PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 5: SEPARATE CHEMISTRY 1 (PACK 2)

SCORE	PERCENTAGE
/207	%

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Q1.

Compounds

(a) (i) Balance the equation for the reaction between sodium and chlorine to produce sodium chloride by putting numbers in the spaces provided.

(2)

..... $Na + Cl_2 \rightarrow$ ..... $NaCl$

(ii) In an experiment to make sodium chloride, the yield is 2.5 g.
The theoretical yield of sodium chloride for this experiment is 4.0 g.

Calculate the percentage yield of sodium chloride in this experiment.

(2)

.....

.....

.....

percentage yield = ... %

(iii) Sodium chloride has a high melting point.
Sodium chloride does not conduct electricity when solid but does conduct electricity when molten.

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

These properties show that the structure of sodium chloride is

(1)

☒ **A** ionic

☒ **B** giant molecular, covalent

☒ **C** simple molecular, covalent

☒ **D** metallic

(iv) Calculate the relative formula mass of sodium chloride, NaCl. (relative atomic masses: Na = 23, Cl = 35.5)

(1)

.....

relative formula mass = ...

(b) Calculate the percentage by mass of magnesium in magnesium sulfate, $MgSO_4$.

(relative atomic masses: O = 16, Mg = 24, S = 32

relative formula mass: $MgSO_4$ = 120)

(2)

.....

.....

.....

percentage of magnesium = ... %

(c) The formula of a molecule of ethane is C_2H_6.

(i) Give the empirical formula of ethane.

(1)

.....

(ii) Ethane is a simple molecular, covalent compound.

Ethane has a low boiling point.

Explain, in terms of particles it contains, why ethane has a low boiling point.

(2)

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(Total for question = 11 marks)

Q2.

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)

Q3.

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)

Q4.

The fertiliser ammonium phosphate was made by reacting ammonia solution with dilute phosphoric acid.

(i) In the first step, 25 cm^3 of dilute phosphoric acid was placed in a beaker.

Give the name of a piece of apparatus that could be used to measure out the 25 cm^3 dilute phosphoric acid.

(1)

.....

(ii) Complete the word equation for this reaction.

(1)

ammonia + ... → .....

(iii) Some ammonium phosphate solution was made.

Describe how pure, dry crystals of ammonium phosphate are obtained from the ammonium phosphate solution.

(2)

.....

.....

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.....

(Total for question = 4 marks)

Q5.

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.

(Total for question = 6 marks)

Q6.

* Describe the experimental procedure to carry out a titration to find the exact volume of sulfuric acid needed to neutralise 25.0 cm^3 of sodium hydroxide solution and obtain pure, dry crystals of sodium sulfate.

(6)

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(Total for question = 6 marks)

Q7.

Figure 12 shows a graph of the relative strength of aluminium-magnesium alloys when the percentage by mass of magnesium in the alloy is changed.

