PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



EXAM QUESTION PACK

SECTION 2: INORGANIC CHEMISTRY (PACK 2)

SCORE	PERCENTAGE
/201	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Sodium chloride is a soluble salt.

(a) Name the acid and the alkali that can be used to make sodium chloride.

(2)

acid .....

alkali .....

(b) A teacher drops a bottle containing sodium chloride. The bottle breaks when it

hits the floor. The teacher sweeps up the mixture of sodium chloride and glass.

Describe how the teacher can obtain a pure, dry sample of sodium chloride from the mixture.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q2.

This question is about acids, alkalis and indicators.

(a) Which of these is the colour of litmus indicator in an acidic solution?

(1)

☒ **A** blue

☒ **B** orange

☒ **C** red

☒ **D** yellow

(b) Which of these is the pH value of a neutral solution?

(1)

☒ **A** 0

☒ **B** 4

☒ **C** 7

☒ **D** 14

(c) Which of these describes a solution with a pH value of 9?

(1)

☒ **A** strongly acidic

☒ **B** strongly alkaline

☒ **C** weakly acidic

☒ **D** weakly alkaline

(d) Which of these is the chemical formula of an acid?

(1)

☒ **A** HNO_3

☒ **B** H_2O

☒ **C** NaCl

☒ **D** NaOH

(e) Name the type of reaction that occurs when an acid reacts with an alkali.

(1)

.....

(f) Name the two products of the reaction between hydrochloric acid and potassium hydroxide.

(2)

1 .....

2 .....

(Total for question = 7 marks)

Q3.

This question is about ammonia and ammonium compounds.

(a) Ammonia (NH_3) is a simple covalent molecule.

Draw a dot-and-cross diagram to show the bonding in a molecule of ammonia.

(2)

(b) The table shows the names and formulae of some ammonium compounds.

Name	ammonium sulfate		ammonium carbonate
Formula	$(NH_4)_2SO_4$	NH_4Cl	

(i) Complete the table by giving the missing information.

(2)

(ii) When ammonia reacts with sulfuric acid, ammonium sulfate is formed.

Write a chemical equation for this reaction.

(1)

.....

(iii) Describe a test for ammonium ions.

(3)

.....

.....

.....

.....

.....

.....

(c) The table gives some information about ammonia and ammonium compounds.

Name	Formula	Percentage of nitrogen (%)	Approximate pH in solution
ammonia	$NH_3(g)$	82	11
ammonium nitrate	$NH_4NO_3(s)$		5.5
ammonium sulfate	$(NH_4)_2SO_4(s)$	21	5.5

(i) Calculate the percentage of nitrogen in ammonium nitrate.

[M_r of NH_4NO_3 = 80]

(2)

percentage of nitrogen = ... %

(ii) Fertilisers add nitrogen to the soil to help plants grow.

Ammonia and ammonium sulfate can both be used as fertilisers.

Discuss the advantages and disadvantages of using each of these compounds as fertilisers.

Use information from the table in your answer.

[pH of rainwater is approximately 5.6]

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

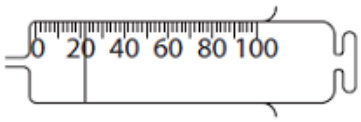
(Total for question = 14 marks)

Q4.

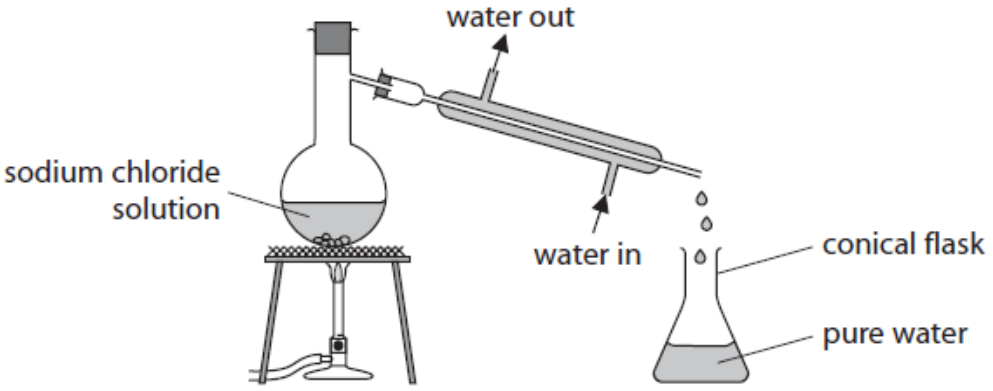
This question is about apparatus used in the laboratory.

(a) Complete the table by giving the name of each piece of apparatus and a unit used for the quantity it measures.

