Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0) Higher

Resource Set Topic G: Extracting metals and equilibria

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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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.

3 Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 2.

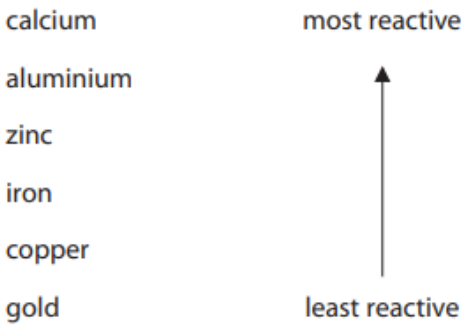


Figure 2

(a) Iron ore contains iron oxide.

Iron is extracted from iron oxide by heating the oxide with carbon.

$$\text{iron oxide} + \text{carbon} \rightarrow \text{iron} + \text{carbon dioxide}$$

(i) In this reaction

(1)

☐ **A** carbon is reduced

☐ **B** iron oxide is neutralised

☒ **C** iron oxide is reduced

☐ **D** iron is oxidised

(b) Aluminium cannot be extracted by heating its oxide with carbon.
Aluminium has to be extracted from its oxide by electrolysis.

Explain why.

(2)

Aluminium is more reactive than carbon so it will not be reduced.

(c) Predict the method that will have to be used to extract calcium from its ore.

(1)

electrolysis

(d) In recent years, researchers have been investigating alternative methods of extracting metals from soils.

Researchers have found that growing certain plants in appropriate areas can result in the phytoextraction of copper.

Describe how growing plants can result in the phytoextraction of copper.

(2)

Plants can be grown in soil containing low percentage of copper ore. As the plants grow, they absorb metal ions and concentrate them in their cells. The plants are then harvested and burnt. The ash, which contains a high percentage of copper is used for extraction.

9 (a) A student placed a piece of metal **P** in a test tube containing excess dilute sulfuric acid.
The student repeated this with three other metals, **Q**, **R** and **S**.
All the pieces of all four metals were the same size.

(i) The student recorded the observations until each metal had reacted with the acid for two minutes.
The observations are shown in Figure 9.

metal	observations
P	bubbles produced very slowly some metal remained
Q	bubbles produced quickly no metal remained
R	bubbles produced slowly no metal remained
S	bubbles produced very quickly no metal remained

Figure 9

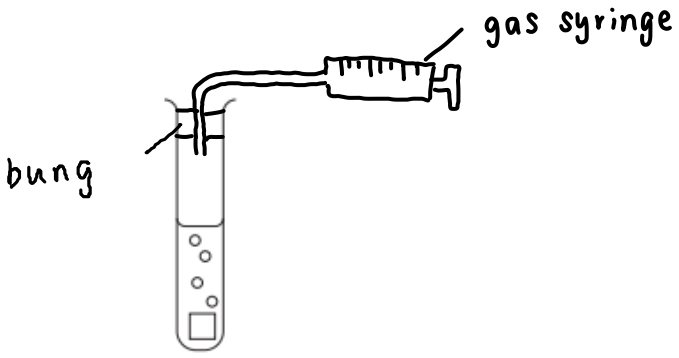
Use this information to put the four metals in order of reactivity from the least reactive to the most reactive.

(2)

least reactive | P | R | Q | S | **most reactive**

(ii) Complete the diagram below to show how the student could add to the apparatus to measure the volume of gas produced in the two minutes.

(2)



(c) Acid solutions contain hydrogen ions.

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}.

Complete the balanced ionic equation for this reaction.

(2)

$$\underline{2\ Al} + \underline{6\ H^+} \rightarrow \underline{2\ Al^{3+}} + \underline{3\ H_2}$$

5 (a) One way to extract metals from land contaminated with metal compounds is phytoextraction.
When plants grow they absorb metal ions through their roots.
The plants are harvested, dried and burned forming an ash.
The ash contains metal compounds.

Plants were grown in a piece of ground contaminated with nickel compounds.

(i) 1 kg of the ash from these plants contained 142.0 g of nickel compounds.

Calculate the percentage by mass of nickel compounds in the ash.

(3)

$\frac{142.0}{1 \times 1000} \times 100 = 14.2\%$

percentage by mass = 14.2 %

(ii) Nickel is extracted from nickel compounds.

State an advantage of extracting nickel by phytoextraction rather than from its ore.

