PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 5: SEPARATE CHEMISTRY 1 (PACK 1)

SCORE	PERCENTAGE
/146	%

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Q1.

The concentration of dilute sulfuric acid can be determined by titration with sodium hydroxide solution of known concentration.

25.00 cm^3 of dilute sulfuric acid was measured out using a pipette and transferred to a conical flask.

A few drops of methyl orange indicator were added to the acid in the conical flask. Sodium hydroxide solution was added to the acid from a burette until the indicator changed colour.

The titration was repeated until two concordant results were obtained.

The accurate result was the average of the two concordant results.

A brief report of the practical method has been given above.
Further detail can be added to this method to ensure that anyone following the method will obtain an accurate result.

Explain **two** details that could be added to this practical method to ensure an accurate result is obtained.

(4)

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(Total for question = 4 marks)

Q2.

* Large amounts of ethanol are produced in the chemical industry by fermentation and by hydration of ethene.

Figure 8 summarises the two processes for making ethanol on a large scale.

	fermentation of glucose	hydration of ethene
equation	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	$C_2H_4 + H_2O \rightarrow C_2H_5OH$
raw materials	plants	crude oil
raw material renewable	yes	no
temperature	30 – 40 °C	300 °C
pressure	1 atmosphere	65 atmospheres
rate of reaction	slow	fast
purity of product	needs to be fractionally distilled to concentrate the ethanol	pure

Figure 8

Using this information, discuss the possible advantages and disadvantages of producing ethanol by fermentation rather than by hydration of ethene.

(6)

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(Total for question = 6 marks)

Q3.

* Pure metal can be converted into alloys.

In many cases alloys are more useful than pure metals, for example they are stronger. Gold alloys, stainless steel and nitinol are examples of useful alloys.

Describe how alloying improves the usefulness of metals and how strength is increased in terms of structure.

You may use diagrams to help your answer.

(6)

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Q4.

Many elements are useful in everyday life.

Some metallic elements are used in everyday life as alloys rather than as pure metals.

Use words from each of the boxes to complete the sentences in parts (i) and (ii).

(i)

compounds	elements	denser	shinier	mixtures

Alloys made from two metals are ..... .

(1)

(ii)

brass	copper	magnalium	nitrogen	sulfur

Examples of alloys include ..... and ..... .

(1)

(Total for question = 2 marks)

Q5.

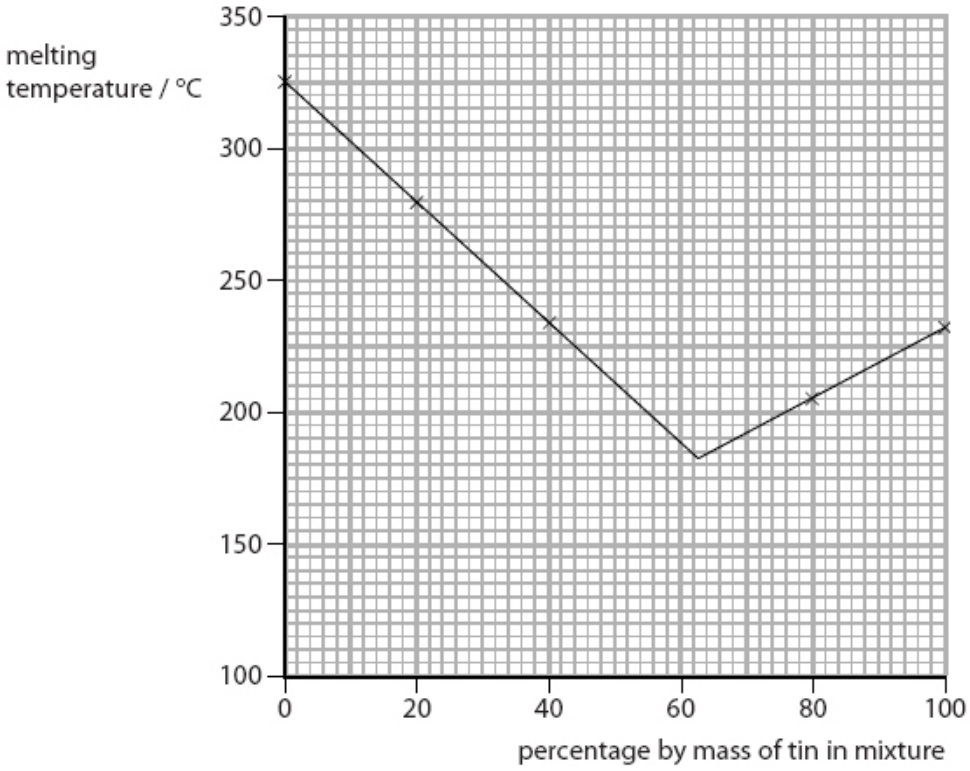
Alloys are made by melting mixtures of metals and then leaving them to solidify.

