PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 4: EXTRACTING METALS AND EQUILIBRIA

SCORE	PERCENTAGE
/158	%

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Q1.

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)

..... + ... H^+ → ..... Al^{3+} + ...

(Total for question = 2 marks)

Q2.

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 14.

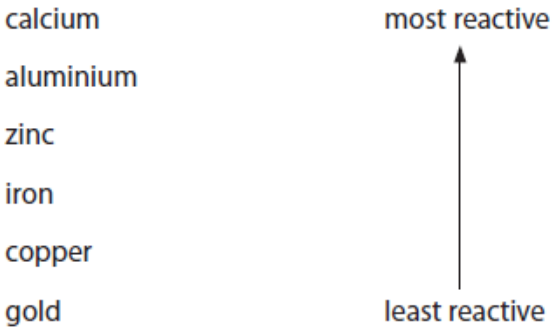


Figure 14

* Aluminium is extracted from its ore by electrolysis.
Iron is extracted from its ore by heating with carbon.
Both metals can also be obtained by recycling.

Explain the advantages of recycling aluminium and iron rather than extracting them from their ores.

(Total for question = 6 marks)

Q3.

(a) Drinks are often sold in cans.
These cans are made either of aluminium or of steel coated with tin.
The table gives information about these three metallic substances.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
steel (iron)	0.32	5
tin	12.6	0.0002

Use the table to give **two** reasons why it could be more important to recycle tin than to recycle aluminium or steel.

(2)

reason 1

.....

.....

reason 2

.....

.....

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction for the extraction of aluminium from its ore involves

(1)

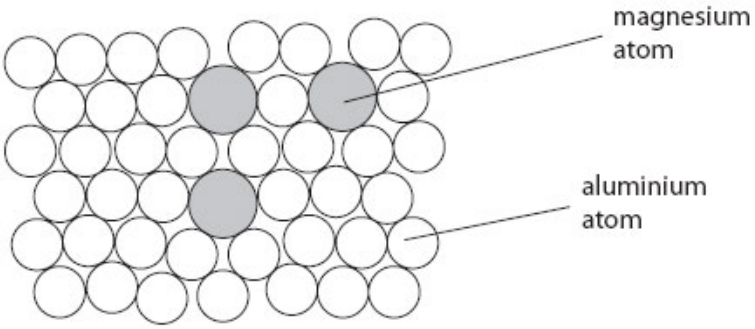
☒ **A** heating with carbon

☒ **B** thermal decomposition

☒ **C** reduction

☒ **D** neutralisation

(c) Magnalium is an alloy of aluminium and magnesium.
The diagram shows the structure of this alloy.



(i) Explain what you understand by the term **alloy.**

(2)

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.....

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(ii) Explain, in terms of their structures, why magnalium is stronger than pure aluminium.

(3)

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(Total for Question = 8 marks)

Q4.

When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.

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

(a) Explain what is meant by a **dynamic equilibrium.**

(2)

.....

.....

.....

.....

(b) In industry, the reaction between nitrogen and hydrogen is affected by the conditions used.

(i) The pressure used is 250 atmospheres.
Explain how the use of a higher pressure would affect the equilibrium yield of ammonia.

(2)

.....

.....

.....

.....

(ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic. The temperature used is 450°C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

.....

.....

.....

.....

(ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic.
The temperature used is 450°C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

.....

.....

.....

.....

(iii) Even at 450°C, the reaction is very slow.

State what is used in industry to overcome this problem.

(1)

.....

(c) (i) Calculate the minimum volume of hydrogen required to completely convert 1000 dm^3 of nitrogen into ammonia.

(1)

.....

.....

volume of hydrogen = ... dm^3

(ii) Ammonia is reacted with excess nitric acid, HNO_3, to make ammonium nitrate, NH_4NO_3.

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Calculate the mass of ammonium nitrate produced by the complete reaction of 34 g of ammonia.

(Relative atomic masses H = 1.0, N = 14, O = 16)

(3)

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.....

.....

mass of ammonium nitrate produced =.....g

(Total for Question = 11 marks)

Q5.

A student plans to heat the pure solution of ammonium chloride to dryness to obtain a sample of pure, dry ammonium chloride.

A teacher explains that if dry ammonium chloride is heated, the following reaction can occur.

$$NH_4Cl \rightarrow NH_3 + HCl$$

(i) Which statement describes this reaction of ammonium chloride to form ammonia and hydrogen chloride?

(1)

☒ **A** a crystallisation reaction

☒ **B** a decomposition reaction

☒ **C** a neutralisation reaction

☒ **D** a reaction at equilibrium

(ii) Describe how you could alter the method of obtaining the pure, dry ammonium chloride to avoid losing product by heating the sample too strongly.

(2)

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(Total for question = 3 marks)

Q6.

The reactivity of copper, magnesium and zinc was investigated.
Each metal was placed separately in dilute hydrochloric acid.
The amount of effervescence was observed.