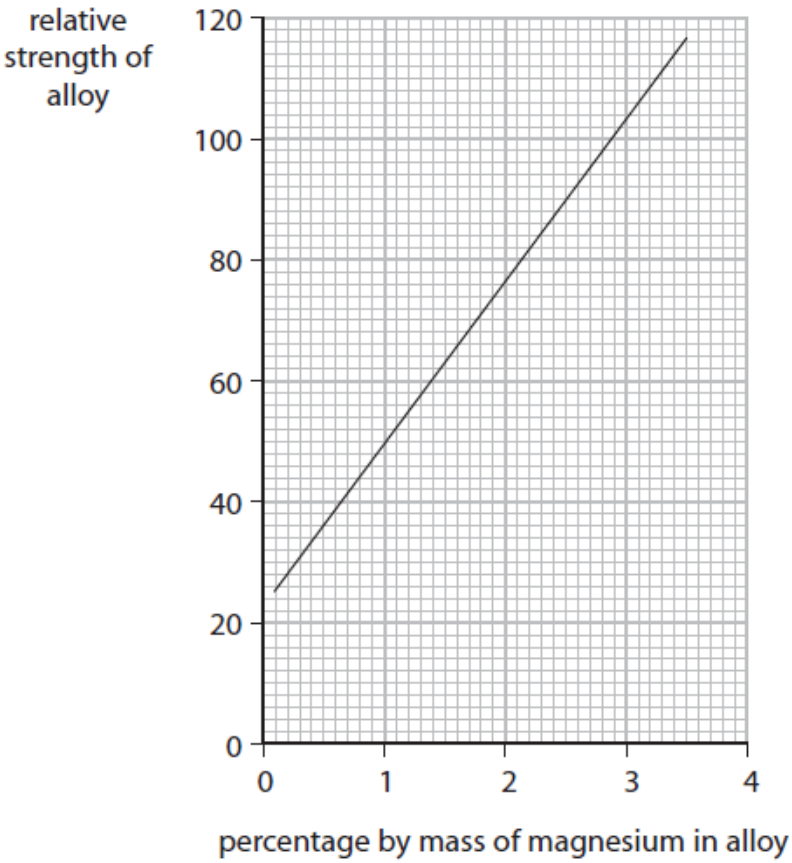


Figure 12

(i) Describe what Figure 12 shows about the relative strength of these alloys when the percentage by mass of magnesium changes.

(2)

.....

.....

.....

(ii) Determine, using Figure 12, the percentage by mass of aluminium in an aluminium-magnesium alloy with a relative strength of 103.

(2)

.....

.....

percentage by mass of aluminium = ...

(Total for question = 4 marks)

Q8.

Figure 5 shows a graph of the relative strength of aluminium-magnesium alloys when the percentage by mass of magnesium in the alloy is changed.

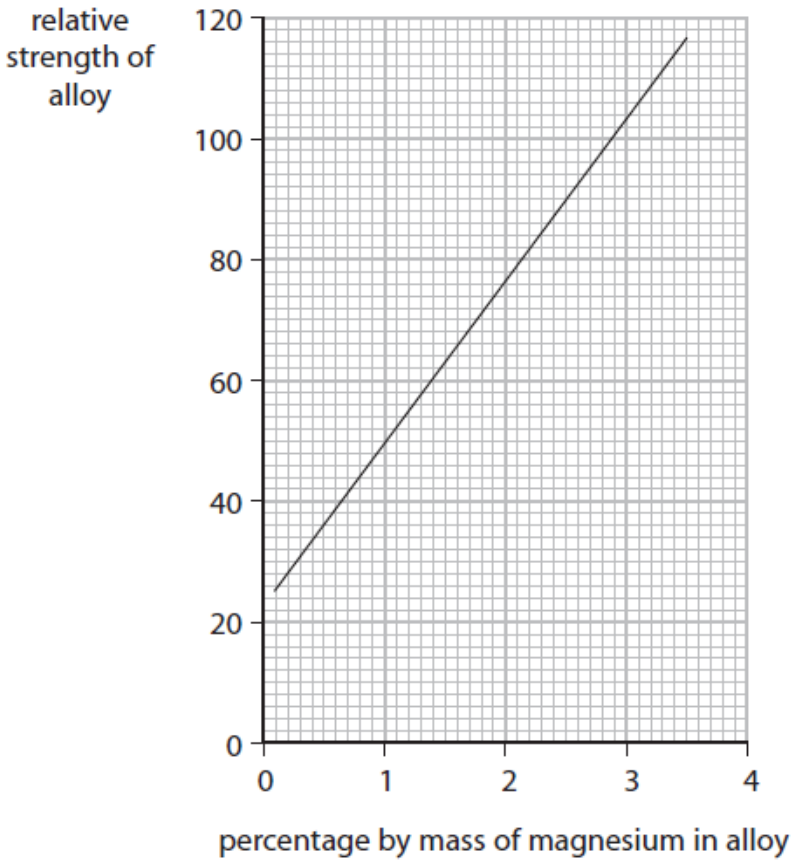


Figure 5

(i) Describe what Figure 5 shows about the relative strength of these alloys when the percentage by mass of magnesium changes.

