Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0) Foundation

Resource Set Topic H – Test 2: Separate Chemistry 1 (F tier only)

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021
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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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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.

Q1bi_ii_iii

(b) (i) Ammonia can be manufactured by the Haber process.

The word equation for the reaction is

nitrogen + hydrogen ⇌ ammonia

State the meaning of the ⇌ symbol.

(1)

reaction is reversible

(ii) In the Haber process, the percentage yield of ammonia at equilibrium changes with temperature.

Figure 2 shows how the percentage yield of ammonia at equilibrium changes with temperature.

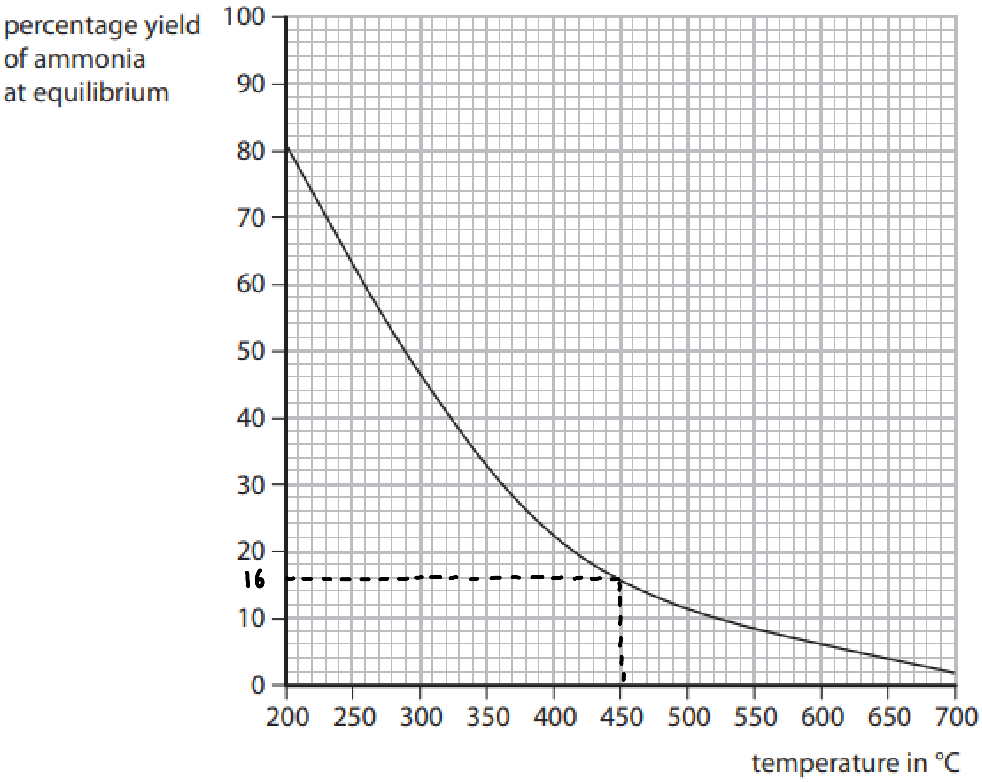

Figure 2

State what happens to the percentage yield of ammonia at equilibrium as the temperature increases.

(1)

Percentage yield gradually decreases.

(iii) Use the graph to find the percentage yield of ammonia at equilibrium at 450°C.

(1)

percentage yield of ammonia at equilibrium = 16

Q1ci_ii_iii

(c) Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

ammonia + nitric acid → ammonium nitrate

(ii) An ammonium ion has the formula NH_4^+.

A nitrate ion has the formula NO_3^-.

Which of the following is the formula for ammonium nitrate?

(1)

- ☐ **A** $(NH)_4NO_3$
- ☐ **B** $(NH_4NO)_3$
- ☒ **C** NH_4NO_3
- ☐ **D** $(NHNO)_{12}$

(iii) Explain why farmers spread ammonium nitrate on their fields.

(2)

Ammonium nitrate is used as a fertiliser as it is a soluble source of nitrogen.

2 (a) A titration of sodium hydroxide solution with hydrochloric acid can be carried out as follows

1 a pipette is used to measure 25.00 cm^3 of sodium hydroxide solution into a conical flask
2 a few drops of indicator are added to the sodium hydroxide solution
3 the burette is filled with hydrochloric acid
4 the hydrochloric acid is added to the sodium hydroxide solution until the indicator changes colour.