(i) The same mass of metal was used in each experiment.
Which piece of apparatus should be used to find the mass of metal used?

(1)

☒ **A** a balance

☒ **B** a pipette

☒ **C** a stopwatch

☒ **D** a thermometer

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this

investigation.

(2)

1 .....

.....

2 .....

.....

(iii) Magnesium produces the most vigorous effervescence.
Copper does not produce any effervescence.

Give the reason why copper does not produce any effervescence.

(1)

.....

(iv) The magnesium reacts with dilute hydrochloric acid to form magnesium chloride solution and hydrogen gas.

The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(.....) + H_2(.....)$$

Fill in the missing state symbols in the spaces provided.

(2)

(Total for question = 6 marks)

Q7.

Some metals are found in the Earth's crust as uncombined elements.
Reactive metals are found in ores.

In ores, metals are combined with other elements.

An ore of iron is mostly iron oxide, Fe_2O_3.
Iron can be extracted from this iron oxide by heating it with carbon.

Balance this equation for the reaction that takes place.

(1)

$$2Fe_2O_3 + ...C \rightarrow .....Fe + ...CO_2$$

(Total for question = 1 mark)

Q8.

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)

.....

.....

.....

.....

percentage by mass = ...

(ii) Nickel is extracted from nickel compounds.

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

(1)

.....

.....

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(Total for question = 4 marks)

Q9.

Some metals are found in the Earth's crust as uncombined elements.
Reactive metals are found in ores.

In ores, metals are combined with other elements.

Most copper ores are described as low grade.
This means that the percentage of copper in the ore is very small.

5000 kg of one copper ore was found to contain 42.5 kg of copper.

Calculate the percentage of copper in this ore.

(2)

.....

.....

.....

percentage of copper in ore = ...

(Total for question = 2 marks)

Q10.

The reaction between nitrogen and hydrogen happens at a pressure of 200 atmospheres.

Another unit of pressure is Pascals, Pa (1 atmosphere = 101 325 Pa).

Calculate the value of 200 atmospheres in Pascals.

(2)

.....

.....

pressure = ... Pa

(Total for question = 2 marks)

Q11.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

When chloride ions are added to a pale blue solution containing copper ions, the mixture turns yellow.

This is a reversible reaction.

pale blue solution + chloride ions ↔ yellow solution + water

What effect does the removal of chloride ions have on the colour of the yellow mixture?

(1)

☒ **A** does not change colour

☒ **B** turns blue

☒ **C** turns colourless

☒ **D** turns darker yellow

(Total for question = 1 mark)

Q12.

Figure 5 shows molecules of nitrogen, hydrogen and ammonia before the reaction and at equilibrium.

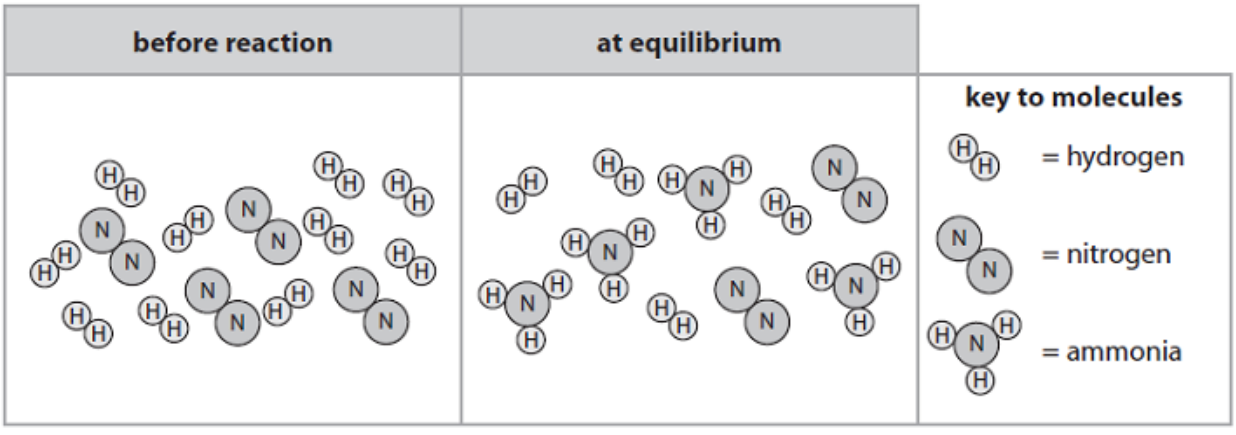


Figure 5

(i) Complete the table showing

- the number of hydrogen molecules before reaction
- the number of hydrogen molecules at equilibrium
- the change in the number of hydrogen molecules.

(1)

	number of molecules before reaction	number of molecules at equilibrium	change in number of molecules
nitrogen	4	2	–2
hydrogen	.....	.....	.....
ammonia	0	4	+4

(ii) Complete the equation for this reaction.

(2)

..... + ... ↔ 2 NH_3

(Total for question = 3 marks)

Q13.

The industrial production of sulfuric acid involves several steps.