(1)

There is a higher percentage of nickel obtained through phytoextraction

(b) Some nickel ores contain nickel sulfide.

(i) In the first stage of extracting nickel from nickel sulfide, the nickel sulfide, NiS, is heated in air to form nickel oxide, NiO, and sulfur dioxide.

Write the balanced equation for this reaction.

(2)

$2NiS + 3O_2 \rightarrow 2NiO + 2SO_2$

(ii) In the final stage of the extraction process, a nickel compound is electrolysed to produce pure nickel.

An advantage of producing a metal by electrolysis is that

(1)

- ☒ **A** electrolysis uses a large amount of electricity
- ☒ **B** the metal produced by electrolysis is very pure
- ☒ **C** electrolysis is a very cheap method of extraction
- ☒ **D** electrolysis is the only method of extracting unreactive metals

6 (a) Hydrated copper sulfate, $CuSO_4.5H_2O$, is a blue solid.
Anhydrous copper sulfate, $CuSO_4$, is a white solid.

Heat energy is needed to convert hydrated copper sulfate to anhydrous copper sulfate.
This is a reversible reaction.

$$CuSO_4.5H_2O \rightleftharpoons CuSO_4 + 5H_2O$$

Devise an experiment to show that this is a reversible reaction.

(4)

when hydrated copper sulfate is heated in a test tube, using a bunsen burner, the blue solid turns white and anhydrous copper sulfate is formed. water will be collected at the top of the test tube. when anhydrous copper sulfate is dissolved in water, a blue solution is formed. The blue solution can be heated until the crystallisation point is reached, and a blue solid, which is hydrated copper sulfate, can be obtained.

(b) Hydrogen reacts with iodine to form hydrogen iodide.
Iodine gas is purple and hydrogen iodide gas is colourless.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

Hydrogen and iodine are placed in a sealed container.
The container is left until equilibrium is reached.

The conditions are changed favouring the forward reaction.

Explain what you would **see**.

(2)

The intensity of the purple colour decreases.

8 Pieces of zinc react with copper sulfate solution.
Zinc sulfate solution is colourless.

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

(a) Describe what you would **see** when an excess of zinc is added to copper sulfate solution and the mixture left until the reaction is complete.

(2)

The solution changes from blue to colourless and a solid is form. when reaction is complete, the zinc solid stops dissolving.

(b) This reaction is described as a redox reaction.

Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced in this reaction.

(4)

Zinc is oxidised as its oxidation state changes from 0 to +2. It has lost 2 electrons.

Copper is reduced from +2 to 0. It has gained 2 electrons.

(c) The copper sulfate solution used has a concentration of 15.95 g dm^{-3}.

Calculate the number of moles of copper sulfate, $CuSO_4$, in 50.00 cm^3 of this solution.
(relative atomic masses: O = 16, S = 32, Cu = 63.5)

(3)

concentration in $mol\,dm^{-3}$: $\frac{15.95}{63.5+32+4(16)}$ = 0.1 $mol\,dm^{-3}$

no. of moles : $0.1 \times \frac{50}{1000}$ = 0.005

number of moles of copper sulfate = 0.005 mol

(d) In another experiment, 0.043 mol of copper sulfate, $CuSO_4$, is used.

Calculate, to one decimal place, the minimum mass of zinc that must be added to react with all the copper sulfate.
(relative atomic mass: Zn = 65)

(2)

mass of 0.043 mol of Zn : $0.043 \times 65 = 2.795$

$\simeq 2.8$

mass = 2.8 g

(b) Iron, when heated in air, reacts with oxygen to form iron oxide.

(i) This reaction is an example of

(1)

☒ **A** crystallisation

☒ **B** distillation

☒ **C** neutralisation

☒ **D** oxidation

8

(b) Calcium and potassium react with water in similar ways.

(i) One similarity in the reactions is that hydrogen gas is produced.

State **one** other similarity in the products of the reactions of calcium and potassium with water.

(1)

A metal hydroxide is produced.

(ii) Potassium is higher in the reactivity series than calcium and reacts more vigorously with water than calcium reacts with water.

State why potassium is higher in the reactivity series and reacts more vigorously with water than calcium.

(1)

Potassium has a higher tendency to lose an electron, since the nuclear charge is lower and the nuclear attraction for the valence electron is weaker

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TOTAL FOR PAPER IS 40 MARKS