(2)

.....

.....

.....

(ii) Determine, using Figure 5, the percentage by mass of aluminium in an aluminium-magnesium alloy with a relative strength of 103.

(2)

.....

.....

percentage by mass of aluminium = ...

(Total for question = 4 marks)

Q9.

Copper is a transition metal.

Magnesium reacts with copper sulfate solution to form copper and a solution of magnesium sulfate.
Magnesium sulfate solution is colourless.

Describe **two** changes you would **see** during this reaction.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

Q10.

A torch contains a chemical cell.
The torch is turned on and then left on for many hours.

Describe what you would see happen when the torch is turned on and then left for many hours.

(2)

.....

.....

(Total for question = 2 marks)

Q11.

Alloys of gold are often used to make jewellery.
The purity of gold is measured in carats.
Different alloys of gold have different carats.

Figure 2 shows the relationship between the purity of gold in carats and the percentage of gold in the alloy.

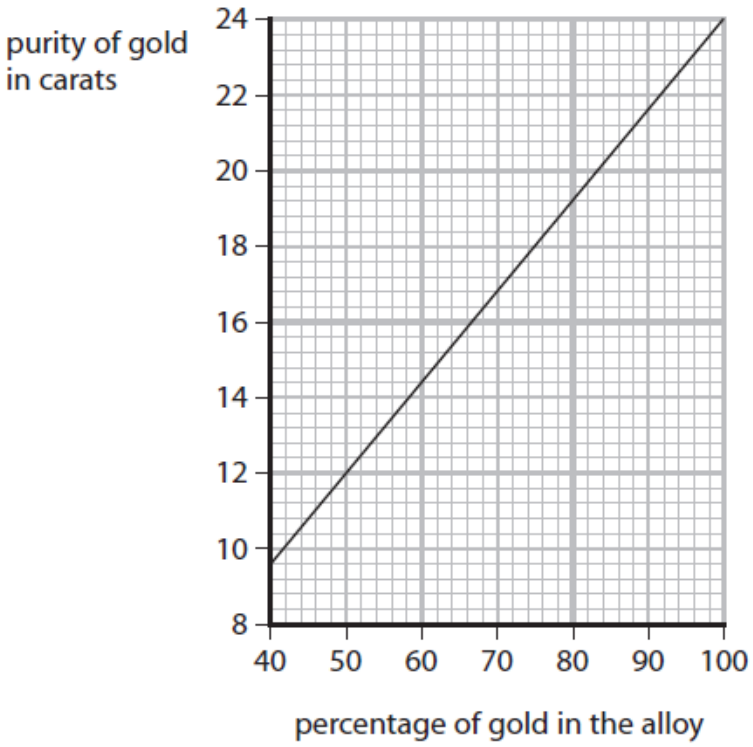


Figure 2

A necklace with a mass of 5.0 g was found to contain 2.9 g of gold.

Determine the purity of the gold necklace in carats.
Show your working.

(3)

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.....

.....

purity of the gold necklace = ... carats

(Total for question = 3 marks)

Q12.

Ammonium sulfate and ammonium nitrate are used as fertilisers as they both contain nitrogen, which will increase the yield of crops.

(i) Suggest **one** other reason for using solid ammonium sulfate and solid ammonium nitrate as nitrogenous fertilisers.

(1)

.....

.....

(ii) Ammonium nitrate can be made by the reaction of ammonia with nitric acid.

Write the balanced equation for this reaction.

(2)

.....

(iii) Describe **one** similarity and **one** difference between the industrial production of ammonium sulfate and the laboratory
preparation of ammonium sulfate.

(2)

similarity .....

.....

difference .....

.....