(2)

Apparatus	Name	Unit
		
		

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

.....

.....

.....

.....

(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

.....

.....

.....

.....

(iii) Describe a physical test to show that the liquid in the conical flask is pure water.

(2)

.....

.....

.....

.....

(Total for question = 8 marks)

Q5.

The reactions of metals with water and with dilute sulfuric acid can be used to determine the order of reactivity of the metals.

The table shows the reactions of four metals, W, X, Y and Z, with water and with dilute sulfuric acid.

Metal	Reaction with water	Reaction with dilute sulfuric acid
W	no reaction	no reaction
X	very slow reaction	reacts quickly
Y	no reaction	reacts slowly
Z	reacts quickly	reacts violently

(a) What is the order of reactivity of these metals?

(1)

	most reactive ⟶			least reactive
☒ **A**	W	X	Y	Z
☒ **B**	Z	X	Y	W
☒ **C**	W	Y	X	Z
☒ **D**	Z	Y	X	W

(b) (i) State which metal, W, X, Y or Z, could be copper.

(1)

.....

(ii) State which metal, W, X, Y or Z, could be magnesium.

(1)

.....

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

(2)

1 .....

.....

2 .....

.....

(Total for question = 5 marks)

Q6.

This question is about barium chloride.

(a) Barium chloride can be made by reacting barium carbonate with dilute hydrochloric acid.

The chemical equation for the reaction is

$BaCO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + H_2O(l) + CO_2(g)$

Describe a method to produce dry crystals of hydrated barium chloride, starting with barium carbonate powder and dilute hydrochloric acid.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) A colourless solution contains sodium carbonate and sodium sulfate.

Describe a test using barium chloride to show that the colourless solution contains sulfate ions.

(2)

.....

.....

.....

.....

(Total for question = 8 marks)

Q7.

When iron is left in damp air, rust forms on its surface.

(a) (i) State the chemical name for rust.

(1)

.....

(ii) Explain how a barrier method prevents rusting.

(2)

.....

.....

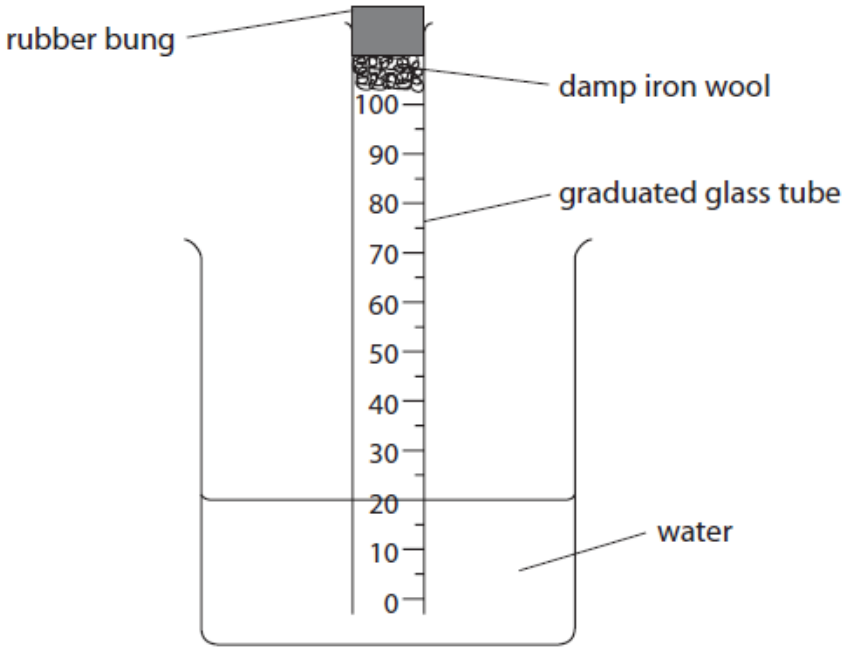
.....

.....

.....

.....

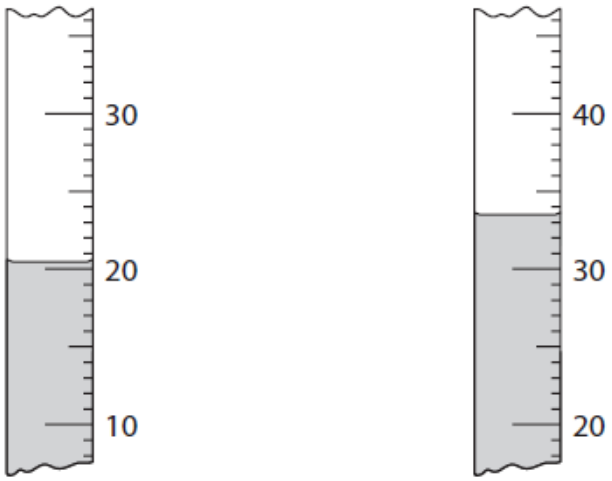
(b) A student uses this apparatus to find the approximate percentage by volume of oxygen in air.



