

High Demand Questions

QUESTIONSHEET 1

Since 1900 it has been known that substances containing nitrogen increase the yield of crops. European countries imported large quantities of sodium nitrate (NaNO_3) from Chile. This nitrate was a non-renewable resource.

- (a) Name the group of chemicals that plants make from nitrate fertilisers.

..... [1]

- (b) What is meant by the term 'non-renewable'.

.....
..... [1]

- (c)(i) Calculate the relative molecular mass of sodium nitrate.
The relative atomic masses of N = 14, O = 16, and Na = 23.

.....
..... [1]

- (ii) Calculate the percentage of nitrogen in sodium nitrate.

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

- (d) Today nitrate fertilisers are made by first making ammonia gas from nitrogen and hydrogen.

- (i) Name the raw material used as a source of nitrogen.

..... [1]

- (ii) Name a raw material used as a source of hydrogen.

..... [1]

- (e) Ammonia is made by passing a mixture of nitrogen and hydrogen over finely divided iron metal.

- (i) What is the purpose of the iron?

..... [1]

- (ii) Explain why the iron used is finely divided.

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

(Continued...)

QUESTIONSHEET 1 CONTINUED

- (f) A solid fertiliser is made by dissolving ammonia gas in water. Ammonia solution is then reacted with an acid. Name the acid you would react with ammonia to make ammonium sulphate.

..... [1]

- (g) Overuse of nitrate fertilisers can be harmful. They can cause eutrophication in lakes and rivers. Explain what happens in the eutrophication process.

.....
.....
.....
.....
.....
.....
..... [4]

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QUESTIONSHEET 2

National Quicklime is a company that is involved in the quarrying of limestone. They propose to open a new limestone quarry in the Peak District National Park. The proposed site is well known as an area of outstanding natural beauty.

- (a) Give **three** reasons in favour of opening the quarry.

.....
.....
.....
.....
..... [3]

- (b) Give **three** reasons against the opening of the quarry.

.....
.....
.....
..... [3]

- (c) The limestone (calcium carbonate) will be used to make quicklime (calcium oxide). The equation for the reaction is given below:



- (i) What do the symbols (s) and (g) mean?

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

- (ii) Calculate the relative molecular masses of calcium carbonate, calcium oxide, and carbon dioxide. (relative atomic masses C=12, O=16, Ca= 40)

.....
.....
..... [3]

(Continued...)

QUESTIONSHEET 2 CONTINUED

(d) The company wants to produce 1,680 tonnes of quicklime per week.

(i) Calculate the minimum mass of limestone needed to produce 1,680 tonnes of quicklime.

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

(ii) Suggest a reason why more than the minimum mass you have calculated would have to be heated to obtain 1,680 tonnes of quicklime.

.....
..... [1]

(e) Give another use of limestone.

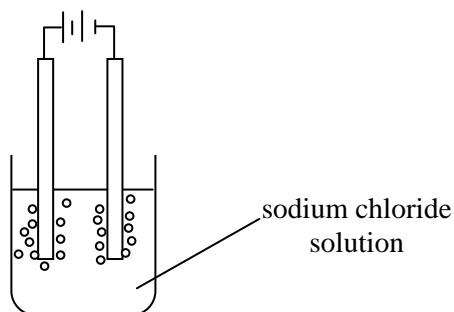
..... [1]

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QUESTIONSHEET 3

Chlorine is manufactured by the electrolysis of sodium chloride solution.
A simple electrolysis cell that can be used in the laboratory is shown below.



(a) Label the anode on the diagram. [1]

(b) How would you prove that the gas collected was chlorine?

Test

..... [1]

Result

..... [1]

(c) Give one important use of chlorine. [1]

..... [1]

(d) Complete the ionic equation showing the formation of chlorine gas.



(e) Name the other gas formed in the electrolysis of salt solution. [1]

..... [1]

(f) After running the cell for several minutes, some Universal Indicator was added to the cell.
The indicator turned blue.

(i) What does this test show? [1]

..... [1]

(ii) Give the chemical name of the substance formed that turns the indicator blue.

..... [1]

(Continued...)

QUESTIONSHEET 3 CONTINUED

- (g) Some students decided to investigate how changing some of the factors in the experiment would affect the amount of chlorine produced. John made the following prediction:

'more chlorine will be produced if the concentration of sodium chloride solution is increased.'

Describe how the students could use this apparatus to test their prediction.

.....
.....
.....
.....
.....
.....
..... [5]

- (h) Suggest two other changes that John could investigate to see if they affected the amount of chlorine produced.

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

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QUESTIONSHEET 4

Aluminium is obtained from bauxite.

Bauxite is purified to form aluminium oxide.

- (a) Write down the formulae of the ions present in aluminium oxide.

aluminium ion _____ oxide ion _____ [2]

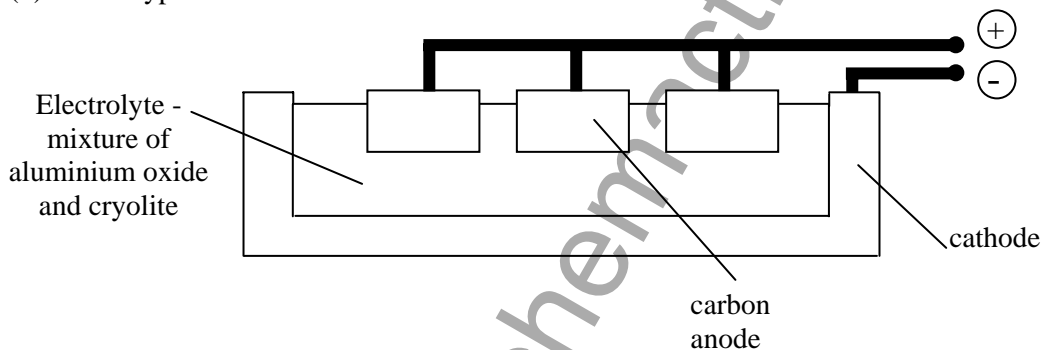
- (b) Aluminium oxide is mixed with cryolite before being placed in the cell.
What is the function of the cryolite?