(Total for question = 5 marks)

Q13.

* Pure metals are often converted into more useful alloys.
For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery.
These processes of alloying change the structures of the metals.

Some properties of pure aluminium, iron and gold are shown in Figure 12.

	density in g cm^{-3}	malleability	relative strength
aluminium	2.70	easy to bend	low
iron	7.75	easy to bend	low
gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(Total for question = 6 marks)

Q14.

Electrolysis

(a) Some metal objects are electroplated to improve their appearance.

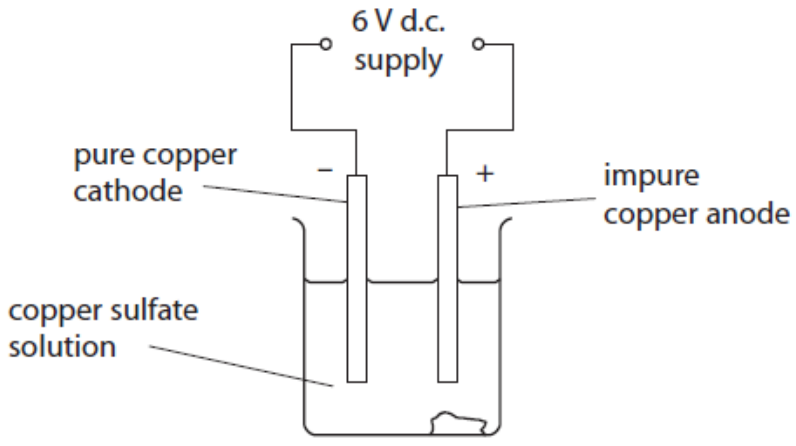
Give another reason why some metal objects are electroplated.

(1)

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.....

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.

The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

(3)

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.....

(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

.....

*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

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(Total for question = 12 marks)

Q15.

A solution of sodium chloride contains the four ions shown in the box.

Na^+	Cl^-	OH^-	H^+

(a) The sodium chloride solution is electrolysed.

Give the formulae of the **two** ions that will be attracted to the positively charged electrode.

(1)

.....

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

When molten lead bromide is electrolysed the products are

(1)

☒ **A** lead and hydrogen

☒ **B** hydrogen and bromine

☒ **C** hydrogen and oxygen

☒ **D** lead and bromine

(c) During electrolysis, oxidation takes place at the anode and reduction takes place at the cathode.

Explain, in terms of electrons, what is meant by **oxidation** and **reduction**.

(2)

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(d) Explain why some metal objects are electroplated.

(2)

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Q16.

The apparatus shown in Figure 13 was used to electroplate a spoon with nickel.

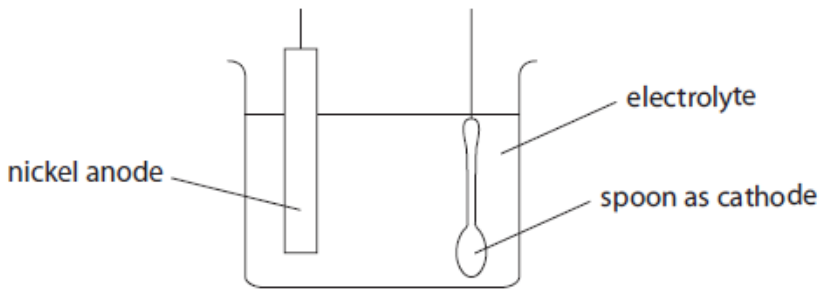


Figure 13

(i) State to what the anode and cathode have to be connected in order to carry out the electroplating.

(1)

.....

(ii) Predict the name of a substance that could be dissolved in water to form the electrolyte for this electroplating.

(1)

.....

(Total for question = 2 marks)

Q17.

Elements in the periodic table

(a) Copper is a metal.

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

In the periodic table copper is in

(1)

☒ **A** group 0

☒ **B** group 1

☒ **C** group 7

☒ **D** the transition metals

(ii) Which of these is a property of copper metal?