Tin and lead form an alloy called solder.

Samples of solder containing different amounts of tin and lead were prepared.

The temperature at which each sample started to melt was recorded as the melting temperature.

The results are shown on the graph.



(i) Use the graph to find the percentage of tin in the mixture that has the lowest melting temperature.

(1)

.....%

(ii) Describe how the melting temperature changes as the percentage by mass of tin in the mixture increases from 0% to 100%.

(2)

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.....

Q6.

(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

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(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)

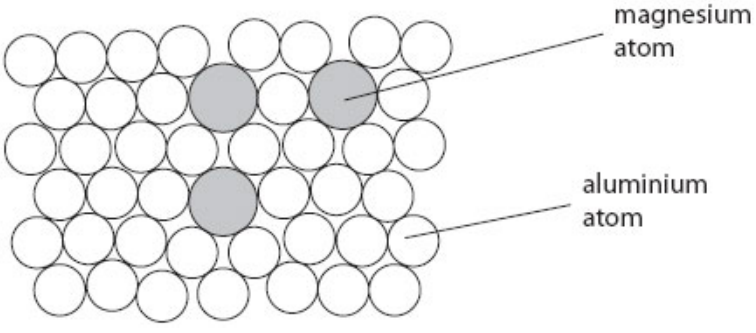
☒ **A** heating with carbon

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

(3)

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(Total for Question = 8 marks)

Q7.

In the Haber process nitrogen and hydrogen are reacted together to form ammonia.

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

The nitrogen used in the Haber process is obtained from

(1)

☒ **A** air

☒ **B** coal

☒ **C** crude oil

☒ **D** sea water

(b) The balanced equation for the reaction forming ammonia is

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

(i) All substances in this reaction are in the same physical state.

Give the name of this physical state.

(1)

.....

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

(1)

.....

.....

(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

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(d) Ammonium sulfate is used as a fertiliser.

State why farmers use fertilisers on their fields.

(1)

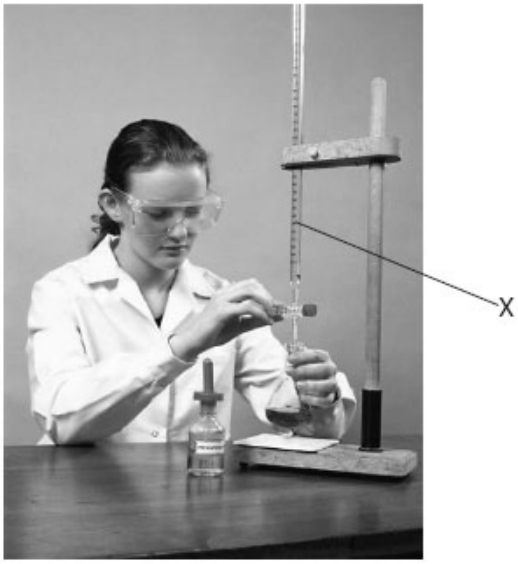
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(e) Titration can be used to determine the exact volume of ammonia solution that reacts with 25.0 cm^3 of sulfuric acid.

The photograph shows a student carrying out a titration.

(1)



(i) Give the name of the piece of apparatus labelled X.

.....

(ii) State what is added to the sulfuric acid to show when it has been neutralised by the ammonia solution.

(1)

.....

(Total for Question = 8 marks)

Q8.

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)

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(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)

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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)

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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)

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(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)

Q9.

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)

Q10.

In the Haber process nitrogen and hydrogen are reacted together to form ammonia.

Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

.....

Q11.

A titration is to be carried out to find the concentration of a solution of sodium hydroxide.