This is the student's method.

- place a graduated glass tube in a beaker of water
- place some damp iron wool and a rubber bung in the top of the tube
- record the reading of the water level in the tube
- leave the apparatus for a few days
- record the reading of the water level again

The diagram shows the readings at the start and at the end of the experiment.



(i) Use the readings to complete the table, giving all values to the nearest 0.5 cm^3.

(2)

reading at start in cm^3	20.5
reading at end in cm^3	
volume of oxygen used in cm^3	

(ii) The student uses these results to calculate the percentage by volume of oxygen in air.

Suggest why her calculated value is lower than the expected value.

(1)

.....

.....

.....

(c) The student repeats the experiment using the same apparatus.

These are her results for the second experiment.

volume of air in tube at start = 80.0 cm^3

reading at start = 20.0

reading at end = 35.5

Use the results to calculate the percentage by volume of oxygen in air.

(3)

percentage = ... %

(Total for question = 9 marks)

Q8.

The table shows the molecular formulae of six organic compounds, A, B, C, D, E and F.

A	B	C	D	E	F
C_2H_4	C_2H_6	C_3H_6	C_3H_8	C_4H_8	C_4H_{10}

(a) (i) Explain which homologous series compound B belongs to.

(2)

.....

.....

.....

(ii) Give the letter of the compound that has the same empirical formula as its molecular formula.

(1)

.....

(iii) Compound F exists as two isomers.

Explain what is meant by the term **isomers**.

Include the structures of the two isomers of compound F in your answer.

(3)

.....

.....

.....

.....

.....

.....

(b) Describe how compound D can be obtained from crude oil using the industrial process of fractional distillation.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Compound C can be used to make a polymer.

(i) State the type of polymer formed from compound C.

(1)

.....

(ii) Name the polymer formed from compound C.

(1)

.....

(iii) Draw the structure of this polymer.

Include the displayed formula of the repeat unit.

(2)

(Total for question = 14 marks)

Q9.

A metal is added to copper(II) sulfate solution.

A displacement reaction only occurs if the metal added is more reactive than copper.

metal + copper(II) sulfate → metal sulfate + copper

Displacement reactions are exothermic. The more reactive the metal added, the greater the temperature rise.

A student uses the following method in an experiment to compare the reactivities of different metals:

- pour some copper(II) sulfate solution into a boiling tube and record its temperature using a thermometer
- add some metal to the tube and stir with the thermometer
- record the maximum temperature of the contents of the tube.

He repeats the method using the same amount, in moles, of different metals.

(a) To make the experiment valid, he starts with the copper(II) sulfate solution and the added metal at the same temperature.

State **two** other variables that must be controlled if the experiment is to be valid.

(2)

1 .....

.....

2 .....

.....

(b) Another student uses the same method three times for each of the metals **E**, **F**, **G** and **H**. The table shows her results for these metals.

Metal	Temperature increase / °C			Mean temperature increase / °C
	1	2	3	
E	7.0	4.0	8.0	7.5
F	0.0	0.0	0.0	0.0
G	6.0	5.0	5.4	
H	5.5	11.0	12.0	

(i) The student calculates the mean temperature increase for metals **E** and **F**.

She does not include anomalous values in her calculations.

Calculate the mean temperature increase for metals **G** and **H**, ignoring any anomalous values. Write your answers in the table.

(2)

(ii) Explain which metal is the most reactive.

(2)

.....

.....

(iii) Explain which metal is less reactive than copper.

(2)

.....

.....

(Total for question = 8 marks)

Q10.

Ethene (C_2H_4) can be converted into chloroethene (C_2H_3Cl) in a two-stage process.

(a) The first stage is to convert ethene into 1,2-dichloroethane, $C_2H_4Cl_2$

Ethene is reacted with hydrogen chloride and oxygen.

Complete the chemical equation for this reaction.

(1)

..... C_2H_4 + ... HCl + ... O_2 → ..... $C_2H_4Cl_2$ + ... H_2O

(b) In the second stage, 1,2-dichloroethane is converted into chloroethene.

$$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$$

This is a thermal decomposition reaction.

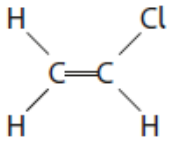
State what is meant by the term **thermal decomposition**.

(1)

.....

.....