One of these steps is the reaction of sulfur dioxide, SO_2, with oxygen to form sulfur trioxide, SO_3.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

* The reaction to produce sulfur trioxide reaches an equilibrium.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.
The rate of attainment of equilibrium and the equilibrium yield of sulfur trioxide are affected by pressure and temperature.

A manufacturer considered two sets of conditions, A and B, for this reaction.
In each case sulfur dioxide is mixed with excess oxygen.
The manufacturer changed the temperature and the pressure and only used a catalyst in B.
The sets of conditions A and B are shown in Figure 7.

set of conditions	pressure in atm	temperature in °C	catalyst
A	2	680	no catalyst used
B	4	425	catalyst used

Figure 7

The manufacturer chooses set of conditions B rather than set of conditions A.

Explain, by considering the effect of changing the conditions on the rate of attainment of equilibrium and on the equilibrium yield of sulfur trioxide, why the manufacturer chooses the set of conditions B rather than the set of conditions A.

(Total for question = 6 marks)

Q14.

Iron objects can corrode when exposed to the atmosphere.

(i) Corrosion involves the oxidation of iron.

State what is meant by **oxidation**.

(1)

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.....

.....

(ii) Painting iron objects prevents corrosion.

Explain why painting iron objects prevents corrosion.

(2)

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.....

(iii) Corrosion of iron objects can be prevented by painting them or by electroplating them.

State one **other** way of preventing the corrosion of iron objects.

(1)

.....

(Total for question = 4 marks)

Q15.

The order of reactivity of copper, magnesium and zinc can be determined by the displacement reactions between these metals and solutions of their salts.

You are provided with

- samples of the three metals
- solutions of copper sulfate, magnesium sulfate and zinc sulfate.

Describe the experiments that can be done to determine the order of reactivity of these metals by displacement reactions.

(3)

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(Total for question = 3 marks)

Q16.

When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.

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

Explain what is meant by a **dynamic equilibrium.**

(2)

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Q17.

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

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

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)

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.....

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.....

(Total for question = 2 marks)

Q18.

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)

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(Total for question = 4 marks)

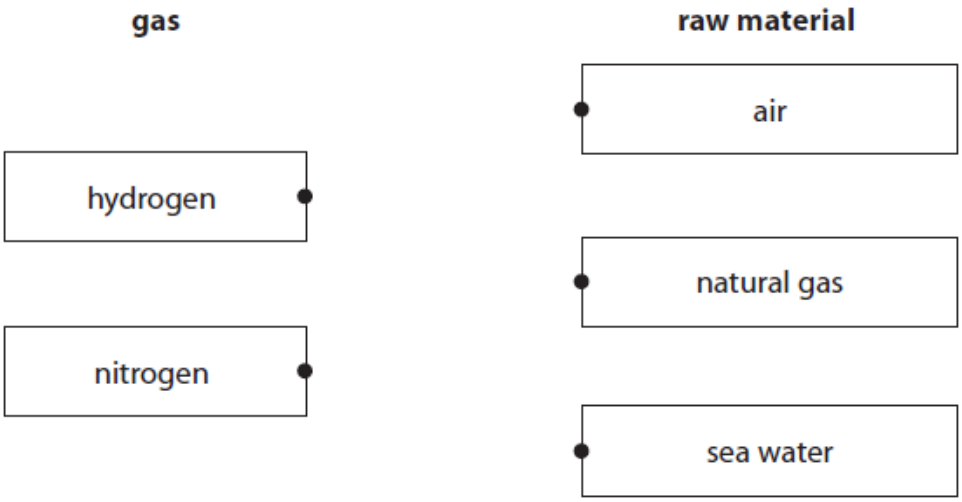
Q19.

Ammonia is made by reacting nitrogen with hydrogen.

The nitrogen and hydrogen are obtained from raw materials.

Draw one straight line from each gas to the raw material it is obtained from.

(2)



(Total for question = 2 marks)

Q20.

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)

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.....

(Total for question = 2 marks)

Q21.

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

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

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)

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.....

(Total for question = 4 marks)

Q22.

When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.

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

In industry, the reaction between nitrogen and hydrogen is affected by the conditions used.

(i) The pressure used is 250 atmospheres.
Explain how the use of a higher pressure would affect the equilibrium yield of ammonia.

(2)

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.....

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.....

(ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic. The temperature used is 450°C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

.....

.....

.....

.....

(iii) Even at 450°C, the reaction is very slow.

State what is used in industry to overcome this problem.

(1)

.....

Q23.

Some metals are found in the Earth's crust as uncombined elements.
Reactive metals are found in ores.

In ores, metals are combined with other elements.

In one stage of the extraction of lead from its ore, lead oxide is heated strongly with carbon.

The equation for the reaction is

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

Explain, using this equation, which substance has been oxidised in this reaction.

(2)

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.....

(Total for question = 2 marks)

Q24.

Metals can be extracted from ores found in the Earth's crust.