The sodium hydroxide solution is titrated with dilute sulfuric acid.

The available apparatus includes a burette, a pipette, a funnel, a conical flask and an indicator.

(a) State one safety precaution that must be taken when using sodium hydroxide solution and dilute sulfuric acid.

(1)

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(b) The sodium hydroxide solution is made by dissolving 4.3 g of sodium hydroxide in water and making the solution up to 250 cm^3 with water.

Calculate the concentration of the solution in g dm^{-3}.

(2)

concentration = ... g dm^{-3}

(c) Write the balanced equation for the reaction of dilute sulfuric acid, H_2SO_4, with sodium hydroxide.

(2)

.....

(d) The results of titrations to determine how much of an acid is required to neutralise a given volume of an alkaline solution are shown in Figure 14.

	titration 1	titration 2	titration 3	titration 4
final burette reading (cm^3)	27	27.40	29.20	29.30
initial burette reading (cm^3)	0	2.10	4.00	3.50
volume of acid used (cm^3)	27	25.30	25.20	25.80

Figure 14

Two of the titrations in Figure 14 should **not** be used to calculate the mean volume of acid required.

Identify each titration and give a reason why it should not be used in the calculation of the mean.

(2)

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(Total for question = 7 marks)

Q12.

* An experiment is carried out to find what is required to cause an iron nail to rust.

One iron nail is left in each of three test tubes, A, B and C, as shown in Figure 8.

Tube A contains tap water, tube B contains a drying agent, tube C contains water which has been boiled to remove air and then covered by a layer of oil.

The test tubes are left for one week.

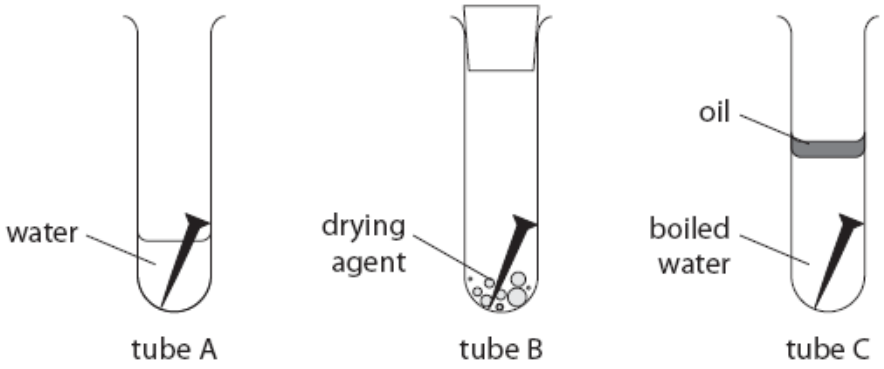


Figure 8

The results are shown in Figure 9.

tube A	tube B	tube C
a red-brown deposit is seen on the nail and at the bottom of the tube	no change	no change

Figure 9

Analyse the results shown in Figure 9 to explain what is required for iron to rust.

(6)

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(Total for question = 6 marks)

Q13.

Many metals corrode.

An experiment is carried out to see if magnesium ribbon wrapped around a piece of iron rod has an effect on the rate at which the iron rod rusts.

The apparatus is shown in Figure 4.

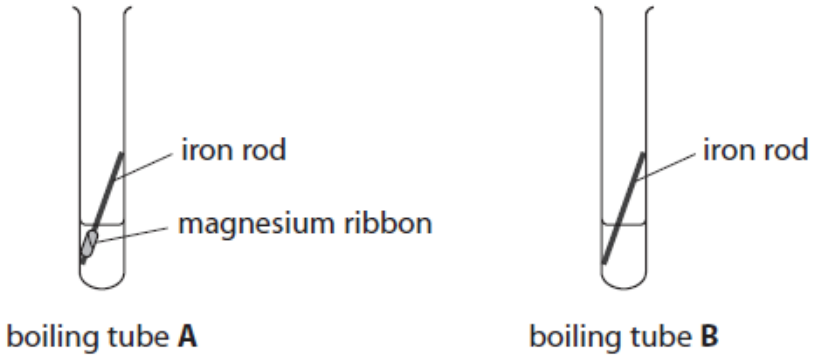


Figure 4

The method used is

- an iron rod, with magnesium ribbon wrapped around it, is placed in a boiling tube labelled **A**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube
- an identical rod but with no magnesium ribbon wrapped around it is placed in a second boiling tube labelled **B**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube.

