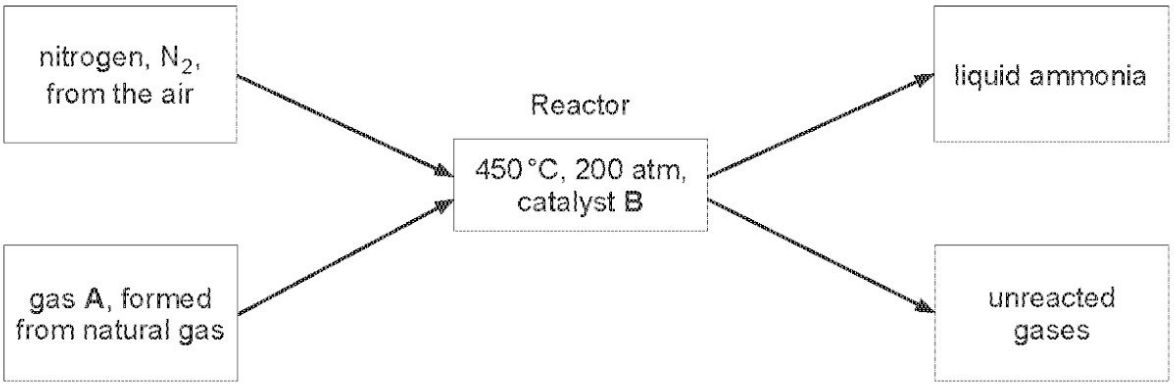
WJEC Chemistry GCSE

11: Production, Use and Disposal of Important Chemicals and Materials

Practice Questions

England Specification

1. Ammonia is produced during the Haber process. The reaction is summarised in the diagram below.



(a) Give the name of gas **A**. ..... [1]

(b) Name catalyst **B** and state why it is used. [2]

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(c) The yield of ammonia is only 28 % therefore 72 % of the gases remain unreacted.

Describe what happens to these unreacted gases and state why this is important. [2]

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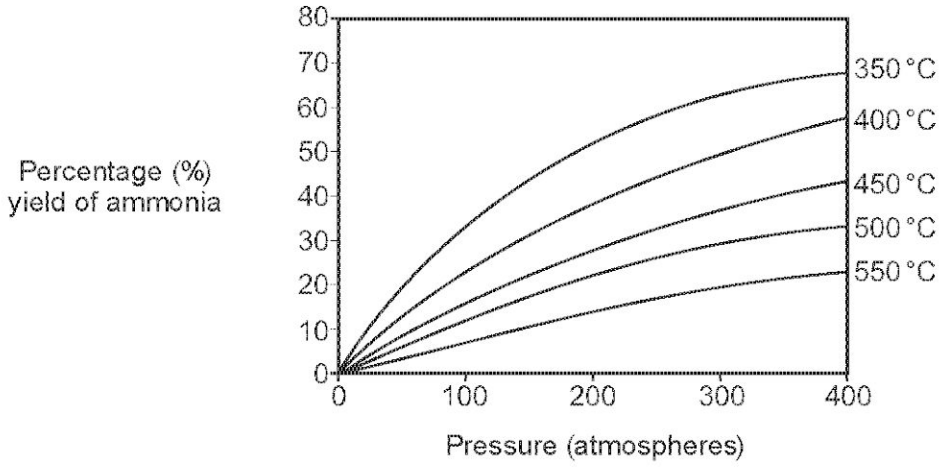
(d) The following graph shows the effect of temperature and pressure on the yield of ammonia during the Haber process.



Describe how the yield of ammonia varies with temperature and pressure. [2]

Temperature

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Pressure

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(e) Write a balanced **symbol** equation for the production of ammonia. [3]

..... + ... ⇌ .....

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2.

Ammonia is manufactured from nitrogen and hydrogen using the Haber process.

(a) The equation below shows the formation of ammonia.

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

(i) State the numbers of nitrogen atoms and hydrogen atoms on the **left** hand side of the equation. Use these numbers to show that the equation is balanced. [2]

Number of nitrogen atoms ..... *Number of hydrogen atoms* .....

.....

(ii) Give the meaning of (g) in the equation. [1]

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(b) The box below shows some of the conditions and terms used when describing the Haber process.

ammonia	**hydrogen**	**450 °C**	**iron**	**cooling**
nitrogen	**reversible**	**200 atmospheres**		**recycling**

(i) Choose from the box

I. the process used to remove the product from the reaction mixture, [1]

.....

II. the method used to reduce the waste of reactants. [1]

.....

(ii) Choose from the box the catalyst used in the reaction. State the purpose of a catalyst. [2]

Catalyst .....

Purpose .....