Explain why aluminium cannot be extracted from its ore by heating with carbon but can be extracted by electrolysis.

(2)

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.....

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.....

(Total for question = 2 marks)

Q25.

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 14.

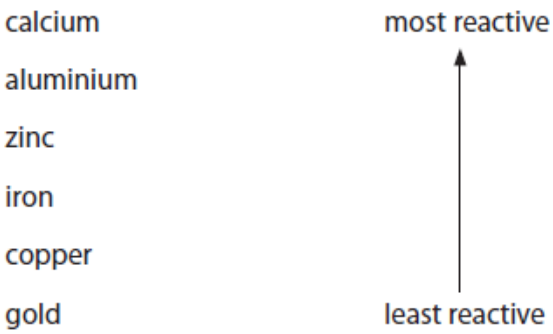


Figure 14

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

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

.....

.....

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.....

.....

mass of iron = ... tonnes

(Total for question = 4 marks)

Q26.

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 14.

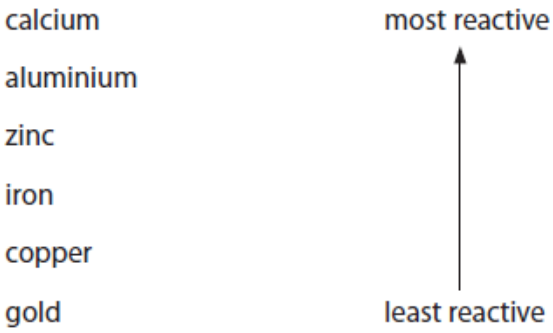


Figure 14

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

Explain why.

(2)

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.....

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.....

(Total for question = 2 marks)

Q27.

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.

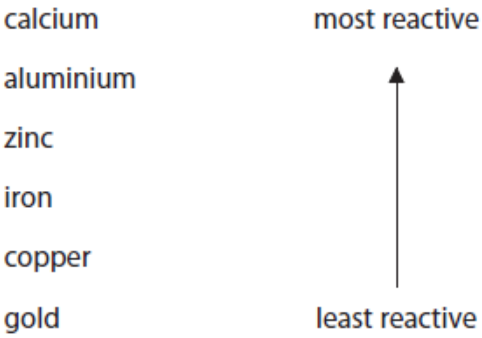


Figure 2

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

Explain why.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q28.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction for the extraction of aluminium from its ore involves

(1)

☒ **A** heating with carbon

☒ **B** thermal decomposition

☒ **C** reduction

☒ **D** neutralisation

Q29.

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.

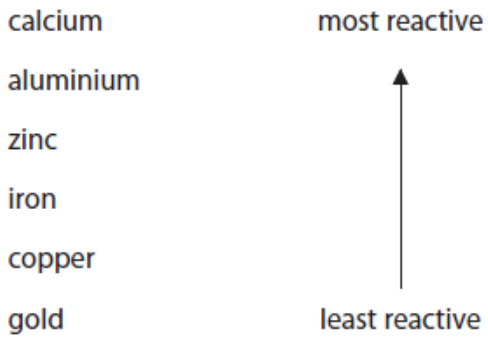


Figure 2

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

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

.....

.....

.....

.....

.....

.....

mass of iron = ... tonnes

(Total for question = 4 marks)

Q30.

Iron is extracted from iron oxide, Fe_2O_3.

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

.....

Q31.

(a) Iron can be extracted from a naturally occurring substance called haematite.

State the name given to the naturally occurring substances from which metals are extracted.

(1)

.....

(b) In the extraction of iron, iron oxide is heated with carbon to form iron.
A gas is also formed.

Write the word equation for this reaction.

(2)

.....

.....

Q32.

The list shows some metals in order of reactivity.

most reactive	sodium
	aluminium
	zinc
	iron
	copper
least reactive	gold

(a) Aluminium and iron are extracted by reduction of their oxides.

State what is meant by reduction.

(1)

.....

.....

(b) Electrolysis and heating with carbon are two methods of reduction.

Explain why aluminium needs to be extracted from its ore by electrolysis, rather than by heating with carbon.

(2)

.....

.....

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.....

Q33.

Fertilisers and ammonia

(a) State why farmers spread fertilisers on their fields.

(1)

.....

.....

.....

(b) Using too much fertiliser can harm the environment.

Describe how the spreading of too much fertiliser on fields can harm the environment.

(2)

.....

.....

.....

.....

(c) Ammonium nitrate is a fertiliser.

Ammonium nitrate is formed when nitric acid reacts with ammonia.

(i) Write the word equation for this reaction.

(2)

..... + ... → .....

(ii) This hazard symbol appears on a bottle of nitric acid.



Complete the sentence by putting a cross (☒) in the box next to your answer.

This hazard symbol shows that the nitric acid is

(1)

☒ **A** corrosive

☒ **B** explosive

☒ **C** flammable

☒ **D** toxic

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

nitrogen + hydrogen $\rightleftharpoons$ ammonia

(i) The $\rightleftharpoons$ 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)

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The formula for a molecule of ammonia is

(1)

☒ **A** Am_3

☒ **B** HN

☒ **C** NH_3

☒ **D** N_3O

(Total for question = 8 marks)

Q34.