.....
..... [1]

- (c) Explain why the electrolyte has to be molten in order to conduct electricity.

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

- (d) A typical cell is shown below.



- (i) Aluminium ions are attracted to the cathode.
Write an equation to show how aluminium ions are changed into atoms.

.....
..... [1]

- (ii) Explain what happens to the oxide ions.

.....
.....
..... [3]

(Continued...)

QUESTIONSHEET 4 CONTINUED

- (e) Extraction of aluminium from its ore uses electricity.
Iron can be extracted from its ore by heating with carbon.
Gold is found occurring naturally.
Explain why these three metals have such different ways of extracting them.

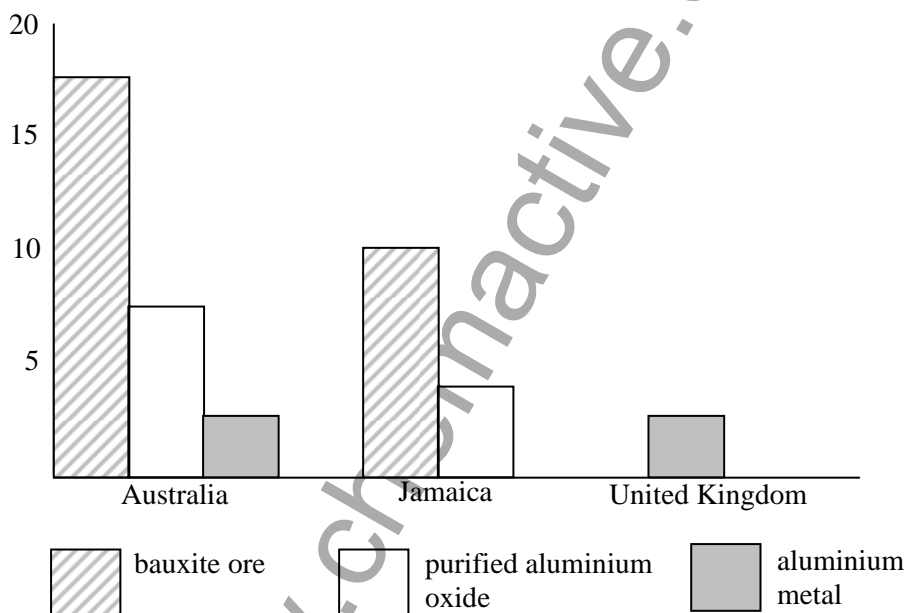
.....

.....

.....

..... [2]

- (f) The graph below shows the production of bauxite ore, purified aluminium oxide and aluminium metal from three different countries.



- (i) Which country has no deposits of bauxite?

..... [1]

- (ii) Suggest two reasons why Jamaica produces little aluminium metal, despite mining large quantities of bauxite.

.....

.....

..... [2]

High Demand Questions

QUESTIONSHEET 5

Many power stations burn coal as their source of energy. Coal mainly consists of the element carbon.

- (a) Write a symbol equation for the burning of carbon in a good supply of air.

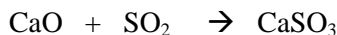
.....
..... [1]

- (b) Coal also contains small amounts of sulphur. The sulphur burns to form sulphur dioxide gas. Explain how sulphur dioxide causes pollution and how this harms trees.

.....
.....
.....
.....
..... [3]

- (c) One method of preventing this pollution is to remove sulphur dioxide gas before it escapes into the air. This can be done by reacting the gas with calcium oxide in the power station chimney.

The equation for the reaction is shown below:



- (i) Give the name used to describe this type of reaction.

..... [1]

- (ii) Calculate the relative molecular masses of:

CaO _____ [1]
SO₂ _____ [1]

(Relative atomic masses: O = 16, S = 32, Ca = 40)

- (iii) A power station produces 32 tonnes of sulphur dioxide in one day. Calculate the minimum mass of calcium oxide needed to absorb 32 tonnes of sulphur dioxide.

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

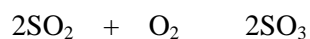
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QUESTIONSHEET 5 CONTINUED

(iv) Give two reasons why a greater mass of calcium oxide would be needed in practice.

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

(d) Another method is to remove the sulphur from coal before it is burnt.
The sulphur may be used in the contact process.
Sulphur dioxide reacts with oxygen as shown in the equation below:



(i) What does the symbol mean?

..... [1]

(ii) Name the product formed in this reaction.

..... [1]

(iii) Name the major chemical formed in the contact process.

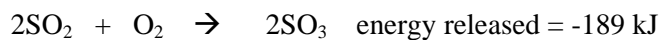
..... [1]

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High Demand Questions

QUESTIONSHEET 6

- (a) Sulphuric acid is made from sulphur by the contact process. Sulphur is burned to form sulphur dioxide. This is then changed to sulphur trioxide by reacting it with more oxygen. A catalyst is used in this stage of the process.



The reverse reaction is



What is the energy change for this reaction?