Both boiling tubes are left for a few days.

(i) Explain why iron rod rather than stainless steel rod is used in this experiment.

(2)

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(ii) State why it is not necessary to use a pipette to measure out 10 cm^3 water in this experiment.

(1)

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(iii) After a few days the two boiling tubes were examined.

The results are shown in Figure 5.

boiling tube A	the appearance of the iron rod is unchanged the magnesium has started to disappear
boiling tube B	a small amount of brown deposit has formed around the rod

Figure 5

Explain the results of this experiment.

(2)

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(Total for question = 5 marks)

Q14.

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

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

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

Give your answer to two significant figures.

(4)

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atom economy = ... %

(Total for question = 4 marks)

Q15.

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

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

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

Give your answer to two significant figures.

(4)

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atom economy = ... %

(Total for question = 4 marks)

Q16.

(a) Calcium nitrate solution reacts with sodium carbonate solution.
The products are calcium carbonate and another salt.

Write the word equation for this reaction.

(2)

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

The colour produced in a flame test by calcium ions is

(1)

☒ **A** green

☒ **B** lilac

☒ **C** orange-red

☒ **D** yellow

(ii) Describe how a flame test is carried out on a solid.

(2)

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(c) If calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

If 100 g of calcium carbonate is heated a calculation shows that 44 g carbon dioxide should be formed.

(i) In an experiment 100 g of calcium carbonate was heated and only 40 g carbon dioxide was formed.

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

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percentage yield of carbon dioxide =.....%

(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

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

Ionic compounds

(1)

☒ **A** conduct electricity when solid

☒ **B** do not conduct electricity when molten

☒ **C** have low boiling points

☒ **D** have high melting points

(Total for Question = 9 marks)

Q17.

Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.

$$Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$$

The theoretical yield of lead sulfate for this reaction was 2.85 g.
The actual yield of lead sulfate obtained was 2.53 g.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield = ... %

(Total for question = 3 marks)

Q18.

(a) Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.

$$Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$$

In an experiment, the theoretical yield of lead sulfate for this reaction was 2.85 g. In the experiment only 2.53 g of lead sulfate is obtained.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield = ...%

(b) The method used to make the lead sulfate is:

- pour 100 cm^3 lead nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate is seen
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid lead sulfate onto a filter paper.

Explain **two** ways of improving this experimental method in order to increase the amount and quality of lead sulfate that could be obtained from 100 cm^3 of lead nitrate solution.

(4)

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(Total for question = 7 marks)

Q19.

Solder is an alloy of tin and lead.

A sample of a solder was made by mixing 22.5 g of lead with 15.0 g of tin.

Calculate the percentage of tin in this solder.

(2)

percentage of tin = ... %

(Total for question = 2 marks)

Q20.

Another student carried out the titration accurately.

12.15 cm^3 of dilute sulfuric acid with a concentration of 0.140 mol dm^{-3} reacted completely with 25.00 cm^3 of potassium hydroxide solution.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

Calculate the concentration of this potassium hydroxide solution.

(4)

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.....

concentration of potassium hydroxide solution = ... mol dm^{-3}

(Total for question = 4 marks)

Q21.

In a titration, 25.0 cm^3 of a different sodium hydroxide solution is titrated with 0.200 mol dm^{-3} sulfuric acid, H_2SO_4.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

24.80 cm^3 of acid are required to neutralise 25.0 cm^3 of the sodium hydroxide solution.

Calculate the concentration of the sodium hydroxide solution, NaOH, in mol dm^{-3}.

(4)

concentration = ... mol dm^{-3}

(Total for question = 4 marks)

Q22.

A 695.0 g sample of an aluminium-magnesium alloy contains 2.00 % by mass of magnesium.

Calculate the mass of aluminium in this sample.

(2)

.....

.....

mass of aluminium = ... g

(Total for question = 2 marks)

Q23.

A 695.0 g sample of an aluminium-magnesium alloy contains 2.00% by mass of magnesium.

Calculate the mass of aluminium in this sample.

(2)

.....