(a) Nitrogen reacts with hydrogen to form ammonia.

(i) Which of these is the balanced equation for this reaction?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** $N + 3H \rightleftharpoons NH_3$

☒ **B** $N_2 + H_2 \rightleftharpoons NH_3$

☒ **C** $N_2 + 3H_2 \rightleftharpoons 2\ NH_3$

☒ **D** $N + H_3 \rightleftharpoons NH_3$

(ii) State the meaning of the symbol $\rightleftharpoons$ in an equation.

(1)

.....

.....

(b) Ammonia is used in the manufacture of some fertilisers.

(i) The table shows information about three fertilisers manufactured from ammonia.

substance	% by mass of nitrogen	% by mass of oxygen
ammonium nitrate	35	60
ammonium sulfate	21	48
urea	47	27

Use the information in the table to explain why urea might be the best fertiliser.

(2)

.....

.....

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

.....

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Q35.

Alloy steels are made when iron is alloyed with other transition metals such as cobalt and chromium.

Iron fences can be galvanised by coating them with a layer of zinc. When the layer of zinc is scratched exposing the iron to the weather, the iron does not rust.

Explain why the exposed iron does not rust.

(2)

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.....

(Total for question = 2 marks)

Q36.

Gases and ammonia

(a) Hydrogen reacts with oxygen to form water vapour.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

If 200 cm^3 of hydrogen react completely with 100 cm^3 of oxygen, what is the maximum volume of water vapour formed, if all volumes are measured at the same temperature and pressure?

Put a cross (☒) in the box to show your answer.

(1)

☒ **A** 100 cm^3

☒ **B** 200 cm^3

☒ **C** 300 cm^3

☒ **D** 400 cm^3

(b) Zinc reacts with dilute hydrochloric acid to form zinc chloride and hydrogen.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

Calculate the maximum volume of hydrogen formed, at room temperature and pressure, when 13.0 g of zinc reacts completely with excess hydrochloric acid.
(relative atomic mass: Zn = 65.0,
1 mol of any gas occupies 24 dm^3 at room temperature and pressure)

(2)

.....

.....

.....

.....

volume of hydrogen = ... dm^3

(c) In industry, ammonia is produced by the Haber process.

$$\text{nitrogen} + \text{hydrogen} \rightleftharpoons \text{ammonia}$$

(i) What is the source of the hydrogen used in the Haber process?

Put a cross (☒) in the box to show your answer.

(1)

☒ **A** air

☒ **B** reaction of zinc with dilute sulfuric acid

☒ **C** electrolysis of water

☒ **D** natural gas

(ii) When nitrogen reacts with hydrogen, the amount of ammonia gradually increases until it becomes constant.

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

Explain why the amount of ammonia remains constant.

(2)

.....

.....

.....

.....

*(d) The reaction between nitrogen and hydrogen is exothermic.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

If nitrogen and hydrogen were reacted at 90 atm pressure and 300 °C, without a catalyst, some ammonia would be formed eventually.

In the Haber process a pressure of 150 atm and a temperature of 450 °C are used, in the presence of an iron catalyst.

Explain, with reasons, why the Haber process conditions are better for the manufacture of ammonia.

(6)

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(Total for question = 12 marks)

Q37.

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

$$\text{hydrogen} + \text{nitrogen} \rightleftharpoons \text{ammonia}$$

(i) The $\rightleftharpoons$ 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)

.....

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

(1)

.....