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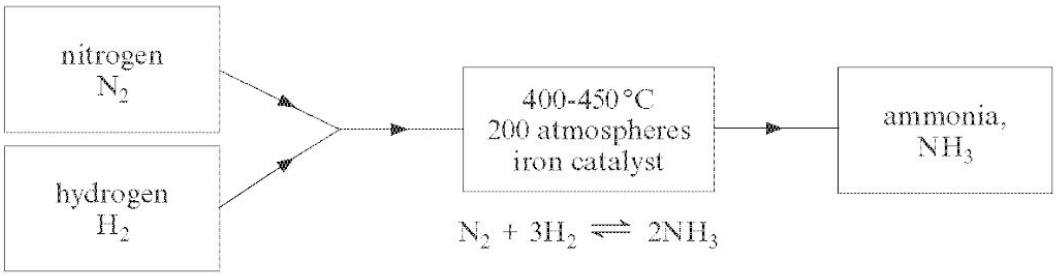
3.

The diagram and equation below outline the manufacture of ammonia by the Haber process.



Explain the choice of temperature and pressure used in the process and why it is necessary to use a catalyst. [6 QWC]

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4.

(a) Ammonia is made industrially from nitrogen and hydrogen by the Haber process.

The table below shows the yield of ammonia under different pressure and temperature conditions.

Pressure (atmospheres)	Temperature (°C)				
	100	200	300	400	500
	Yield of ammonia (%)				
10	88.2	50.7	14.7	3.9	1.2
50	94.5	75.0	39.5	15.3	5.6
100	96.7	81.7	52.5	25.2	10.6
200	98.4	89.0	66.7	40.0	18.3
400	99.4	94.6	79.7	55.4	31.9
1 000	99.9	98.3	92.6	79.8	57.5

(i) Using **only** the data in the table suggest the conditions that should be chosen for the process. [1]

Pressure ..... atmospheres *Temperature* ..... °C

(ii) Give the disadvantage of using a low temperature in the process and state how this problem is overcome. [2]

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(iii) The actual pressure used in the process is 200 atmospheres. Apart from safety issues, suggest a disadvantage of using a higher pressure. [1]

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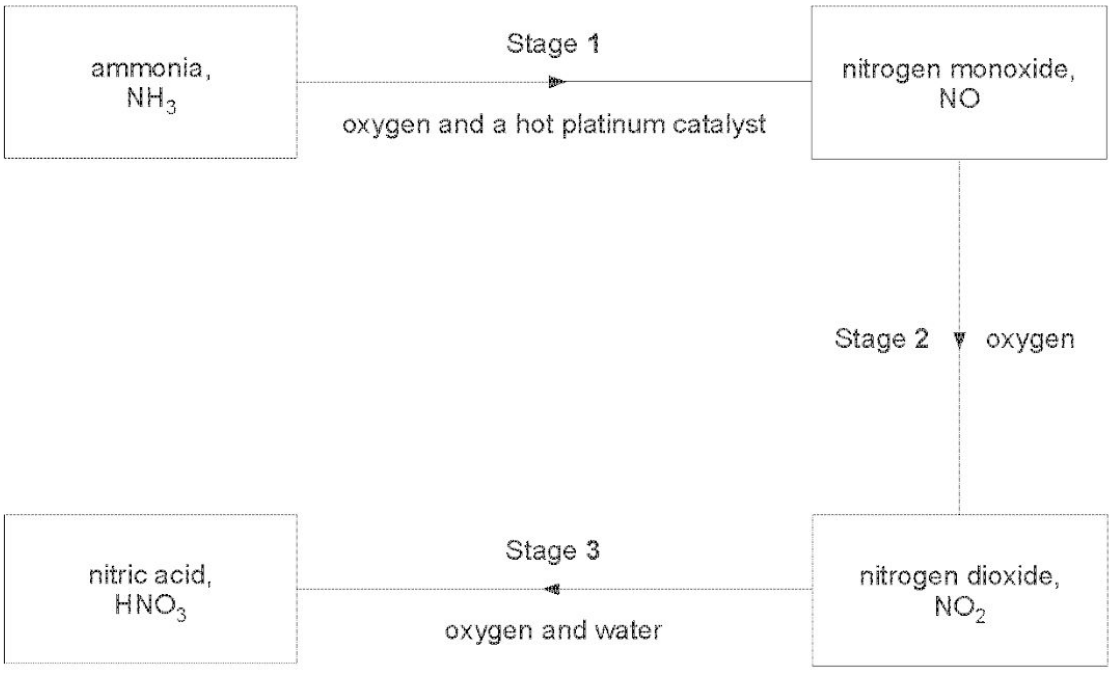
(b) Ammonia is used to form nitric acid in a three-stage reaction.