(c) The diagram shows the displayed formula of chloroethene.



(i) State why chloroethene is described as an unsaturated compound.

(1)

.....

.....

(ii) Describe a test to show that chloroethene is unsaturated.

(2)

.....

.....

.....

.....

(d) Name the polymer formed from chloroethene.

(1)

.....

(Total for question = 6 marks)

Q11.

This question is about copper and copper compounds.

(a) A sample of copper contains two isotopes.

- Cu-63 with relative abundance 69.5%
- Cu-65 with relative abundance 30.5%

(i) State what is meant by the term **isotopes**.

(2)

.....

.....

.....

.....

(ii) Calculate the relative atomic mass (A_r) of this sample of copper.

Give your answer to three significant figures.

(3)

A_r of copper = ...

(b) When copper(II) carbonate is heated, copper(II) oxide and carbon dioxide are formed.

(i) What is the name of this type of reaction?

(1)

☒ **A** decomposition

☒ **B** neutralisation

☒ **C** oxidation

☒ **D** reduction

(ii) Which colour change occurs during this reaction?

(1)

☒ **A** blue to black

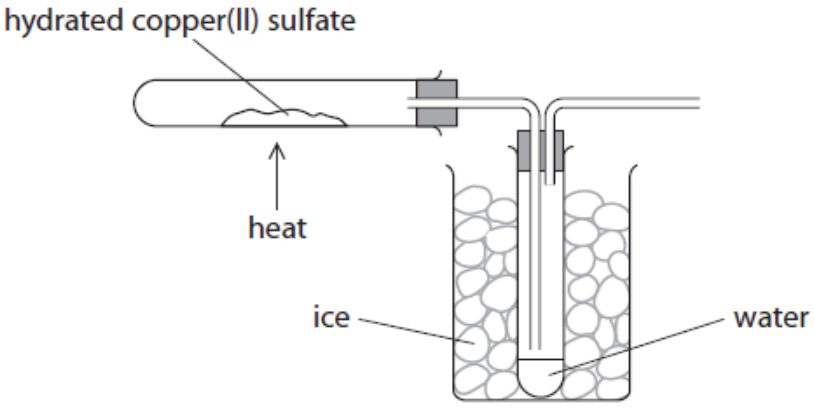
☒ **B** blue to white

☒

C green to black

☒ **D** green to orange

(c) A student uses this apparatus to find the value of x in the formula $CuSO_4.xH_2O$



This is the student's method.

- find the mass of an empty boiling tube
- add hydrated copper(II) sulfate to the tube and record the new mass
- heat the hydrated copper(II) sulfate until it changes colour
- allow the tube to cool and record the mass again

The table shows the student's results.

mass of empty tube in g	20.52
mass of tube and $CuSO_4.xH_2O$ in g	31.77
mass of tube and $CuSO_4$ in g	28.20

(i) Calculate the mass of $CuSO_4$ formed.

(1)

mass of $CuSO_4$ = ... g

(ii) Calculate the mass of water formed.

(1)

mass of water = ... g

(iii) Show that the value of x is approximately 4

[M_r of $CuSO_4$ = 159.5 M_r of H_2O = 18]

(3)

(iv) The actual value of x is 5

Give a reason why the calculated value of x is lower than the actual value.

(1)

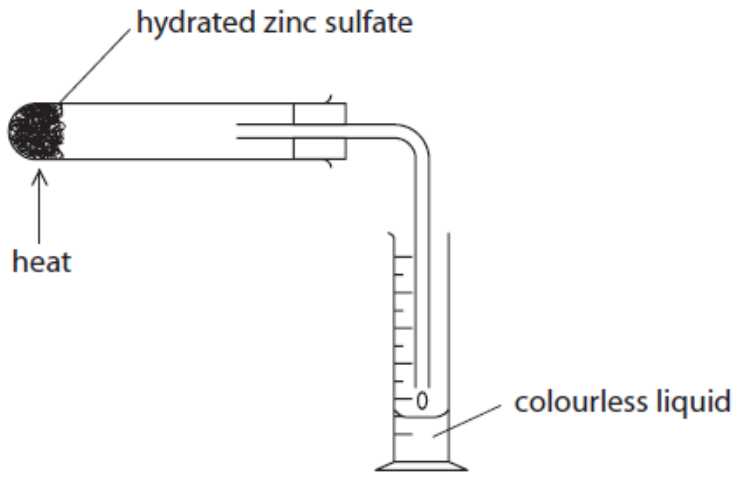
.....

.....

(Total for question = 13 marks)

Q12.

A student uses this apparatus to heat crystals of hydrated zinc sulfate and collect the liquid produced.