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

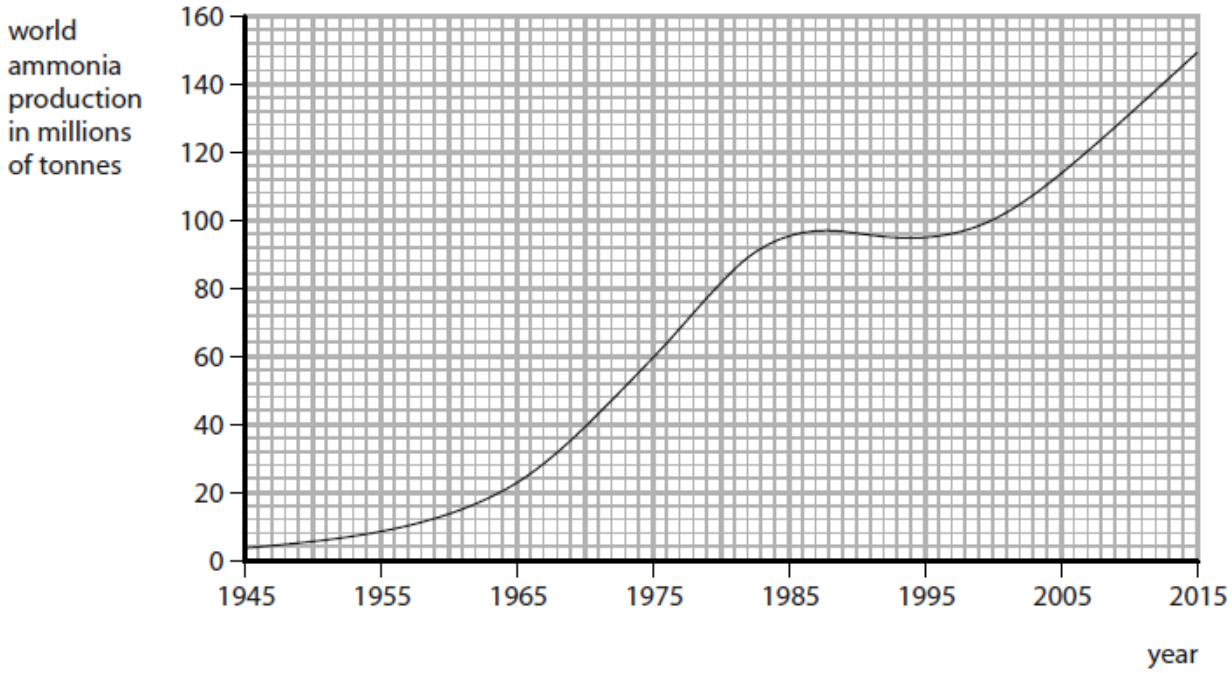


Figure 7

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

(1)

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(Total for question = 3 marks)

Q38.

Metals are extracted from substances naturally occurring in the Earth's crust.

Aluminium is extracted from aluminium oxide by electrolysis.
Aluminium oxide is made up of ions.

(i) The formula of aluminium oxide is Al_2O_3.

Give the number of ions in the formula Al_2O_3.

(1)

.....

(ii) Complete the balanced equation for the overall reaction by putting numbers in the spaces.

(2)

$2Al_2O_3 \rightarrow$ ..... Al + ... O_2

(Total for question = 3 marks)

Q39.

Some metals are found in the Earth's crust as uncombined elements.
Reactive metals are found in ores.

In ores, metals are combined with other elements.

Give **two** advantages of recycling metals rather than extracting metals from their ores.

(2)

1 .....

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2 .....

.....

(Total for question = 2 marks)

Q40.

Nitrogen reacts with hydrogen to form ammonia.

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

(i) Calculate the minimum volume of nitrogen, in dm^3, required to react completely with 1000 dm^3 of hydrogen.

All volumes are measured at the same temperature and pressure.

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** 333 dm^3

☒ **B** 1000 dm^3

☒ **C** 3000 dm^3

☒ **D** 4666 dm^3

(ii) The minimum volumes of nitrogen and hydrogen that must react completely to form 5000 dm^3 of ammonia are calculated.

These volumes are mixed and left, under appropriate conditions, until the reaction reaches equilibrium.

Explain which gas or gases will be present when equilibrium is reached.

(2)

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(iii) The Haber process is carried out under a pressure of about 200 atm.

Explain the effect on the **equilibrium yield** of ammonia, if the process is carried out at a pressure higher than 200 atm.

(2)

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(iv) Explain the effect on the **rate of attainment of equilibrium**, if the process is carried out at a pressure higher than 200 atm.

(3)

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Q41.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Ammonia is manufactured by the Haber process.

The equation for the reaction is

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

The reaction is reversible and can reach equilibrium.

(i) An iron catalyst can be used in the reaction.

Which row of the table shows how adding the iron catalyst affects the rate of attainment of equilibrium and the equilibrium yield of ammonia?

(1)

		rate of attainment of equilibrium	equilibrium yield of ammonia
☒	**A**	increases	increases
☒	**B**	decreases	does not change
☒	**C**	decreases	increases
☒	**D**	increases	does not change

(ii) Which of the following statements is correct when the reaction reaches equilibrium?

(1)

☒ **A** the reverse reaction starts to take place

☒ **B** the amounts of nitrogen, hydrogen and ammonia are equal

☒ **C** the amounts of nitrogen, hydrogen and ammonia become constant

☒ **D** the reaction stops

(iii) The reaction is carried out at a pressure of 200 atmospheres.

Explain what effect a pressure higher than 200 atmospheres would have on the rate of attainment of equilibrium and on the equilibrium yield of ammonia.

(4)

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(Total for question = 6 marks)

Q42.

Metals are extracted from substances naturally occurring in the Earth's crust.

Which of these metals is usually found uncombined in the Earth's crust?

(1)

☒ **A** calcium

☒ **B** gold

☒ **C** iron

☒ **D** magnesium

(Total for question = 1 mark)

Q43.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Titanium and iron are examples of transition metals.

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

(ii) The equipment shown in Figure 7 can be used to find the mass of oxygen that combines with iron.