(i) Describe how the pipette should be used to measure exactly 25.00 cm^3 of sodium hydroxide solution into the conical flask.

(2)

Use a pipette filler to suck up sodium hydroxide until the line is reached, ensuring there are no air bubbles.

(ii) The burette is first washed with water.
It is then rinsed with some of the acid before it is filled with the acid to begin the titration.

Explain why the burette is rinsed with the acid.

(2)

To ensure that no water remains in the burette so that the acid is not diluted.

(b) Universal indicator solution is not a suitable indicator for an acid-alkali titration.

(i) Give the name of an indicator that is suitable for use in the titration of sodium hydroxide solution with hydrochloric acid.

(1)

Methyl orange

(ii) Universal indicator goes through a series of gradual colour changes as the pH changes in a solution.

Give a reason why universal indicator is not a suitable indicator to use in an acid-alkali titration.

(1)

It is difficult to identify the endpoint

(c) Figure 3 shows some titration results obtained from an experiment in which an alkali is titrated with an acid.

	titration		
	rough	1	2
final burette reading in cm^3	25.75	49.35	23.70
initial burette reading in cm^3	0.00	25.75	0.00
volume of acid used in cm^3	25.75	23.60	23.70

Figure 3

Calculate the accurate volume of acid reacting with the alkali.

(2)

$\frac{23.60 + 23.70}{2} = 23.65$

accurate volume of acid reacting 23.65 cm^3

Q10b

(b) Lead can be obtained by heating its oxide with carbon.
The balanced equation for the reaction is

$$2PbO + C \rightarrow 2Pb + CO_2$$

Calculate the atom economy for the production of lead in this reaction.
(relative atomic masses: C = 12, O = 16, Pb = 207
relative formula masses: PbO = 223, CO_2 = 44)

Give your answer to two significant figures.

(4)

$$\frac{2(207)}{2(223) + 12} \times 100 = 90.39\%$$

$$\doteq 90\%$$

atom economy = 90 %

Q10ci_ii

(c) (i) In an experiment to produce lead, 7.67 g of lead are obtained. The theoretical yield of lead for the experiment is 11.80 g.

Calculate the percentage yield of lead in this experiment.

(2)

$\frac{7.67}{11.80} \times 100 = 65\%$

percentage yield = 65%

(ii) In most reactions, the percentage yield of any product is less than 100%.

Give **two** reasons why the percentage yield is less than 100%.

(2)

reason 1 the reaction might be reversible and is not complete

reason 2 some of the products were lost when being removed from the mixture

7 (a) Fertilisers contain compounds that promote plant growth.

(i) State the name of an element in these compounds that promotes plant growth.

(1)

nitrogen

(ii) Potassium nitrate is present in some fertilisers.

Potassium nitrate is formed by the reaction of potassium hydroxide solution with nitric acid.

Complete the balanced equation for this reaction.

(2)

$KOH + HNO_3 \rightarrow$ KNO_3 + H_2O

(b) In the Haber process, hydrogen and nitrogen react to form ammonia.

hydrogen + nitrogen ⇌ ammonia

(i) The ⇌ symbol in the word equation shows that the reaction goes forwards and backwards at the same time.

Give the name of this type of reaction.

(1)

reversible

(ii) State the formula of a molecule of ammonia.

(1)

NH_3

(iii) Figure 7 shows a graph of world ammonia production, in millions of tonnes, from 1945 to 2015.