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

(1)

☒ **A** does not conduct an electric current

☒ **B** forms colourless compounds

☒ **C** has a low melting point

☒ **D** is malleable

(b) Helium and argon are noble gases.

(i) Choose the correct word from this box to complete the sentence below.

non- flammable	odourless	reactive

(1)

Argon can be used to put out fires because it is .....

(ii) Choose the correct phrase from this box to complete the sentence below.

has a high density	has a low density	is colourless



(1)

Helium is used in airships because it .....

(c) Chlorine, bromine and iodine are halogens.

(i) The table shows the appearance of bromine and iodine at room temperature.

Complete the table to show the appearance of chlorine at room temperature.

(2)

halogen	appearance at room temperature
chlorine	
bromine	dark red liquid
iodine	grey solid

(ii) Chlorine reacts with hydrogen to form hydrogen chloride.

Write the word equation for this reaction.

(2)

..... + ... → .....

(Total for question = 8 marks)

Q18.

*Hydrogen-oxygen fuel cells can be used to provide electrical energy in a spacecraft.

The reaction that takes place in the fuel cell is

$$\text{hydrogen} + \text{oxygen} \rightarrow \text{water}$$

Evaluate the advantages and disadvantages of providing electrical energy in a spacecraft using hydrogen-oxygen fuel cells rather than chemical cells.

(6)

(Total for question = 6 marks)

Q19.

Sodium hydroxide solution reacts with hydrochloric acid.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

(i) 25.0 cm^3 of 0.100 mol dm^{-3} sodium hydroxide, NaOH, solution is added to 35.0 cm^3 of 0.0750 mol dm^{-3} dilute hydrochloric acid, HCl.

Use the information to determine which reagent is in excess.

(3)

(ii) To find the exact amount of dilute hydrochloric acid that reacts with 25.0 cm^3 of the sodium hydroxide solution, a titration is carried out. Figure 14 shows the results for the titrations.

	1st titration	2nd titration	3rd titration	4th titration
final burette reading / cm^3	37.60	36.20	39.15	38.40
initial burette reading / cm^3	1.80	0.00	3.95	2.10
volume of acid used / cm^3	35.80	36.20	35.20	36.30

Figure 14

In this titration, the accurate volumes of acid used that are within 0.20 cm^3 of each other are considered concordant volumes.

Use the concordant results to calculate the mean volume of hydrochloric acid required.

(1)

mean volume = ... cm^3

(iii) During the titration, the indicator used changed colour at the end point.

Which of the following shows an indicator with the colour change that would be seen in this titration?

(1)

		indicator	colour in alkali	colour at end point
☐	**A**	phenolphthalein	colourless	pink
☐	**B**	phenolphthalein	pink	yellow
☐	**C**	methyl orange	red	yellow
☐	**D**	methyl orange	yellow	orange

(Total for question = 5 marks)

Q20.

* The reaction between nitrogen and hydrogen is exothermic.

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

If nitrogen and hydrogen were reacted at 150 atm pressure and 300 °C, without a catalyst, some ammonia would be formed.

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 why the conditions used in the Haber process are better than the first set of conditions for the manufacture of ammonia.

(6)

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(Total for question = 6 marks)

Q21.

Methane reacts with steam to form hydrogen and carbon dioxide.

The reaction takes place in two stages.

stage 1: $CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g)$

stage 2: $CO(g) + H_2O(g) \rightleftharpoons H_2(g) + CO_2(g)$

(i) Stage 1 takes in heat energy, it is endothermic.

Explain the effect of increasing the temperature on the yield of the products of stage 1.

(2)

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.....

(ii) The overall equation for the process is

$$CH_4(g) + 2H_2O(g) \rightarrow 4H_2(g) + CO_2(g)$$

0.40 g of methane were fully reacted with steam to form carbon dioxide and hydrogen.