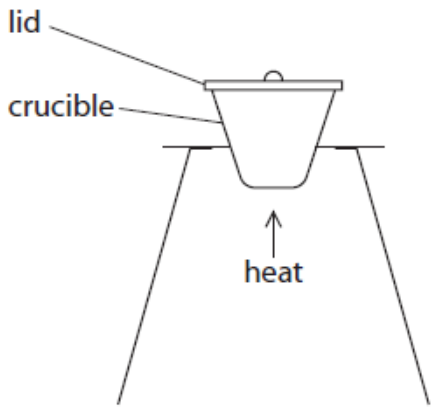


Figure 7

Describe how the equipment shown in Figure 7 could be used to find the mass of oxygen that combines with 0.500 g of iron wool in a crucible and lid of known mass.

(3)

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(Total for question = 4 marks)

Q44.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Some metals are found in the Earth's crust as uncombined elements.
Reactive metals are found in ores.

In ores, metals are combined with other elements.

Which of these metals is found as the uncombined element in the Earth's crust?

(1)

☐ **A** aluminium

☐ **B** gold

☐ **C** potassium

☐ **D** zinc

(Total for question = 1 mark)

Q45.

Lead oxide can be converted into lead by heating it with carbon.

The word equation for the reaction is

lead oxide + carbon → lead + carbon dioxide

Explain how this equation shows that lead oxide is reduced and carbon is oxidised.

(2)

.....

.....

Q46.

Metals are extracted from substances naturally occurring in the Earth's crust.

(i) The environmental impact of a product is assessed in a life-cycle assessment.

The stages in this assessment are given below.
They are not in the correct order.

A disposal of the product
B manufacturing the product
C obtaining and processing the raw materials
D using the product

List the stages of the life-cycle assessment, using letters **A**, **B**, **C**, **D**, in the correct order from start to finish.

(2)

(ii) Aluminium can be obtained by recycling aluminium waste.

Give **two** advantages of obtaining aluminium by recycling aluminium waste rather than mining the raw material and extracting aluminium from that raw material.

(2)

1 .....

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2 .....

.....

(Total for question = 4 marks)

Q47.

Drinks are often sold in cans.
These cans are made either of aluminium or of steel coated with tin.
The table gives information about these three metallic substances.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
steel (iron)	0.32	5
tin	12.6	0.0002

Use the table to give **two** reasons why it could be more important to recycle tin than to recycle aluminium or steel.

(2)

reason 1

.....

.....

reason 2

.....

.....

Q48.

Metals

(a) In the extraction of tin from tin oxide, tin oxide is heated with carbon.

$$SnO_2 + C \rightarrow Sn + CO_2$$

Complete the sentence by putting a cross (☒) in the box next to your answer.

When the tin oxide reacts with carbon to form the products

(1)

☒ **A** tin is oxidised

☒ **B** tin oxide is reduced

☒ **C** carbon is reduced

☒ **D** carbon dioxide is oxidised

(b) Pure gold is too soft to be used for some jewellery.

(i) Gold alloys contain other metals such as copper and silver.

In terms of the arrangement of metal atoms, explain why gold alloys are stronger than pure gold.

(2)

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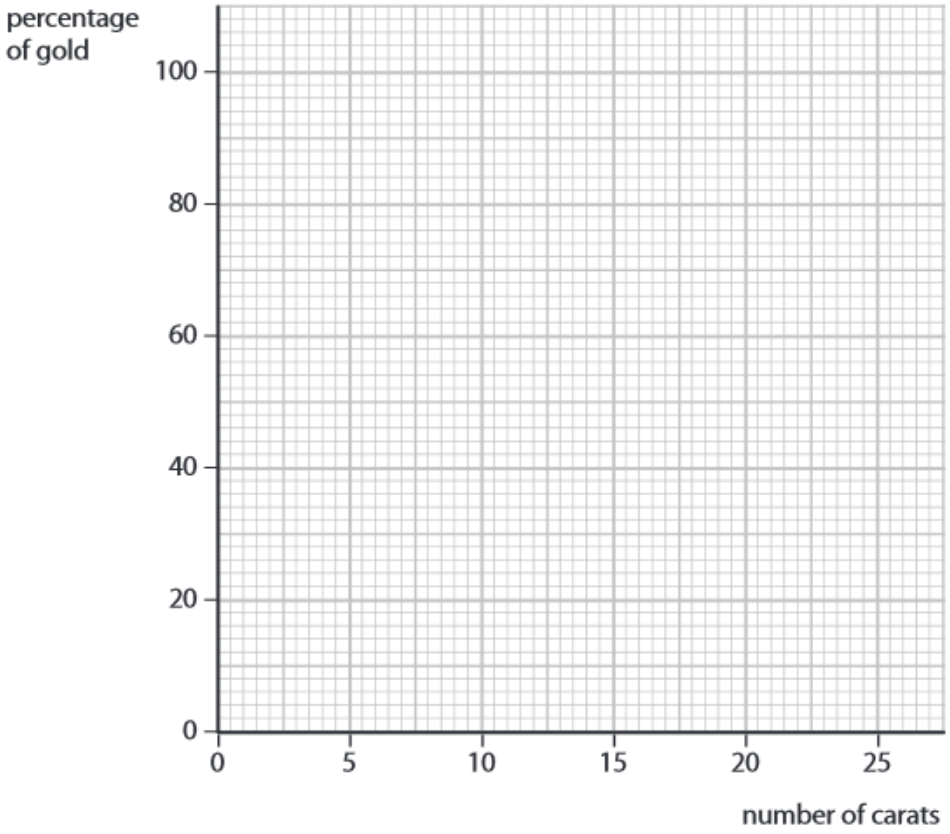
(ii) The purity of gold is often measured in carats.