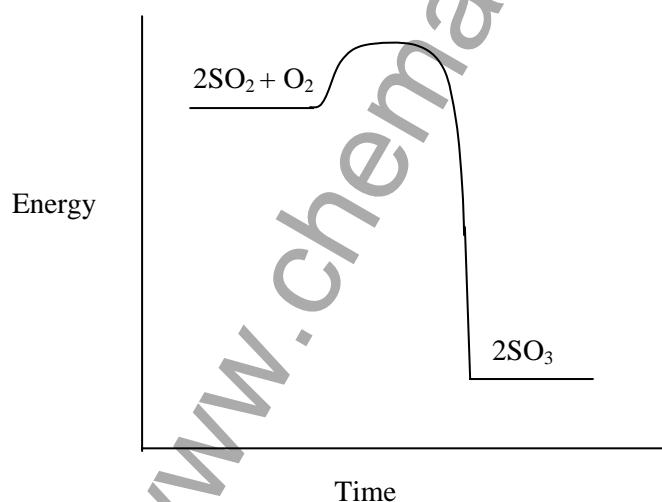
..... [1]

- (b) A catalyst is used because it lowers the activation energy.

- (i) What is meant by activation energy?

.....
 [1]

- (ii) Label the activation energy on the energy level diagram for the formation of sulphur trioxide. [1]



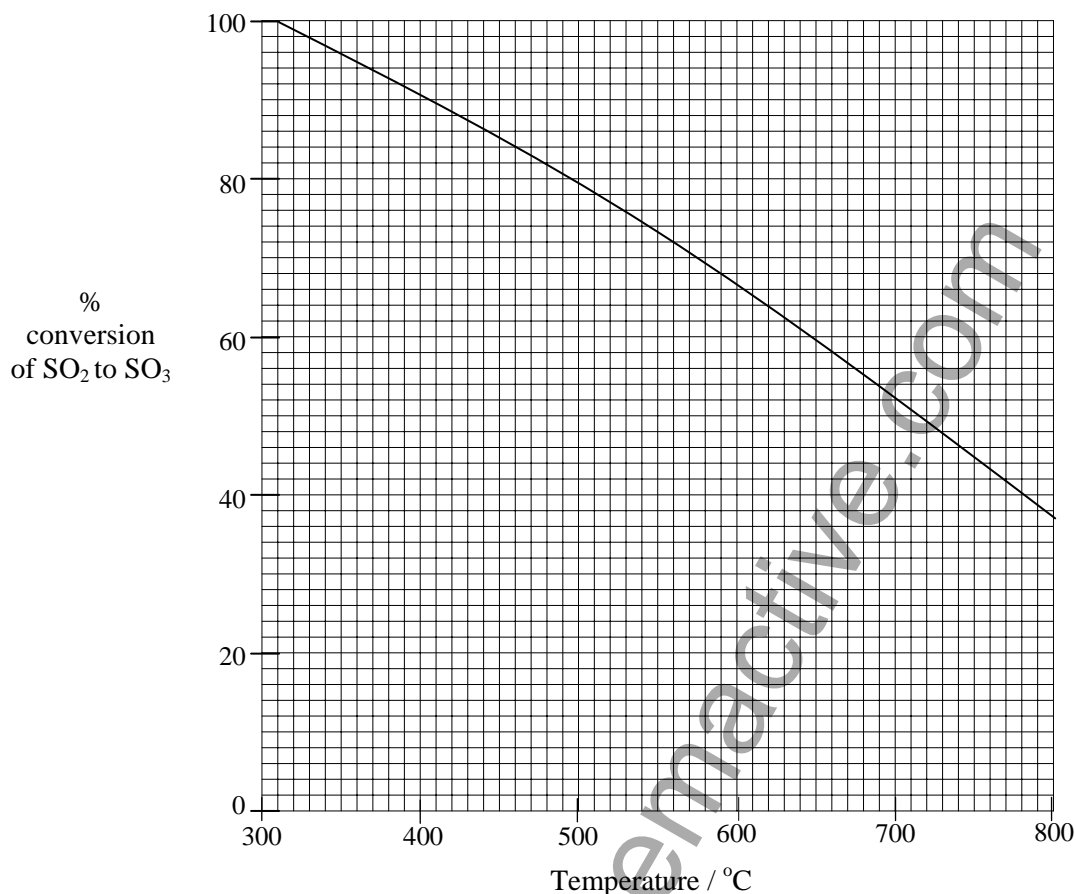
- (iii) What effect does a catalyst have by lowering the activation energy?

.....
 [1]

(Continued...)

QUESTIONSHEET 6 CONTINUED

- (c) The percentage conversion of sulphur dioxide varies with the temperature. This is shown in the graph below:



- (i) Use the graph to find the percentage of sulphur trioxide produced at a temperature of 575°C.

..... [1]

- (ii) Calculate the amount of sulphur dioxide converted when 300 tonnes of sulphur dioxide are reacted with oxygen at 575°C.

.....

..... [2]

- (iii) Running the process at 300 °C has the advantage of 100% conversion. Suggest one disadvantage of operating at this temperature.

.....

..... [1]

(Continued...)

QUESTIONSHEET 6 CONTINUED

(d) Sulphur trioxide is mixed with concentrated sulphuric acid to form oleum, $\text{H}_2\text{S}_2\text{O}_7$.
The oleum is diluted to produce more sulphuric acid.

(i) Give the symbol equation for this reaction.

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

(ii) Explain why the oleum is not added directly to water to form sulphuric acid.

..... [1]

(e) The catalyst used contains vanadium.

(i) Name the block of the Periodic Table to which vanadium belongs.