.....

mass of aluminium = ... g

(Total for question = 2 marks)

Q24.

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

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

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

(1)

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mass of carbon dioxide = ... g

(Total for question = 1 mark)

Q25.

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

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

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

(1)

.....

.....

.....

mass of carbon dioxide = ... g

(Total for question = 1 mark)

Q26.

A gold alloy contains 78 % gold by mass.

Calculate the mass of gold in 2.00 kg of this alloy.
Give your answer in grams.

(3)

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.....

.....

mass = ... g

(Total for question = 3 marks)

Q27.

Gold is often alloyed with other metals when it is used to make jewellery.

The proportion of gold in a piece of gold jewellery is measured in carats.

Pure gold is 24 carats.

A 9 carat gold ring has a mass of 12 g.

Calculate the mass of gold in this ring.

(2)

mass of gold ring = ... g

(Total for question = 2 marks)

Q28.

In an experiment, ammonia gas is made by heating a mixture of ammonium chloride and calcium hydroxide.

$$2NH_4Cl(s) + Ca(OH)_2(s) \rightarrow CaCl_2(s) + 2NH_3(g) + 2H_2O(l)$$

10.0 g of ammonium chloride is added to an excess of calcium hydroxide.

Calculate the maximum volume of ammonia gas that could be formed.

(relative atomic mass H = 1.00, N = 14.0, O = 16.0 and Ca = 40.0; one mole of any gas occupies 24 dm^3 at room temperature and pressure)

(2)

volume = ... dm^3

(Total for question = 2 marks)

Q29.

In one stage of the production of nitric acid, nitrogen oxide, NO, is reacted with oxygen to make nitrogen dioxide, NO_2.

$$2NO + O_2 \rightarrow 2NO_2$$

Calculate the minimum volume of air, measured at room temperature and pressure, required to react with 1000 g nitrogen oxide to form nitrogen dioxide.

Assume that the air contains 20% oxygen by volume.
(relative atomic masses: N = 14, O = 16
1 mol of gas occupies 24 dm^3 at room temperature and pressure)

(4)

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volume of air = ... dm^3

(Total for question = 4 marks)

Q30.

A different solution of potassium hydroxide had a concentration of 0.175 mol dm^{-3}.

This potassium hydroxide solution was made by dissolving 2.56 g of impure potassium hydroxide to form 250 cm^3 of solution.

Calculate the percentage by mass of potassium hydroxide in the impure potassium hydroxide.

(relative formula mass: KOH = 56.0)

(3)

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percentage by mass of potassium hydroxide = ...

(Total for question = 3 marks)

Q31.

Transition metals have many uses.

The pie chart in Figure 6 shows the uses of one transition metal.

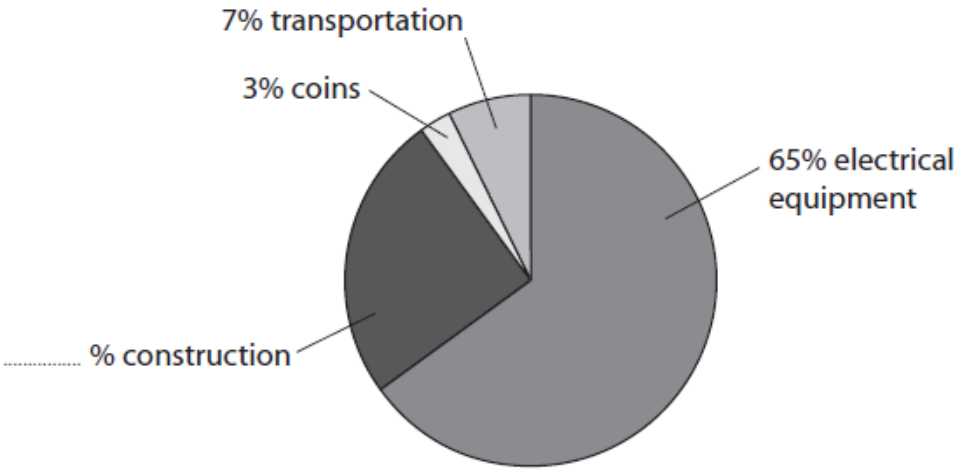


Figure 6

Calculate the percentage of this transition metal used in construction.