The data shows how the number of carats is related to the percentage of gold.

number of carats	percentage of gold
24	100
22	92
18	75
9	38

On the grid provided, draw a graph of the percentage of gold against the number of carats.

(2)



(iii) A gold ring is 14 carat gold.

Use the graph to determine the percentage of gold in the ring.

(1)

.....

(*c) Metals are obtained from the Earth's crust by different methods.

Some metals are found uncombined but others have to be extracted from their ores by electrolysis or by heating the ore with carbon.

Explain, using aluminum, gold and iron as examples, how the method used to obtain the metal is related to its position in the reactivity series and to the cost of the extraction process.

(6)

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(Total for question = 12 marks)

Q49.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

When chromium reacts with oxygen, chromium oxide is formed.

(i) Write the word equation for this reaction.

(1)

..... + ... →
.....

(ii) What type of reaction occurs when chromium reacts with oxygen?

(1)

☐ **A** condensation

☐ **B** evaporation

☐ **C** neutralisation

☐ **D** oxidation

(iii) Calculate the relative formula mass of chromium oxide, Cr_2O_3.

(relative atomic masses: O = 16, Cr = 52)

(2)

.....

.....

relative formula mass = ...

(Total for question = 4 marks)

Q50.

Metals are extracted from substances naturally occurring in the Earth's crust.

Zinc can be extracted by heating zinc oxide with carbon.

The products are zinc and carbon dioxide.

(i) Write the word equation for this reaction.

(2)

.....

.....

(ii) In this reaction zinc oxide loses oxygen.

State the type of reaction taking place when an oxide loses oxygen.

(1)

.....

(Total for question = 3 marks)

Q51.

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)

.....

.....

(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

(Total for question = 3 marks)

Q52.

When nitrogen and hydrogen are reacted together, the reaction can reach a dynamic equilibrium.

Use words from the box to complete the sentences about dynamic equilibrium.

(2)

backward	different	equal	faster	reversible

In a dynamic equilibrium two reactions occur at the same time.

These are the forward reaction and the ..... reaction.

The rates of the two reactions are ..... .

(Total for question = 2 marks)

Q53.

Iron is extracted by heating iron oxide with carbon.
Electrolysis of molten iron oxide is not used to extract iron.

(i) State why iron can be extracted by heating iron oxide with carbon.

(1)

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(ii) State why electrolysis is **not** used to extract iron.

(1)

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(Total for question = 2 marks)

Q54.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Sodium reacts with hydrochloric acid to form sodium chloride and hydrogen.

(i) Write the word equation for this reaction.

(2)

..... → .....

(ii) The hazard symbol shown in Figure 1 is used on containers of sodium.



Figure 1

What is the meaning of this hazard symbol?

(1)

- ☒ **A** corrosive
- ☒ **B** flammable
- ☒ **C** oxidising
- ☒ **D** toxic

(iii) Hydrogen has one electron in its electron shell.

Figure 2 shows the incomplete dot and cross diagram of a hydrogen molecule.

Complete Figure 2 to show the electrons in the covalent bond between the two atoms of hydrogen.

(1)

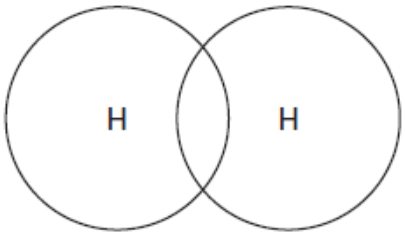


Figure 2

(Total for question = 4 marks)

Q55.

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)

.....

(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)

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.....

(Total for question = 2 marks)

Q56.

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

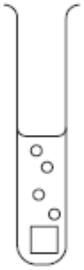
Use this information to put the four metals in order of reactivity from the least reactive to the most reactive.

(2)

least reactive | | | | | **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)



(Total for question = 4 marks)

Q57.

Covalent substances can be simple molecular covalent or giant covalent.

(i) Ammonia is a simple molecular, covalent substance.

Which is the most likely set of properties for ammonia?

(1)

	melting point in °C	boiling point in °C	ability to conduct electricity in liquid state
☒ **A**	1713	2950	does not conduct
☒ **B**	−78	−33	does not conduct
☒ **C**	−39	357	conducts
☒ **D**	801	1413	conducts

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

(2)

.....

(Total for question = 3 marks)