..... [1]

(ii) Vanadium is a very expensive metal. Explain why, despite the high cost, it can be used in this process.

.....
..... [1]

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High Demand Questions

QUESTIONSHEET 7

The world produces close to 10 million tonnes of copper each year.

Copper pyrites is one of the main ores of copper.

The ore contains the elements copper and sulphur.

To extract the copper the ore is crushed and concentrated.

The concentrated ore is roasted in air to separate the copper from the sulphur.

The sulphur reacts with air to form sulphur dioxide gas.

- (a) Explain why the ore needs to be concentrated.

..... [1]

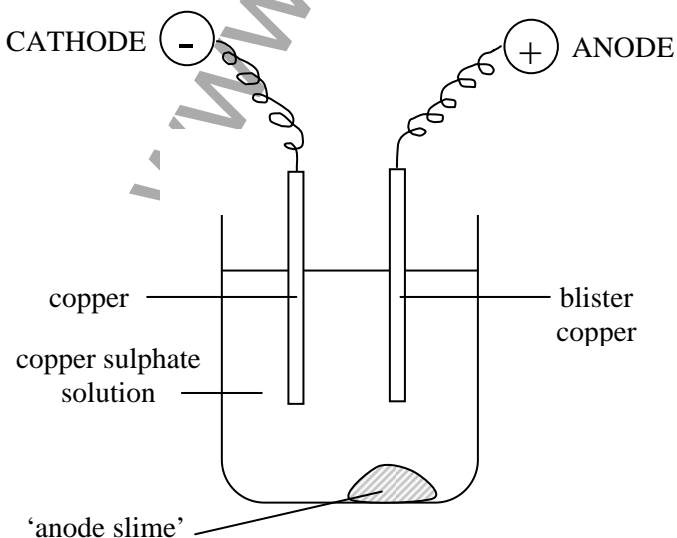
- (b) Explain why it is important that the sulphur dioxide gas is not allowed to escape into the atmosphere.

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

- (c) Sulphur dioxide may be used to make sulphuric acid.
Outline the major stages in this industrial process.

.....
.....
.....
.....
..... [3]

- (d) The copper formed is called blister copper and is impure.
Copper is purified by electrolysis. A diagram of the process is shown below.



(Continued...)

QUESTIONSHEET 7 CONTINUED

- (i) Use the diagram to explain how the impure copper is purified.

.....
.....
.....
.....
..... [3]

- (ii) Complete the symbol equation for the reaction at the cathode.



- (iii) The reaction at the cathode is an example of 'reduction'.
Explain this term by using this reaction as an example.

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

- (iv) What is the importance of the 'anode slime' in paying for this expensive process.

..... [1]

- (e) In the periodic table copper is a transition element.
It is used in wiring as it is a good conductor of electricity.
Give **two** other properties of transition elements.

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

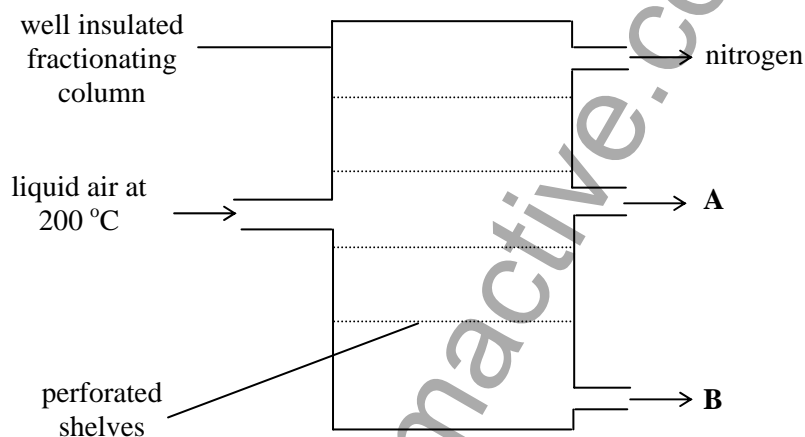
(a) The table below shows the percentage and the boiling point of the three main elements in **liquid air**.

Element	Percentage	Boiling point (°C)
argon		-186
nitrogen	78.04 %	-196
oxygen	20.93%	-183

(i) Complete the table. [1]

(ii) Name the gas with the **highest** boiling point [1]

(b) The following diagram shows the fractionating column for separating liquid air into argon, nitrogen and oxygen.



(i) Name this method of separation [1]

(ii) Name **A**. [1]

(iii) Name **B**. [1]

(c) Name **two** gases which are present in the atmosphere but **not** in liquid air.

..... and [2]

(d) Give one use of

(i) argon

..... [1]

(ii) nitrogen

..... [1]

(e) Explain how oxygen is used in the steel industry.

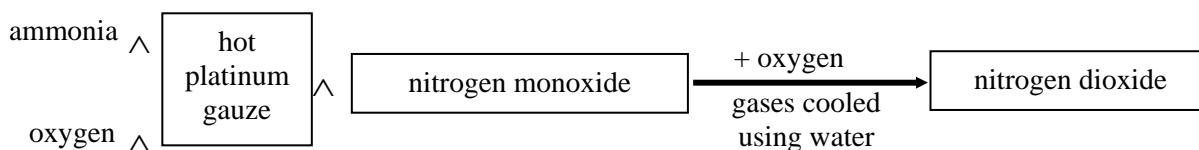
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Medium Demand Questions

QUESTIONSHEET 9

The diagram below shows part of the process in which nitric acid is formed from ammonia.