(1)

.....

percentage of this transition metal used in construction = ...

(Total for question = 1 mark)

Q32.

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

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

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

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

Calculate the percentage yield of calcium oxide.

(2)

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.....

percentage yield = ...

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

A possible reason for this is that

(1)

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

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

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

☒ **D** the decomposition was incomplete

(Total for question = 3 marks)

Q33.

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

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

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

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

Calculate the percentage yield of calcium oxide.

(2)

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percentage yield = ...

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

A possible reason for this is that

(1)

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

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

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

☒ **D** the decomposition was incomplete

(Total for question = 3 marks)

Q34.

The theoretical maximum yield of zinc oxide was 1.86 g.

The actual yield was 1.63 g.

Calculate the percentage yield of zinc oxide.

(2)

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.....

.....

percentage yield = ...

(Total for question = 2 marks)

Q35.

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

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

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

(2)

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.....

.....

relative formula mass = ...

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

(2)

.....

.....

.....

atom economy = ... %

(Total for question = 4 marks)

Q36.

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

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

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

(2)

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relative formula mass = ...

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

(2)

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.....

.....

atom economy = ... %

(Total for question = 4 marks)

Q37.

Calculate the volume of 48 g of oxygen at room temperature and pressure.

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

(2)

.....

.....

.....

.....

volume of oxygen = ... dm^3

(Total for question = 2 marks)

Q38.

A student was asked to plan a titration experiment to find the exact volume of hydrochloric acid that would neutralise 25.0 cm^3 of sodium hydroxide solution.

The student used 25.0 cm^3 of 0.50 mol dm^{-3} sodium hydroxide solution, NaOH, in the titration.

22.85 cm^3 of hydrochloric acid was required to neutralise the sodium hydroxide solution.

The equation for the reaction is

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

Calculate the concentration, in mol dm^{-3}, of the hydrochloric acid, HCl.
Give your answer to 3 significant figures.

(4)

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.....

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.....

concentration = ... mol dm^{-3}

(Total for question = 4 marks)

Q39.

Some elements in the periodic table are called transition metals.

The density of an object is given by the formula

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Figure 3 gives the density of iron and of water.

substance	density in g cm^{-3}
iron	7.87
water	1.00

Figure 3

(i) Calculate the mass of a cube of iron with the dimensions

10.0 cm × 10.0 cm × 10.0 cm.

(3)

.....

.....

.....

.....

.....

.....

mass = ... g

(ii) An iron cube is electroplated with nickel.

The cube is placed in water.

Suggest what you would **see** if this cube is left in the water for one week.

(1)

.....

.....

(iii) A piece of impure zinc contains 1.20 kg of zinc and 50 g of impurity.

Calculate the percentage by mass of pure zinc in this sample.

(3)

.....

.....

.....

.....

.....

.....

percentage by mass of pure zinc = ...

(Total for question = 7 marks)

Q40.

In an experiment to prepare some ammonium chloride crystals, it is calculated that the maximum mass of ammonium chloride produced from the mass of ammonia used should be 24.60 g.

In the experiment, the actual yield was 17.73 g.

Calculate the percentage yield, giving your answer to **three** significant figures.

(3)

.....

.....

.....

.....

.....

.....

percentage yield = ...

(Total for question = 3 marks)

Q41.

In an experiment to prepare some ammonium chloride crystals, it is calculated that the maximum mass of ammonium chloride produced from the mass of ammonia used should be 24.60 g.

In the experiment, the actual yield was 17.73 g.

Calculate the percentage yield, giving your answer to **three** significant figures.

(3)

.....

.....

.....

.....

.....

.....

percentage yield = ...

(Total for question = 3 marks)

Q42.

In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

Sodium carbonate was made in a laboratory experiment.
The theoretical yield of the experiment was 15.0 g.
The actual yield of the experiment was 10.4 g.

(i) Calculate the percentage yield of sodium carbonate in this experiment.

(2)

.....

.....

.....

.....

percentage yield = ...

(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 .....

.....

reason 2 .....

.....

Q43.

A student was asked to plan a titration experiment to find the exact volume of hydrochloric acid that would neutralise 25.0 cm^3 of sodium hydroxide solution.

The concentration of a solution of potassium hydroxide, KOH, is 0.625 mol dm^{-3}.