Calculate the maximum volume of hydrogen in dm^3, measured at room temperature and pressure, that could be made in this reaction.

(relative formula mass: CH_4 = 16, 1 mol of any gas at room temperature and pressure occupies 24 dm^3)

(3)

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maximum volume of hydrogen = ... dm^3

(Total for question = 5 marks)

Q22.

Sulfur trioxide is produced by reacting sulfur dioxide with oxygen.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

(i) This reaction takes place in industry at 1–2 atm pressure and can reach a dynamic equilibrium.

Explain the effect on the rate of attainment of equilibrium, if the process is carried out at a pressure higher than 1–2 atm.

(3)

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.....

(ii) What volume of oxygen, in cm^3, would react completely with 500 cm^3 sulfur dioxide?

(1)

☒ **A** 500 ÷ 2

☒ **B** 500

☒ **C** 500 × 2

☒ **D** 500 × 32

(Total for question = 4 marks)

Q23.

In another stage in the production of nitric acid, ammonia is reacted with oxygen to form nitrogen oxide and water.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

Heat energy is given out when ammonia reacts with oxygen.

The conditions chosen for the reaction are

- excess air, rather than just the right amount
- a pressure of 10 atm, rather than atmospheric pressure
- a temperature of 900 °C, rather than room temperature.

Explain the effect of the conditions chosen on the equilibrium yield of nitrogen oxide and on the rate of attainment of equilibrium.

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(Total for question = 6 marks)

Q24.

* Some gold alloys contain copper.

Copper reacts with oxygen when heated.

copper + oxygen → copper oxide

A teacher calculates that 1.20 g of copper reacts completely with oxygen to form 1.50 g of copper oxide.

A student heats 1.20 g of copper pieces in a container.
Then they heat 1.20 g of copper powder in another container.
After heating, the mass of the solid in the containers is found.

The results are shown in Figure 7.

	colour before heating	mass before heating in g	time of heating in mins	colour after heating	mass after heating in g
copper pieces	red-brown	1.20	5	black	1.28
copper powder	red-brown	1.20	10	black	1.42

Figure 7

Explain the observations and give reasons why the masses after heating are less than expected.

(6)

(Total for question = 6 marks)

Q25.

Duralumin is an alloy of aluminium and copper.

The radii of the aluminium and copper atoms are shown in Figure 11.

	radius of atom / m
aluminium	1.43×10^{-12}
copper	1.27×10^{-12}

Figure 11

Explain why copper added to aluminium to form the alloy makes the alloy stronger than pure aluminium.

(2)

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(Total for question = 2 marks)

Q26.

Alloys of gold are often used to make jewellery.
The purity of gold is measured in carats.
Different alloys of gold have different carats.

Figure 1 shows the percentage of different metals in two samples of gold.

	percentage of metal		
	gold	silver	copper
18 carat gold	75.0	15.0	10.0
24 carat gold	100.0	0.0	0.0

Figure 1

Explain why 18 carat gold is stronger than 24 carat gold.

You may use diagrams to help your answer.

(2)

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.....

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.....

(Total for question = 2 marks)

Q27.

* The hydrogen used in a hydrogen-oxygen fuel cell can be produced from methanol, CH_3OH.

$$CH_3OH + H_2O \leftrightarrow CO_2 + 3H_2$$

In this reaction the forward reaction is endothermic and heat energy is taken in from the surroundings.
The conditions used for this reaction are

- a nickel catalyst
- a temperature of 220 °C

Explain, in terms of their effects on the rate of attainment of equilibrium and the equilibrium yield of hydrogen, why the reaction is carried out using a catalyst at 220 °C rather than without a catalyst at a lower temperature.

(6)

(Total for question = 6 marks)

Q28.

Aluminium alloys are used instead of pure aluminium in aircraft manufacture.

Explain, in terms of the arrangement of metal particles, why aluminium alloys are stronger than pure aluminium.

(3)

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.....