- (a) Which raw material is used to obtain oxygen?
 [1]
- (b) Write down the formulas for the following substances:
- (i) nitrogen monoxide _____
- (ii) oxygen _____
- (iii) nitrogen dioxide _____ [3]
- (c) Name the catalyst used in this process.
 [1]
- (d) What information given in the diagram suggests that nitrogen monoxide is insoluble in water?

 [1]
- (e) Explain how nitrogen dioxide is converted into nitric acid.

 [2]
- (f) The nitric acid formed may be used to make ammonium nitrate fertiliser.
- (i) What substance is added to nitric acid to form ammonium nitrate?
 [1]
- (ii) What type of reaction takes place when ammonium nitrate is formed?
 [1]

(Continued...)

QUESTIONSHEET 9 CONTINUED

(iii) Explain why nitrate fertilisers are used.

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

(iv) A bag of garden fertiliser has the label 'N:P:K 10:0:5'
Explain what this information means.

.....
.....
.....
..... [3]

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Medium Demand Questions

QUESTIONSHEET 10

The Haber process is used to manufacture ammonia.

Nitrogen gas and hydrogen gas react with each other in the presence of a catalyst.

- (a) Name the catalyst used in the Haber process.

..... [1]

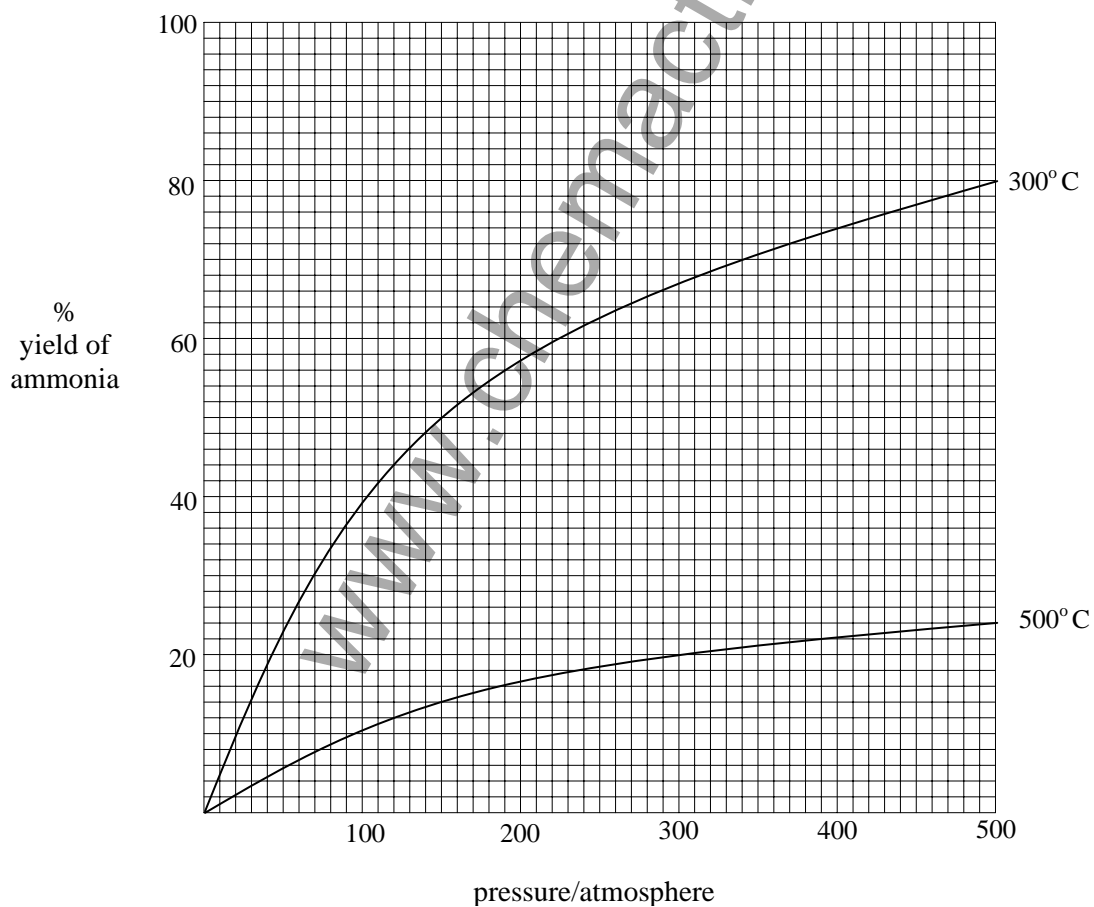
- (b) Balance the following equation for the reaction



- (c) This is a reversible reaction.
Explain what is meant by the term 'reversible reaction'.

..... [1]

- (d) The graph below shows the percentage yield of ammonia at different temperatures and pressures.



(Continued...)

QUESTIONSHEET 10 CONTINUED

- (i) Use the graph to complete the following sentences:

The percentage of ammonia _____ as the pressure increases.

The percentage of ammonia _____ as the temperature increases. [2]

- (ii) Use the graph to find the conditions required to give a yield of 60% ammonia.

temperature _____ °C pressure _____ atmospheres [1]

- (iii) On the graph draw the line you would expect showing the percentage yield of ammonia for a temperature of 350°C. [1]

- (e) Pressures greater than 500 atmospheres increase the yield of ammonia.
Suggest **two** reasons why very high pressures of above 500 atm are not used.

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

- (f) Temperatures lower than 300°C often give a yield of 100% of ammonia.
Suggest a reason why very low temperatures of less than 300°C are not used.