(a) (i) Describe a chemical test to show that the colourless liquid contains water.

(2)

.....

.....

.....

.....

(ii) Describe a physical test to show the colourless liquid is pure water.

(2)

.....

.....

.....

.....

(b) The equation for the decomposition of hydrated zinc sulfate is

$$ZnSO_4Â·7H_2O(s) \rightarrow ZnSO_4(s) + 7H_2O(l)$$

The student records these masses.

mass of boiling tube = 41.64 g

mass of boiling tube + $ZnSO_4Â·7H_2O$ = 54.46 g

Calculate the maximum volume, in cm^3, of pure water that could be produced.

[1.00 cm^3 of pure water has a mass of 1.00 g]

[M_r of $ZnSO_4Â·7H_2O$ = 287 M_r of H_2O = 18]

(5)

maximum volume of pure water = ... cm^3

(c) In an experiment using a different mass of $ZnSO_4Â·7H_2O$ the maximum volume of pure water that could be produced is 8.5 cm^3.

The student collected the pure water and calculated the percentage yield to be 20.3 %.

(i) Calculate the volume, in cm^3, of pure water collected.

(1)

volume of pure water = ... cm^3

(ii) Explain an improvement to the apparatus that would increase the percentage yield of pure water.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 12 marks)

Q13.

A solution of hydrogen peroxide decomposes when a catalyst of manganese(IV) oxide is added.

The products of the reaction are water and oxygen.

(a) Complete the chemical equation for this reaction.

(1)

..... H_2O_2 → ..... H_2O + ... O_2

(b) Give a test for oxygen.

(1)

.....

.....

(c) State the reason for adding a catalyst.

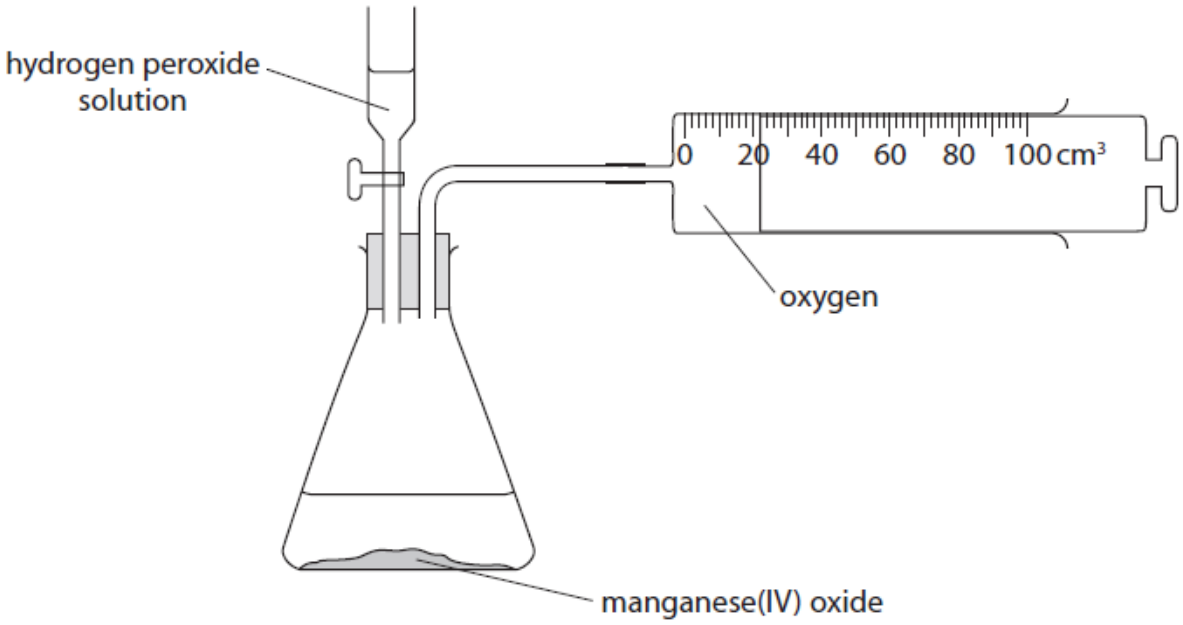
(1)

.....

.....

(d) A student investigates how changing the concentration of the hydrogen peroxide solution affects the rate of this reaction.

She uses this apparatus.



The student records the volume of oxygen that collects every 2 minutes for 16 minutes.

The table shows her results.

Time in minutes	0	2	4	6	8	10	12	14	16
Volume of oxygen in cm^3	0	22	38	50	55	69	76	80	80

(i) Plot the student's results on the grid.