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.....

(Total for question = 3 marks)

Q29.

Aluminium alloys are used instead of pure aluminium in aircraft manufacture.

Explain, in terms of the arrangement of metal particles, why aluminium alloys are stronger than pure aluminium.

(3)

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.....

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(Total for question = 3 marks)

Q30.

(i) Explain why covering iron tools with a thin layer of grease prevents rusting.

(2)

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.....

(ii) Sacrificial protection is another way of preventing rusting.

An example of sacrificial protection is when lumps of zinc are connected to the iron-containing structure of an oil rig.

Explain how the zinc protects the iron from rusting.

(2)

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.....

(Total for question = 4 marks)

Q31.

Alloys are mixtures of two or more metals.

Magnalium is an alloy of magnesium and aluminium.
It is often used for aircraft parts.

(i) Figure 4 shows information about pure aluminium and magnalium.

substance	density in g cm^{-3}	relative strength	resistance to corrosion
aluminium	2.7	low	high
magnalium	2.0	high	very high

Figure 4

Explain, using the information in Figure 4, why magnalium, rather than pure aluminium, is used for aircraft parts.

(3)

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(ii) 63.0 g of magnalium contains 3.15 g of magnesium.

Calculate the percentage by mass of magnesium in the magnalium.

(2)

.....

.....

.....

.....

percentage of magnesium in the magnalium = ...

(Total for question = 5 marks)

Q32.

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 ☒.

Iron rusts when it is left in certain conditions.

(i) Figure 9 shows the apparatus used to investigate the rusting of some iron nails.

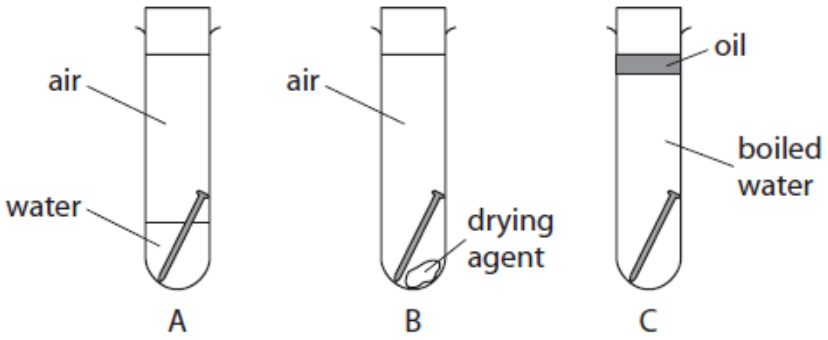


Figure 9

Explain why the iron nail in tube A would rust but the iron nails in tubes B and C would not rust.

(3)

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(ii) Magnesium is more reactive than iron.

Figure 10 shows an iron nail with a strip of magnesium wrapped around it, placed in some water. The tube was left for a few days.

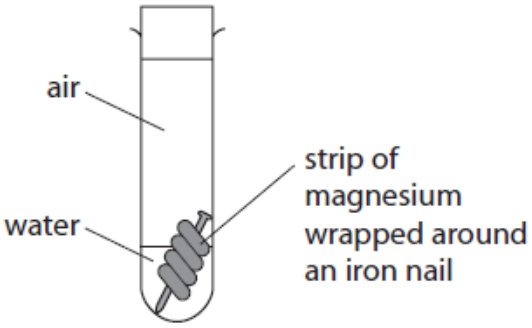


Figure 10

State what would happen to this iron nail.

(1)

.....

.....

(iii) When iron rusts, a brown solid forms on the surface of the iron.

What happens to the iron as the rust forms?

(1)

☒ **A** the iron is hydrated

☒ **B** the iron is neutralised

☒ **C** the iron is oxidised

☒ **D** the iron is reduced

(Total for question = 5 marks)

Q33.

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

potassium hydroxide + hydrochloric acid → potassium chloride + water

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

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)

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(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)

.....