.....
..... [1]

- (g) After reacting the gases with the catalyst a mixture of unreacted nitrogen, unreacted hydrogen and ammonia is formed. The boiling points of these three gases are given in the table below.

gas	boiling point (°C)
ammonia	-33
hydrogen	-252
nitrogen	-196

Use the information to suggest a method for extracting the ammonia.

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

- (h) What happens to the nitrogen and hydrogen that leave the process unreacted?

.....
..... [1]

Medium Demand Questions

QUESTIONSHEET 11

Iron is extracted from its ore in a blast furnace.

The raw materials are iron ore, limestone, carbon, and hot air.

- (a) Name one ore of iron.

..... [1]

- (b) The iron ore is reduced using carbon monoxide.

- (i) Explain how carbon monoxide is formed in the blast furnace.

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

- (ii) What is meant by the term 'reduced'?

.....
..... [1]

- (c) The limestone (CaCO_3) is heated to a high temperature and it decomposes.

- (i) Write a symbol equation for the decomposition of limestone.

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

- (ii) Explain the reason for adding limestone to the furnace.

.....
..... [1]

- (d) Name the two liquids that are tapped off from the furnace.

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

- (e) The furnace runs for 24 hours a day. Suggest one problem caused by these operating conditions.

.....
..... [1]

(Continued...)

QUESTIONSHEET 11 CONTINUED

- (f) Discuss the factors that would influence the choice of a site for a new blast furnace.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (g) The iron formed is used to make alloys.
Name and give a use of an alloy containing iron.

.....

..... [2]

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Medium Demand Questions

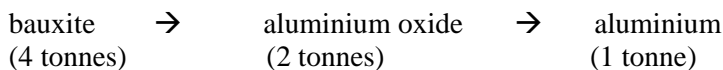
QUESTIONSHEET 12

Aluminium metal is extracted from its ore, bauxite.

Impurities such as iron(III) oxide and silicon oxide have to be removed.

The purified bauxite is mainly aluminium oxide.

Aluminium oxide solid is added to the electrolysis cell.



The cell requires a current of 100,000 amps and reaches a temperature of 1000°C.

In Scotland, aluminium is made near to hydroelectric power plants.

- (a) Suggest **two** reasons why the extraction of aluminium is an expensive process.

.....

.....

.....

..... [2]

- (b) Describe **three** environmental problems which could be caused by an increase in the demand for products made from aluminium.

.....

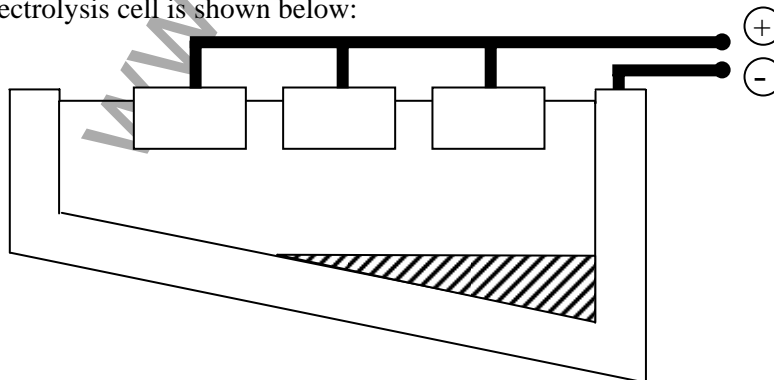
.....

.....

.....

..... [3]

- (c) A typical electrolysis cell is shown below:



- (i) Label the following on the diagram:
anode, cathode, electrolyte, aluminium metal

[3]

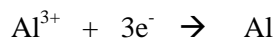
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QUESTIONSHEET 12 CONTINUED

- (ii) Explain why the carbon anodes have to be replaced.

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

- (d) The following reactions take place at the electrodes:



- (i) Which reaction takes place at the cathode?

..... [1]

- (ii) In a day 320 tonnes of oxygen gas are formed.
How much aluminium metal will be formed in this time?
(relative atomic masses: O = 16, Al = 27)

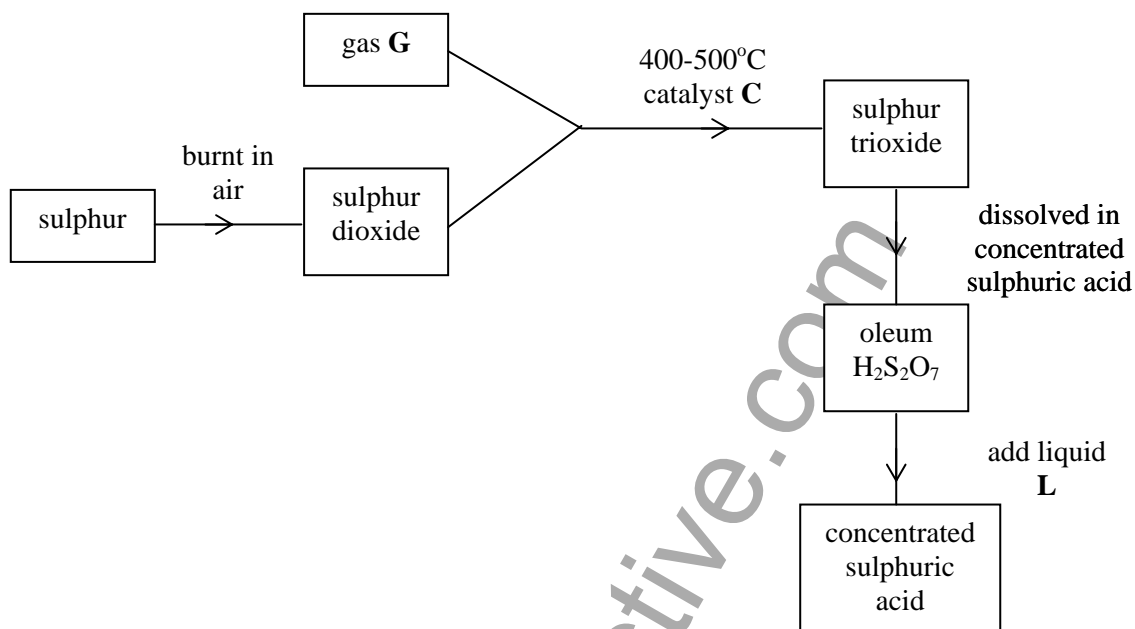
.....
.....
.....
..... [3]