Calculate the concentration of this solution in g dm^{-3}.
(relative atomic masses: H = 1.0, O = 16, K = 39)

(2)

.....

.....

.....

.....

concentration = ... g dm^{-3}

(Total for question = 2 marks)

Q44.

Titration can be used to determine the exact amount of hydrochloric acid that reacts with a given amount of sodium hydroxide solution.

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



Sodium hydroxide solution is titrated with dilute hydrochloric acid.

The results of the experiment are

volume of sodium hydroxide solution = 25.0 cm^3

volume of 0.100 mol dm^{-3} hydrochloric acid used

rough titration	= 23.1 cm^3
1st titration	= 22.6 cm^3
2nd titration	= 22.8 cm^3

(i) State the volume of hydrochloric acid that must be used to calculate the concentration of sodium hydroxide solution.

(1)

volume of hydrochloric acid =..... cm^3

(ii) In a different experiment, 25.0 cm^3 of sodium hydroxide solution reacted with 23.2 cm^3 of 0.100 mol dm^{-3} hydrochloric acid, HCl.

Calculate the concentration of this sodium hydroxide solution, NaOH, in mol dm^{-3}.

(3)

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

.....

.....

.....

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.....

concentration of sodium hydroxide solution = ...mol dm^{-3}

Q45.

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

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

(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)

.....

.....

.....

.....

.....

.....

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

Q46.

During fermentation glucose, $C_6H_{12}O_6$, reacts to form ethanol, C_2H_5OH, and carbon dioxide.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(relative formula masses: $C_6H_{12}O_6 = 180$, $C_2H_5OH = 46$;
volume of 1 mol of gas at room temperature and pressure = 24 dm^3)

Calculate the maximum volume, in dm^3, of carbon dioxide that can be produced when 75 kg of glucose reacts completely.

(3)

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.....

.....

.....

.....

.....

volume = ... dm^3

(Total for question = 3 marks)

Q47.

The concentration of dilute sulfuric acid can be determined by titration with sodium hydroxide solution of known concentration.

25.00 cm^3 of dilute sulfuric acid was measured out using a pipette and transferred to a conical flask.

A few drops of methyl orange indicator were added to the acid in the conical flask. Sodium hydroxide solution was added to the acid from a burette until the indicator changed colour.

The titration was repeated until two concordant results were obtained.

The accurate result was the average of the two concordant results.

In the titration, 25.00 cm^3 of dilute sulfuric acid reacted with 24.25 cm^3 of 0.200 mol dm^{-3} sodium hydroxide solution, NaOH.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the concentration of the dilute sulfuric acid, H_2SO_4, in mol dm^{-3}.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

concentration of sulfuric acid = ... mol dm^{-3}

(Total for question = 4 marks)

Q48.

The concentration of dilute sulfuric acid can be determined by titration with sodium hydroxide solution of known concentration.

25.00 cm^3 of dilute sulfuric acid was measured out using a pipette and transferred to a conical flask.

A few drops of methyl orange indicator were added to the acid in the conical flask. Sodium hydroxide solution was added to the acid from a burette until the indicator changed colour.

The titration was repeated until two concordant results were obtained.

The accurate result was the average of the two concordant results.

The concentration of some dilute sulfuric acid, H_2SO_4, is 0.250 mol dm^{-3}.

Calculate the concentration of sulfuric acid in this solution in g dm^{-3}.
(relative formula mass: H_2SO_4 = 98)

(2)

.....

.....

.....

concentration of sulfuric acid = ... g dm^{-3}

(Total for question = 2 marks)

Q49.

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.

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

Calculate the mass, in kilograms, of 750 dm^3 of sulfur dioxide, measured at room temperature and pressure.

(relative formula mass: SO_2 = 64;

1 mol of any gas at room temperature and pressure occupies 24 dm^3)

(3)

.....

.....

.....

.....

.....

.....

mass of sulfur dioxide = ... kg

(Total for question = 3 marks)

Q50.

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.

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

Calculate the volume of oxygen needed to react completely with 750 dm^3 of sulfur dioxide.

(all volumes of gases are measured under the same conditions of temperature and pressure)

(1)

.....

.....

.....

volume of oxygen = ... dm^3

(Total for question = 1 mark)

Q51.