(i) Once the reaction in stage **1** has started there is sufficient heat to maintain the reaction. Give the term used to describe a reaction that produces heat. [1]

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(ii) Balance the symbol equation below that represents the reaction taking place in stage **3**. [1]

$$\square\ NO_2 + O_2 + 2H_2O \longrightarrow \square\ HNO_3$$

(iii) Write a balanced symbol equation for the reaction that occurs when nitric acid is added to copper(II) carbonate. [2]

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5.

Describe the benefits of the use of nitrogenous fertilisers and the problems that arise when they are washed into rivers. [6 QWC]

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6.

The reaction between hydrogen and chlorine to give hydrogen chloride can be represented by the following equation.

The relative amounts of energy needed to break the bonds shown are given in the table below.

Bond	Amount of energy needed to break the bond (kJ)
H—H	436
Cl—Cl	242
H—Cl	431

NOTE: *The amount of energy* ***released*** *in making a bond is equal and opposite to that* ***needed*** *to break the bond.*

(a) Using the bond energy values in the table, calculate

(i) the relative energy needed to break all the bonds in the **reactants**, [2]

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.....

(ii) the relative energy given out when all the bonds in the **product** are formed. [2]

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(b) Using your answers to part *(a)*, state whether the reaction between hydrogen and chlorine is exothermic or endothermic and give a reason for your answer. [1]

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7. *(a)* Sulfuric acid is produced by the contact process. The main stages in the process are shown below.

Stage 1: Burning sulfur in air to produce gas **A**

Stage 2: Passing gas **A** over a catalyst at 450 °C to produce gas **B**

Stage 3: Dissolving gas **B** in concentrated sulfuric acid to produce oleum

Stage 4: Diluting oleum to produce sulfuric acid

(i) Give the names of gases **A** and **B**. [2]

Gas **A** .....

Gas **B** .....

(ii) Which stage involves a reversible reaction? ..... [1]

(iii) Give a reason why gas **B** is not dissolved directly in water during stage 3. [1]

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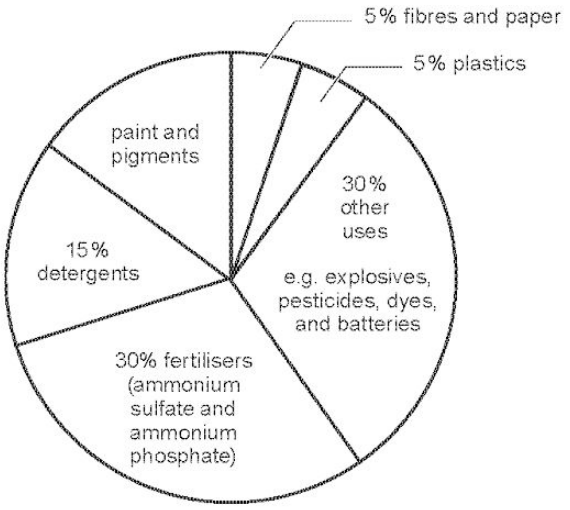
(b) The following pie chart shows the uses of sulfuric acid.



(i) Calculate the percentage of sulfuric acid used for making paint and pigments. [2]

Percentage used for making paint and pigments = ... %

(ii) One important use of sulfuric acid is in the production of fertilisers. Complete the following word equation for the production of ammonium sulfate. [1]

sulfuric acid + ... ⟶ ammonium sulfate

(iii) This type of fertiliser can be washed into rivers. Explain why this is a cause for concern. [3]

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8.

(a) Draw a line from each gas below to the observation made in identifying it. [3]

Gas	Observation
	relights a glowing splint
carbon dioxide	turns flame red
ammonia	turns limewater milky
oxygen	pops with a burning splint
	turns damp red litmus blue

(b) The following box contains observations made when testing for some common metal ions.

lilac flame	yellow flame	green flame
blue precipitate	brown precipitate	green precipitate
	white precipitate	

Choose from the box the result you would expect for the following tests. [3]

A flame test is carried out on a sample of sodium chloride

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A flame test is carried out on a sample of copper(II) sulfate

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Sodium hydroxide solution is added to a solution of iron(III) chloride

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9.

Many metal ores contain sulfides. Chalcocite is an important copper ore which contains copper(I) sulfide, Cu_2S.

Copper can be obtained from the ore by heating in air.

The equation for the reaction that takes place is as follows.

$$Cu_2S + O_2 \longrightarrow 2Cu + SO_2$$

(a) Use the above equation to calculate the mass of copper produced on reacting 20.5 tonnes of copper(I) sulfide with an excess of oxygen. [3]

A_r(Cu) = 64 A_r(S) = 32

Mass of copper = ... tonnes

(b) When the extraction was carried out with 20.5 tonnes of chalcocite only 12.3 tonnes of copper was formed.

Calculate the percentage of **impurity** present in the ore. [2]

Percentage of impurity = ... %

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