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Medium Demand Questions

QUESTIONSHEET 13

Sulphuric acid, H_2SO_4 is made by a method called the contact process. A flow diagram for that process is shown in the following diagram.



(i) Name gas **G**.

..... [1]

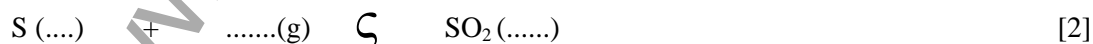
(ii) Name catalyst **C**.

..... [1]

(iii) Name liquid **L**.

..... [1]

(iv) Complete the symbol equation for the sulphur burning in air.



(v) Explain the importance of not allowing any of the sulphur dioxide to escape into the atmosphere.

..... [1]

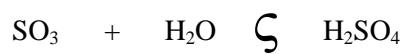
(vi) Name all the elements present in oleum, $\text{H}_2\text{S}_2\text{O}_7$.

..... [1]

(Continued...)

QUESTIONSHEET 13 CONTINUED

(vii) Sulphur dioxide reacts with water to form sulphuric acid:



Explain why this is never done in the contact process.

.....
..... [1]

(viii) Give one industrial use of sulphuric acid.

.....
..... [1]

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Medium Demand Questions

QUESTIONSHEET 14

Ammonia is manufactured by the Haber process where nitrogen is reacted with hydrogen by passing the mixture over iron at certain conditions.

- (a) (i) Complete and balance the equation



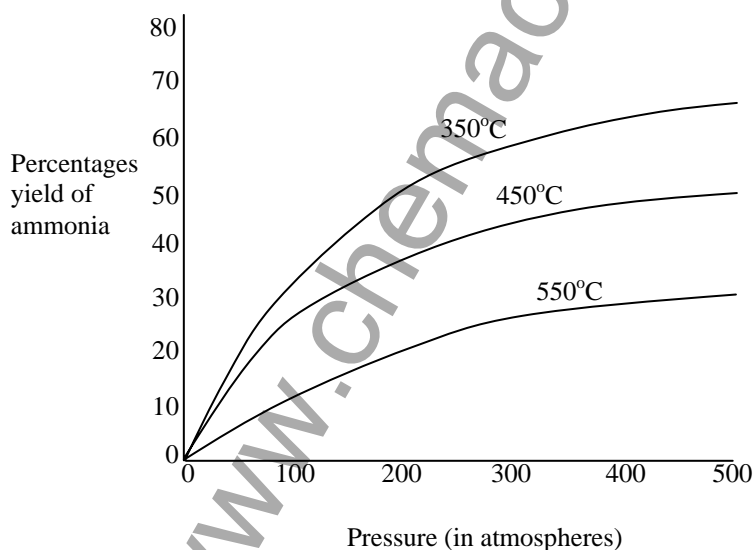
- (ii) Explain why the mixture is passed over iron.

.....
 [1]

- (iii) State how heat affects the speed of the reaction between the two reactants - nitrogen and hydrogen.

.....
 [1]

- (b) The graph below shows the effect of temperature and pressure on the yield of ammonia produced during its manufacture



- (i) State what happens to the yield of ammonia when:

the pressure increases.

..... [1]

the temperature increases.

..... [1]

- (ii) The graph shows the highest yield of ammonia can be obtained by using a pressure of 500 atmospheres. Give **one** reason why this condition is not normally used in industry.

..... [1]

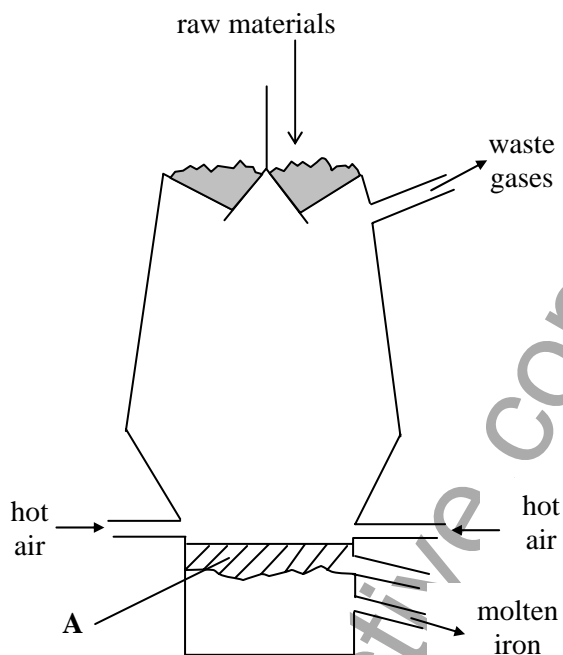
QUESTIONSHEET 14 CONTINUED

(c) One of the main uses of ammonia is to manufacture nitrogenous fertilisers such as ammonium sulphate. Name the substance that is used to neutralise ammonia to make this fertiliser.

