to form sodium hydroxide solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

2 Na(s) + $2H_2O$(l) → 2 NaOH(aq) + H_2(g)

(c) In an experiment equal-sized pieces of lithium, sodium and potassium are added to separate samples of water.

A flame is produced only with potassium because potassium

(1)

- ☒ **A** is the softest metal
- ☒ **B** has the lowest melting point
- ☒ **C** is the most reactive
- ☒ **D** is the only flammable metal

(d) Explain, in terms of electronic configurations, the increase in reactivity from lithium to sodium to potassium.

(2)

Lithium, sodium and potassium are group 1 metals with one electron in the outermost shell. They react by losing the valence electron. Lithium has the least number of shells and the smallest atomic radius, so shielding effect is weak, and nuclear force of attraction for the valence electron is stronger so it is less reactive. Potassium has more shells so shielding effect is greater and nuclear attraction for valence electron is weaker, so it is more reactive.

7 (a) Describe what is **seen** when chlorine water is added to potassium bromide solution and the mixture shaken.

(2)

chlorine water decolourise, reddish-brown solution formed

(b) Chlorine reacts with potassium bromide to form potassium chloride and bromine. In this reaction chlorine forms chloride ions

$$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$$

(i) In this reaction, chlorine has been reduced.

Explain, using the equation, how you know that chlorine has been reduced.

(2)

The oxidation state of chlorine in Cl_2 is 0 and in KCl is -1. The oxidation number has decreased.

(ii) Write the half equation for the formation of bromine from bromide ions.

(2)

$2Br^- \rightarrow Br_2 + 2e^-$

(c) Aluminium reacts with chlorine to form aluminium chloride.

Write the balanced equation for this reaction.

(3)

$2Al + 3Cl_2 \rightarrow 2AlCl_3$

3

(c) Chlorine reacts with hydrogen to form hydrogen chloride.

Write the balanced equation for this reaction.

(3)

$Cl_2 + H_2 \rightarrow 2HCl$

6

(b) Lithium, potassium and rubidium are alkali metals.

(i) Describe what you would see when a small piece of rubidium is dropped on to water.

(2)

Rubidium will react violently with water giving off an explosion, the solid disappears quickly, effervescence observed.

(ii) The electronic configuration of lithium is 2.1
The electronic configuration of potassium is 2.8.8.1
Lithium is less reactive than potassium.

Explain, in terms of their electronic configurations, why lithium is less reactive than potassium.

(3)

The nuclear charge in lithium and potassium is the same but lithium has fewer shells so the shielding effect is weaker. The nuclear attraction for valence electron is stronger in lithium. Lithium and potassium react by losing an electron, so lithium is less reactive.

9 Fluorine, chlorine, bromine, iodine and astatine are elements in group 7.

(a) Describe the test to show that a gas is chlorine.

(2)

Damp blue litmus paper turns red then white in the presence of chlorine.

(b) Bromine reacts with hydrogen to form hydrogen bromide.
Hydrogen bromide dissolves in water to form a solution.

State the name of the solution formed.

(1)

hydrobromic acid

(c) There is a trend in the colour and the state of the halogens at room temperature.

Predict the colour and state of astatine at room temperature.

(2)

colour black

state solid

(d) Bromine, chlorine and iodine are dissolved in water to make aqueous solutions. Potassium iodide solution is added to each of these solutions.

Figure 6 shows the observations.

halogen	initial colour of aqueous solution	final colour of mixture
bromine	orange	brown
chlorine	pale green	brown
iodine	brown	brown

Figure 6

Explain the observations shown in the table.

(4)

Bromine and chlorine are more reactive than iodine so their hallide ions displace iodide from potassium iodide. when bromine and chlorine are reduced to hallide ions, the orange and pale green decolourises. Iodine is produced from the displacement reaction, which give a brown colour.

(e) Fluorine reacts vigorously with iron to produce iron(III) fluoride, FeF_3.

Write the balanced equation for this reaction.

(2)

$3F_2 + 2Fe \rightarrow 2FeF_3$

2

(d) Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols.

(3)

$$2\ K(s) + F_2(g) \rightarrow 2\ KF(s)$$

6

(b) Sodium iodide solution is colourless.

When a solution of bromine is added to sodium iodide solution, a reaction occurs.

$$2NaI + Br_2 \rightarrow 2NaBr + I_2$$

(i) The mixture turns brown.

Give the name of the substance causing the brown colour.

(1)

Iodine

(ii) Explain which substance has been reduced in this reaction.

(2)

The oxidation number of bromine decreases from 0 to -1 so bromine is reduced.

7

(b) The density of a gas can be found using the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

A student carried out an experiment to find the density of argon.

The mass of a stopper and flask, containing no gas, was known.
The flask was completely filled with argon and its mass measured.

Figure 4 shows the results the student wrote down.

mass of stopper and flask in g	78.639
mass of stopper and flask full of argon in g	79.120
volume of flask in cm^3	250.0

Figure 4

(i) Use the results to calculate the density of argon in $g\,cm^{-3}$.

(2)

$\frac{79.120 - 78.639}{250.0} = 0.001924$

$\simeq 0.00192$

density of argon = 0.00192 $g\,cm^{-3}$

(ii) The flask used for the experiment is shown in Figure 5.
The flask holds 250.0 cm^3 when filled up to the line.

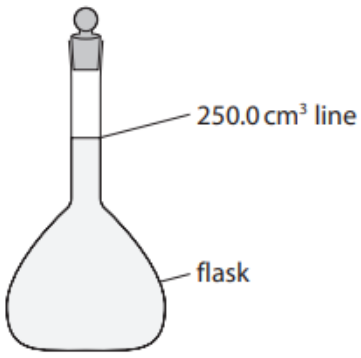

Figure 5

There is an error in the volume the student has used in the calculation.
This would give an incorrect value for the density of argon.

Identify this error and state what should be done to correct it.

(2)

error The actual volume of the flask was greater than 250cm³

what should be done to correct it use the actual volume of the flask

7

(c) Four of the noble gases are argon, helium, krypton and neon.

Give these gases in order of increasing density.

(2)

Helium , neon , argon , krypton

8 The first four elements in group 1 are lithium, sodium, potassium and rubidium.

(a) Rubidium reacts with water to form rubidium hydroxide and hydrogen.

$$2Rb(s) + 2H_2O(l) \rightarrow 2RbOH(aq) + H_2(g)$$

(i) Predict what you would **see** when a small piece of rubidium is placed in a large volume of water.

(3)

Solid disappears very fast , bubbles of gases given off , violent reaction giving off flames or explosion

(ii) Why is rubidium more reactive than potassium?

(1)

☒ **A** the metallic bonds in rubidium are weaker than those in potassium

☒ **B** rubidium is a softer metal than potassium

☒ **C** the outer electron of a rubidium atom is further from the nucleus than potassium's

☒ **D** rubidium has a more exothermic reaction with water than potassium does

(iii) 8.5 g of rubidium are reacted completely with water.

The reaction makes a solution of rubidium hydroxide.
The volume of this solution is 2.5 dm^3.

Calculate the concentration of the rubidium hydroxide solution in g dm^{-3}.

(relative atomic mass: Rb = 85; relative formula mass: RbOH = 102)

(4)

moles of Rb = $\frac{8.5}{85}$

= 0.1 mol

0.04 mol = 0.04 × 102

= 40.8 g

moles of RbOH = 0.1 mol

molarity of RbOH = $\frac{0.1}{2.5}$

= 0.04 $mol dm^{-3}$

concentration = 40.8 g dm^{-3}

TOTAL FOR PAPER IS 57 MARKS