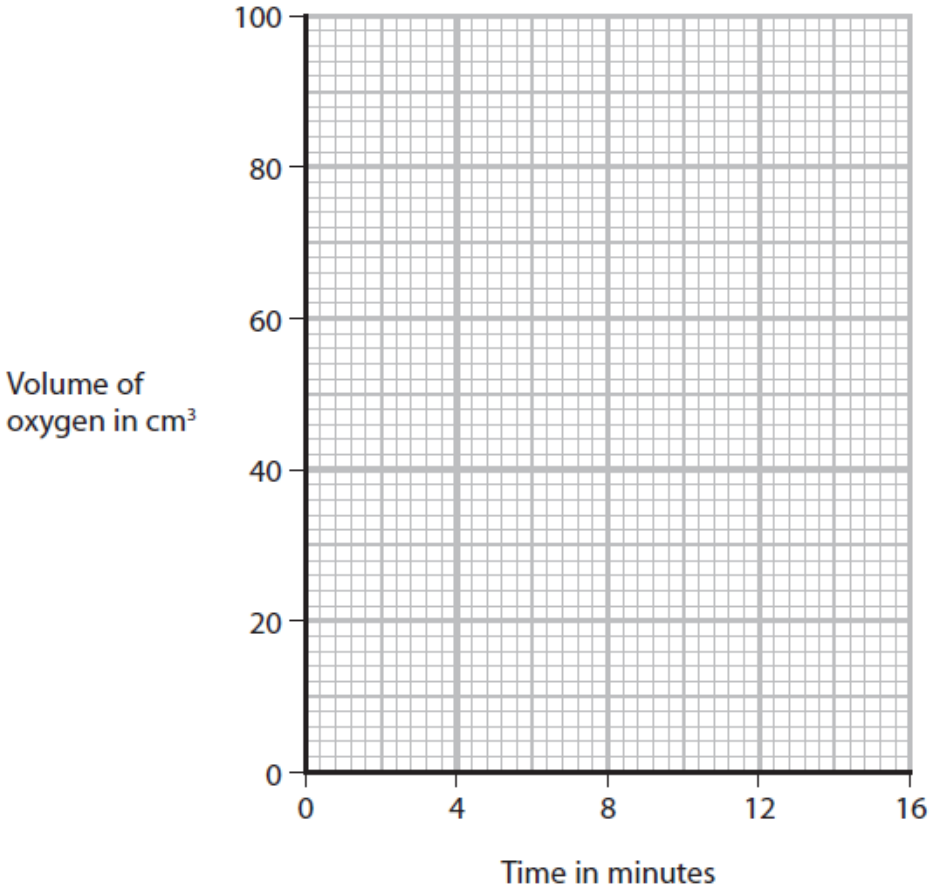
(1)

(ii) Draw a circle on the grid around the anomalous result.

(1)

(iii) Draw a curve of best fit through the points, ignoring the anomalous result.

(1)



(iv) Suggest a mistake that the student might have made to cause the anomalous result.

(1)

.....

.....

.....

(v) Determine the volume of oxygen collected during the first 3 minutes.

Show on your graph how you obtain your answer.

(2)

volume of oxygen = ... cm^3

(e) The student repeats the experiment using hydrogen peroxide solution of half the concentration of the original solution.

She keeps the volume of the hydrogen peroxide solution and all other conditions the same.

(i) Draw on the grid the curve you would expect the student to obtain.

(2)

(ii) Explain how using hydrogen peroxide solution of half the concentration affects the rate of the reaction.

Refer to particle collision theory in your answer.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

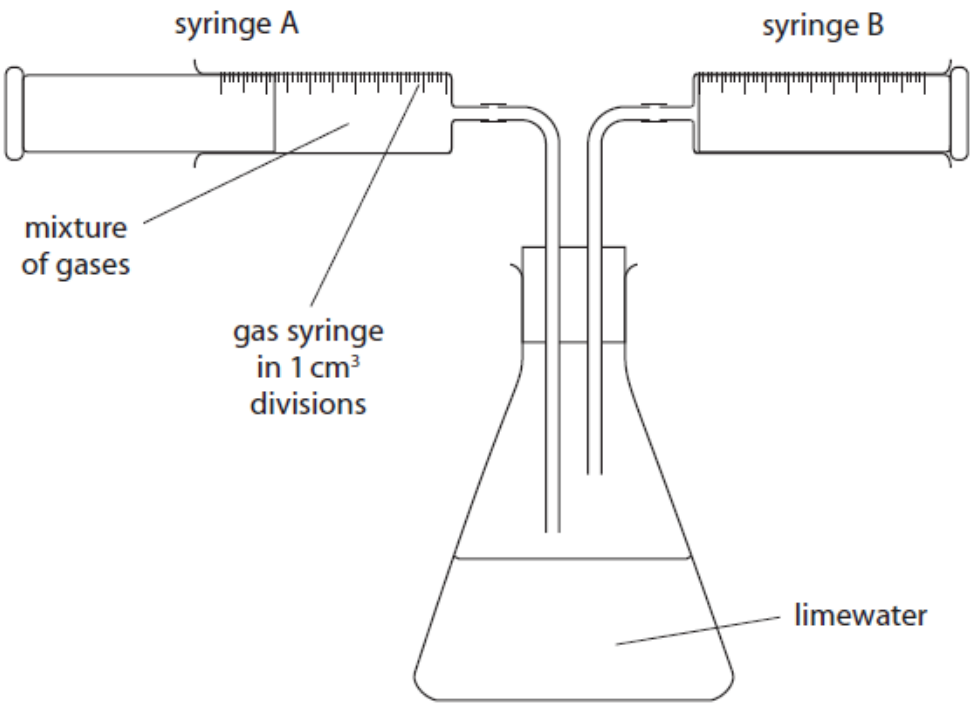
(Total for question = 14 marks)