..... [1]

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The diagram below shows a blast furnace which is used for the extraction of iron from iron ore.



- (a) (i) One of the raw materials fed in at the top of the blast furnace is iron ore, which is mainly iron(III) oxide.

Name the other two raw materials.

1. II. [2]

- (ii) Name the substance which is formed at A.

..... [1]

- (b) One of the main reactions taking place inside the blast furnace is



- (i) Name the **reducing agent** in this equation.

..... [1]

- (ii) Calculate the relative molecular mass (M_r) of iron(III) oxide, Fe_2O_3 .

$$A_r(\text{Fe}) = 56 \quad A_r(\text{O}) = 16$$

.....
 [2]

QUESTIONSHEET 15 CONTINUED

(iii) Use the given equation to calculate the mass of iron formed from 320 tonnes of iron(III) oxide.

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

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Medium Demand Questions

QUESTIONSHEET 16

Aluminium is extracted by the **electrolysis** of **molten** aluminium oxide (dissolved in **molten cryolite**). It is an expensive metal to produce.

(a) (i) Give one reason why aluminium is expensive to make.

..... [1]

(ii) State what is meant by the term **electrolysis**.

..... [1]

(iii) Explain the reason why aluminium oxide is dissolved in **molten cryolite**.

..... [1]

(iv) Explain why the aluminium oxide needs to be in the **molten** state.

..... [1]

(v) During electrolysis the aluminium ion (Al^{3+}) is attracted towards the negative electrode. Give both the **name** and **symbol** of the ion attracted towards the positive electrode.

Name. Symbol. [1]

(b) (i) State and explain **one** important factor that needs to be considered when an aluminium extraction plant site is chosen.

..... [2]

(ii) Aluminium is a metal that is encouraged to be recycled. Explain why we should recycle as much aluminium as possible.

..... [1]

(c) Aluminium has many different uses.

Give **one** reason why aluminium is chosen to make each of the following items:

(i) cooking foil

..... [1]

(ii) electric cables

..... [1]

(iii) window frames

..... [1]

Low Demand Questions

QUESTIONSHEET 17

This question is about the extraction of metals.

(a) (i) Match the metals to their methods of extraction.

Metal
Sodium
Zinc
Copper

Method of extraction
Heat sulphide with oxygen
Electrolysis
Reduction with coke

[3]

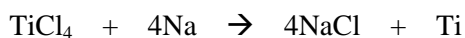
(ii) Explain how you matched the metals to the methods.

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

(iii) What is the main element in coke?

..... [1]

(b) Titanium (Ti) can be extracted from titanium chloride by heating with sodium.



(i) What type of reaction is this?

..... [1]

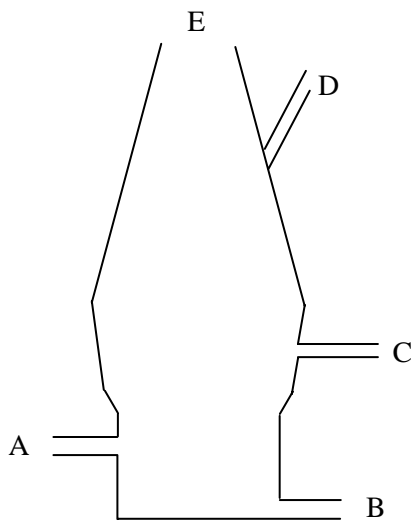
(ii) What does the reaction tell you about titanium compared to sodium?

..... [1]

Low Demand Questions

QUESTIONSHEET 18

The diagram below shows the outline of a Blast Furnace.



(a) Select letters which show:

- (i) the place where the air blast goes in _____ [1]
- (ii) the place where the ore and coke go in _____ [1]
- (iii) the place where the hot gases come out _____ [1]
- (iv) the place where the iron comes out _____ [1]

(b)(i) What use is made of the hot waste gases?

..... [1]

(ii) Name **two** of the waste gases.

..... [2]

(c) The iron formed in the blast furnace is brittle.
What element in the iron causes this?

..... [1]

Low Demand Questions

QUESTIONSHEET 19

Ammonia is made from nitrogen and hydrogen.

- (a) Why is it difficult to react nitrogen with hydrogen?

..... [1]

- (b) The reaction is described as reversible.
What does this mean?

..... [1]

- (c) The reaction is quite slow.
What is added to speed it up?

..... [1]

- (d) Only about 15% of the nitrogen and hydrogen are converted to ammonia.
What happens to the remaining 85%?

.....
..... [1]

- (e) Ammonia is very soluble in water.
In what two ways can you recognise a solution of ammonia?

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

- (f) Ammonia reacts with nitric acid to make a salt which can be used as a fertiliser.

- (i) Name the salt.

..... [1]

- (ii) Why is it a good fertiliser?

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

Low Demand Questions

QUESTIONSHEET 20

(a) A lot of chemicals can be made from common salt.

(i) What is the chemical name for common salt?

..... [1]

(ii) Give **two** other uses for common salt.

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

(b) Sodium hydroxide is made from salt.

(i) Circle a description in the list below that applies to sodium hydroxide.

Strong acid strong alkali neutral weak acid weak alkali [1]

(ii) Name two things made using sodium hydroxide.

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

(c) Chlorine can be extracted from salt.

(i) Circle **two** descriptions in the list below that apply to chlorine.

Solid liquid gas bleach reducing agent [2]

(ii) Give **two** uses of chlorine.

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