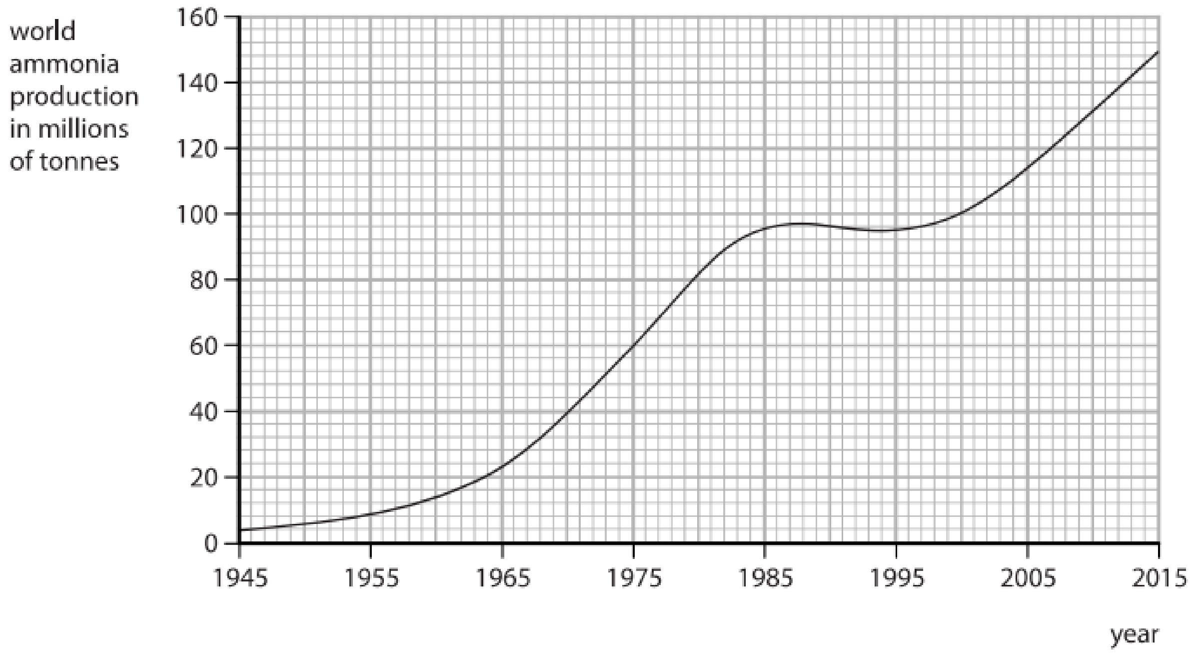

Figure 7

State the overall trend in world ammonia production from 1945 to 2015.

(1)

Increases

(c) Hydrogen can also be used in a hydrogen-oxygen fuel cell.

Give the name of the product formed in this fuel cell.

(1)

water

*(d) Ammonia solution and dilute sulfuric acid are used to prepare pure, dry ammonium sulfate crystals.

In an experiment a titration is carried out to determine the volumes of ammonia solution and dilute sulfuric acid that react together.
Then an ammonium sulfate solution is prepared from which the pure, dry crystals are obtained.

Describe in detail, using suitable apparatus, how this experiment should be carried out.

(6)

Using a pipette, measure 25.0 cm^3 of ammonia solution and place into a conical flask. Fill a burette with dilute sulfuric acid until the 0.00 cm^3 mark. Add a few drops of methyl orange into a conical flask. In the rough titration, add ammonia solution into the conical flask while gently shaking the flask until the methyl orange turns yellow. Obtain the volume of sulfuric acid used and perform two more titrations ensuring results are concordant. Find the average volume of sulfuric acid used in these 2 titrations. Titrate this volume of sulfuric acid into a fresh sample of ammonia solution without the indicator added and gently shake the flask to ensure complete reaction. Heat the solution using a bunsen burner until the crystallisation point is reached. wash the crystals with distilled water and dry using filter paper.

10 Calcium carbonate decomposes on heating to form calcium oxide and carbon dioxide.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

(a) 8.000 g of $CaCO_3$ was heated strongly for about 10 minutes. 6.213 g of solid remained. Calculate the mass of carbon dioxide gas given off.

(1)

8.000 − 6.213 = 1.787

mass of carbon dioxide = 1.787 g

(b) A second sample of calcium carbonate is strongly heated in a crucible until there is no further loss in mass.
The mass of calcium oxide remaining in the crucible is 5.450 g.

(i) The theoretical yield of calcium oxide in this experiment is 5.600 g.

Calculate the percentage yield of calcium oxide.

(2)

$\frac{5.450}{5.600} \times 100 = 97.3\%$

percentage yield = 97.3%

(ii) The mass of solid left in the crucible is less than the theoretical mass of calcium oxide that should be obtained.