Q14.

Two experiments are done to determine the percentage composition by volume of a mixture of three gases, carbon dioxide, oxygen and argon.

(a) In experiment 1, a student bubbles the mixture of gases through limewater. Carbon dioxide reacts with limewater.

The diagram shows the apparatus the student uses.



The student pushes the mixture of gases out of syringe A, but no gas bubbles appear in the limewater.

Give one change the student needs to make to the apparatus for gas bubbles to appear in the limewater.

(1)

.....

.....

(b) When the apparatus in experiment 1 is set up correctly, the mixture of gases is bubbled gently through the limewater so that all the carbon dioxide is removed.

The volume of the mixture of gases in syringe A at the start is 76 cm^3.

The volume of the mixture of gases in syringe B at the end is 66 cm^3.

(i) Calculate the percentage by volume of carbon dioxide in the mixture of gases in syringe A.

(2)

percentage of carbon dioxide = ... %

(ii) Give the change in the appearance of the limewater.

(1)

.....

.....

(iii) Explain why the gas syringes in experiment 1 cannot be used to find the percentage of carbon dioxide in a typical sample of air.

(2)

.....

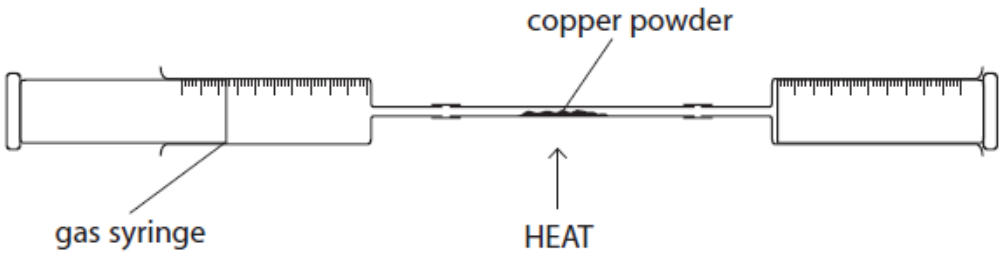
.....

.....

.....

In experiment 2, a teacher pushes the remaining gases over hot copper powder.

The diagram shows the apparatus the teacher uses.



The copper powder turns black as it reacts with oxygen.

Argon is extremely unreactive, so it does not react with copper.

(i) Name the black substance that forms on the copper powder.

(1)

.....

(ii) Suggest why the teacher uses copper powder instead of the same mass of large pieces of copper.

(1)

.....

.....

.....

(iii) Explain why argon is extremely unreactive.

(2)

.....

.....

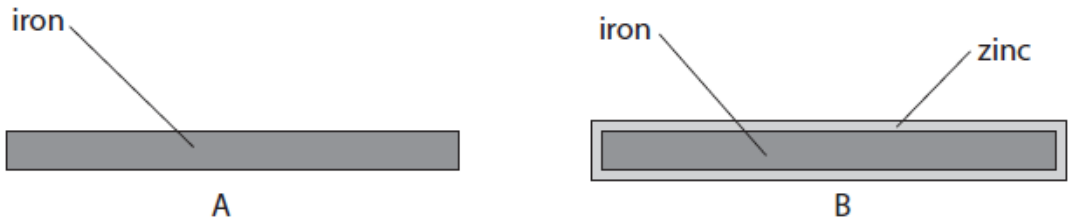
.....

.....

(Total for question = 10 marks)

Q15.

The diagram shows two samples of iron, A and B.