.....

percentage yield = ...

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

(1)

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.....

.....

(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)

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atom economy = ... %

(Total for question = 9 marks)

Q34.

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

potassium hydroxide + hydrochloric acid → potassium chloride + water

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

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)

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(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)

.....

.....

.....

percentage yield = ...

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

(1)

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(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)

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atom economy = ... %

(Total for question = 9 marks)

Q35.

An iron bucket is coated in zinc.
Over many years of use, the iron bucket has been scratched and left outside in the rain.

Although some of the zinc coating has been removed to expose iron, the iron bucket has not rusted.

Explain why the iron has not rusted.

(2)

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(Total for question = 2 marks)

Q36.

Fertilisers and ammonia

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

(1)

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

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

(2)

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.....

(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.

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

(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)

.....

(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)

Q37.

(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)

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(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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Q38.

Figure 1 shows the dot and cross diagram for a molecule of ammonia.

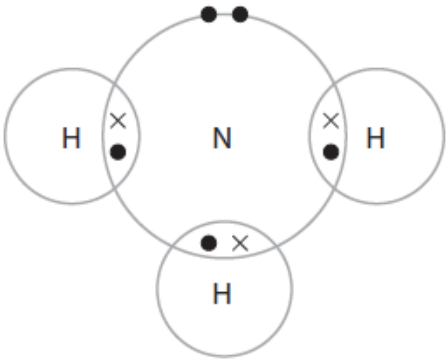


Figure 1

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

..... + ... → .....

(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)

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(Total for question = 4 marks)

Q39.

Bioethanol and hydrogen are fuels that can be used instead of fossil fuels.

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

All fuels **must**

(1)

☒ **A** be liquid at room temperature

☒ **B** burn slowly

☒ **C** produce heat energy when they burn

☒ **D** produce no waste gases when they burn

(b) Hydrogen is used as a fuel in the engines of some vehicles.

In these engines hydrogen reacts with oxygen to form water.

(i) Write the word equation for this reaction.

(2)

.....

(ii) State one advantage of using hydrogen, rather than petrol, as a fuel for vehicles.

(1)

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(iii) Explain one disadvantage of using hydrogen as a fuel for vehicles.

(2)

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Q40.

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)

Q41.

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)

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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)

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*(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)

Q42.

The voltage of a cell is 1.5 V.

Give a reason why this voltage of the cell decreases when the cell is left connected in a circuit.

(1)

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(Total for question = 1 mark)

Q43.

Alloys are mixtures of two or more metals.

Brass is an alloy of copper.
Figure 3 shows the brass pins of an electric plug.



(Source: © Adamlee01/Shutterstock)

Figure 3

Brass is harder than copper.

Give a reason why using a harder substance for the pins is an advantage.

(1)

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.....

(Total for question = 1 mark)

Q44.

Give **two** advantages for electroplating some metal objects.

(2)

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(Total for question = 2 marks)

Q45.

Ammonium phosphate and ammonium sulfate are made from ammonia.

These compounds can be used as fertilisers.

Give **one** advantage of using fertilisers made from ammonia rather than using manure.

(1)

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(Total for question = 1 mark)

Q46.

Ammonium nitrate is produced from ammonia and nitric acid on a large scale in industry.

Ammonium nitrate can also be made in the laboratory by titrating ammonia solution with dilute nitric acid.

$$NH_3 \quad + \quad HNO_3 \quad \rightarrow \quad NH_4NO_3$$

Ammonium nitrate crystals can then be obtained by evaporating off some of the water from the solution.

Give **two** reasons why this laboratory method is not suitable for use on a large scale in industry.

(2)

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(Total for question = 2 marks)

Q47.

Hydrogen-oxygen fuel cells, rather than chemical cells, can be used to power some vehicles.

Give **one** advantage of using a hydrogen-oxygen fuel cell, rather than using a chemical cell, to power a vehicle.

(1)

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(Total for question = 1 mark)