A possible reason for this is that

(1)

☒ **A** some solid was lost from the crucible

☐ **B** the solid remaining absorbed some water from the air

☐ **C** some carbon dioxide remained in the crucible

☐ **D** the decomposition was incomplete

(d) (i) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

40 + 12 + 3(16) = 100

relative formula mass = 100

(ii) Calculate the atom economy for the formation of calcium oxide in this reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

You must show your working.
(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

$\frac{56}{100} \times 100 = 56\%$

atom economy = 56 %

3 In industry, ammonia is manufactured by reacting nitrogen with hydrogen.

(a) (i) Give the name of the industrial process used to manufacture ammonia.

(1)

Haber process

(ii) Write the word equation for this reaction, including the correct symbol to show that the reaction is reversible.

(3)

nitrogen + hydrogen $\rightleftharpoons$ ammonia

(b) The formula of ammonia is NH_3.

State what the formula of ammonia shows about the number of nitrogen atoms and the number of hydrogen atoms combined in a molecule of ammonia.

(1)

1 nitrogen atom and 3 hydrogen atoms combine in a molecule of ammonia.

(c) Most of the ammonia manufactured in industry is used to produce fertilisers.

(i) A fertiliser is made by reacting ammonia with nitric acid.

What is the name of this fertiliser?

(1)

- ☒ **A** ammonia nitrate
- ☐ **B** ammonia nitric
- ☐ **C** ammonium nitrate
- ☐ **D** ammonium nitric

(ii) Explain the importance of fertilisers in farming.

(2)

Fertilisers improve plant growth and increases the yield of crops, by providing nutrients required by plants, such as nitrates.

10 Potassium hydroxide reacts with hydrochloric acid to form potassium chloride and water.

potassium hydroxide + hydrochloric acid → potassium chloride + water

(a) A student carried out a titration to find the exact volume of dilute hydrochloric acid that reacted with 25.0 cm^3 of potassium hydroxide solution.

There were five steps in the titration.
The steps shown are not in the correct order.

/ **step J** pour the potassium hydroxide solution into a conical flask and add a few drops of indicator to this solution

/ **step K** fill a burette with the dilute hydrochloric acid and record the initial reading from the burette

/ **step L** use a measuring cylinder to obtain 25 cm^3 of potassium hydroxide solution

/ **step M** take a final reading from the burette and calculate the volume of the dilute hydrochloric acid reacted

/ **step N** run the dilute hydrochloric acid from the burette into the conical flask until the indicator changes colour

(i) Write the steps in the correct order.

Some of the steps have been completed for you.

(1)

first step				**last step**
K	L	J	N	M

(ii) Suggest an alternative piece of apparatus that could be used in step L to obtain exactly 25.0 cm^3 of potassium hydroxide solution.

(1)

pipette

(b) A student was then asked to produce a pure sample of solid potassium chloride.

After finding the volume of acid reacted in step M, the student added this volume of acid to a fresh 25.0 cm^3 sample of the potassium hydroxide solution.
This mixture was then evaporated.

(i) Explain why this new mixture was evaporated rather than the original mixture from the titration, to produce a pure sample of solid potassium chloride.

(2)

The original mixture contains the indicator, so the potassium chloride obtained will be pure.

(ii) After evaporation, the mass of the potassium chloride was determined.

The theoretical yield of the experiment was 0.70 g.
The actual yield was 0.84 g.

This gave a percentage yield greater than 100%.

Calculate the percentage yield of this experiment.

(2)

$\frac{0.84}{0.70} \times 100 = 120\%$

percentage yield = 120%

(iii) Suggest a reason why the actual yield was greater than the theoretical yield.

(1)

Not all water has been evaporated, so the mass is greater.

(iv) The equation for the reaction between potassium hydroxide solution and dilute hydrochloric acid is

$$KOH + HCl \rightarrow KCl + H_2O$$

Calculate the atom economy for the production of potassium chloride from potassium hydroxide and hydrochloric acid.
(relative formula masses: KOH = 56.0, HCl = 36.5, KCl = 74.5, H_2O = 18.0)

Give your answer to one decimal place.

(4)

$\frac{74.5}{56.0+36.5} \times 100 = 80.5405\%$

$\simeq 80.5\%$

atom economy = 80.5 %

TOTAL FOR PAPER IS 59 MARKS