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

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

Figure 3

Calculate the accurate volume of acid reacting with the alkali.

(2)

.....

.....

.....

accurate volume of acid reacting ..... cm^3

(Total for question = 2 marks)

Q52.

If calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

If 100 g of calcium carbonate is heated a calculation shows that 44 g carbon dioxide should be formed.

(i) In an experiment 100 g of calcium carbonate was heated and only 40 g carbon dioxide was formed.

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

.....

.....

percentage yield of carbon dioxide =.....%

(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

.....

.....

.....

Q53.

In the Haber process nitrogen and hydrogen are reacted together to form ammonia.

The balanced equation for the reaction forming ammonia is

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

(i) All substances in this reaction are in the same physical state.

Give the name of this physical state.

(1)

.....

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

(1)

.....

.....

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 ☒.

A chemical cell can be made by placing two metals into an electrolyte.

Figure 3 shows how the voltage of a simple chemical cell can be measured.

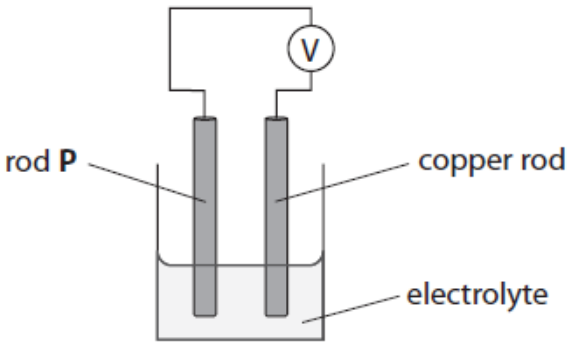


Figure 3

A student investigated how the voltage of this cell was affected by the metal used for the rods.

Which is the only variable that should be changed in the investigation?

(1)

☒ **A** the size of the beaker

☒ **B** the element used for rod **P**

☒ **C** the concentration of the electrolyte

☒ **D** the temperature of the electrolyte

(Total for question = 1 mark)

Q55.

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 ☒.

Hydrogen and oxygen are reactants in some fuel cells.

Which word equation shows the overall reaction that occurs in these fuel cells?

(1)

☒ **A** hydrogen + oxygen → hydroxide

☒ **B** hydrogen + oxygen → sulfuric acid

☒ **C** hydrogen + oxygen → water

☒ **D** hydrogen + oxygen → hydrochloric acid

(Total for question = 1 mark)

Q56.

The concentration of dilute sulfuric acid can be determined by titration with sodium hydroxide solution of known concentration.

25.00 cm^3 of dilute sulfuric acid was measured out using a pipette and transferred to a conical

flask.

A few drops of methyl orange indicator were added to the acid in the conical flask. Sodium hydroxide solution was added to the acid from a burette until the indicator changed colour.

The titration was repeated until two concordant results were obtained.

The accurate result was the average of the two concordant results.

Describe the colour change seen at the end point of the titration.

(1)

from ..... to .....

(Total for question = 1 mark)

Q57.

Hydrogen burns in air at a temperature well above 100 °C to form water.

(i) The boiling points of hydrogen and water are shown in Figure 15.

	boiling point in °C
hydrogen	–253
water	100

Figure 15

Use this information to add the missing state symbols to the equation for the reaction taking place as the hydrogen burns.

(2)

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

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

.....

.....

(Total for question = 3 marks)

Q58.

Hydrogen burns in air at a temperature well above 100 °C to form water.

(i) The boiling points of hydrogen and water are shown in Figure 3.

	boiling point in °C
hydrogen	−253
water	100

Figure 3

Use this information to add the missing state symbols to the equation for the reaction taking place as the hydrogen burns.

(2)

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

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

.....

.....

(Total for question = 3 marks)

Q59.

Complete the half-equation for the reaction taking place at one of the electrodes in a hydrogen-oxygen fuel cell.

(2)

O_2 + ... H^+ + ... →

..... H_2O

(Total for question = 2 marks)

Q60.

Many metals corrode.

When a metal corrodes

(1)

- ☒ **A** the metal reacts with nitrogen
- ☒ **B** the metal reacts with another metal
- ☒ **C** the metal element decomposes
- ☒ **D** the metal is oxidised

(Total for question = 1 mark)