Sample B is coated with a thin layer of zinc.

(a) Name the process used to coat iron with zinc.

(1)

.....

(b) The two samples of iron are left outside for several weeks.

A brown solid containing hydrated iron(III) oxide forms on sample A.

(i) Give the common name for the brown solid.

(1)

.....

(ii) Give the names of the two substances that react with the iron to form the brown solid.

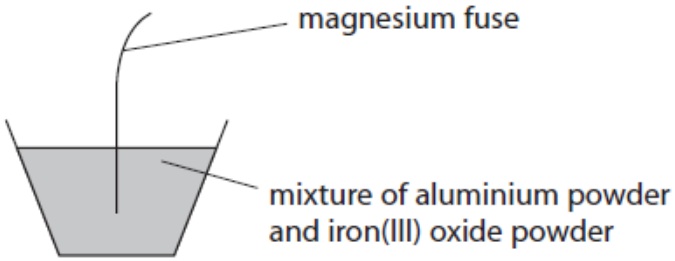
(2)

1 .....

2 .....

(c) Iron can be formed by reacting aluminium powder with iron(III) oxide.

The diagram shows how this reaction can be demonstrated.



When the magnesium fuse is lit, a very exothermic reaction occurs.

(i) State the meaning of the term **exothermic**.

(1)

.....

.....

(ii) The equation for the reaction between aluminium and iron(III) oxide is

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

Explain what this reaction shows about the relative reactivities of aluminium and iron.

(2)

.....

.....

.....

.....

(iii) Explain why the reaction between aluminium and iron(III) oxide is a redox reaction.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 10 marks)

Q16.

(a) Chlorine, bromine and iodine are elements in the Periodic Table.

Explain how the position of these elements in the Periodic Table depends on their electronic

configurations.

(2)

.....

.....

.....

.....

(b) Chlorine reacts with methane to form CH_3Cl and HCl

(i) State the condition necessary for this reaction.

(1)

.....

(ii) Give the equation for this reaction.

(1)

.....

(iii) The bonds in a molecule of CH_3Cl are covalent.

Explain, in terms of electrostatic attractions, what is meant by a covalent bond.

(2)

.....

.....

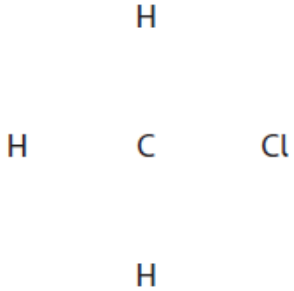
.....

.....

(iv) Draw a dot-and-cross diagram for a molecule of CH_3Cl

Show only the outer electrons of the atoms.

(2)



(v) CH_3Cl has a simple molecular structure.

Explain why CH_3Cl has a low boiling point.

(2)

.....

.....

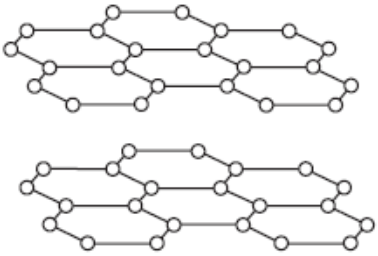
.....

.....

.....

(c) Graphite is another substance that contains covalent bonds.

The diagram shows the structure of graphite.



Most covalent substances do not conduct electricity.

Explain why graphite is able to conduct electricity.

(2)

.....

.....

.....

.....

.....

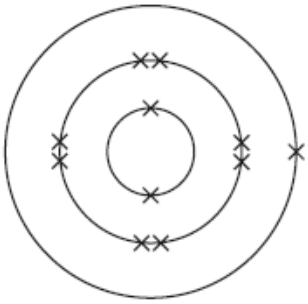
.....

(Total for question = 12 marks)

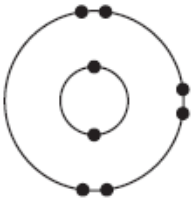
Q17.

This question is about sodium oxide, Na_2O

(a) The diagram shows the electronic configuration of atoms of sodium and oxygen.



Sodium



Oxygen

Describe the changes in the electronic configuration of the atoms of sodium and oxygen to form the ions in sodium oxide.

(3)

.....

.....

.....

.....

.....

.....

(b) Calculate the relative formula mass (M_r) of sodium oxide, Na_2O, using information from the Periodic Table.

(1)

M_r = ...

(c) Explain why solid sodium oxide does not conduct electricity.

(2)

.....

.....

.....

.....

(d) Give a test to show that sodium oxide contains sodium ions.

(2)

.....

.....

.....

.....

(e) When sodium oxide is heated it reacts to form sodium metal and sodium peroxide, Na_2O_2

Complete the equation for this reaction.

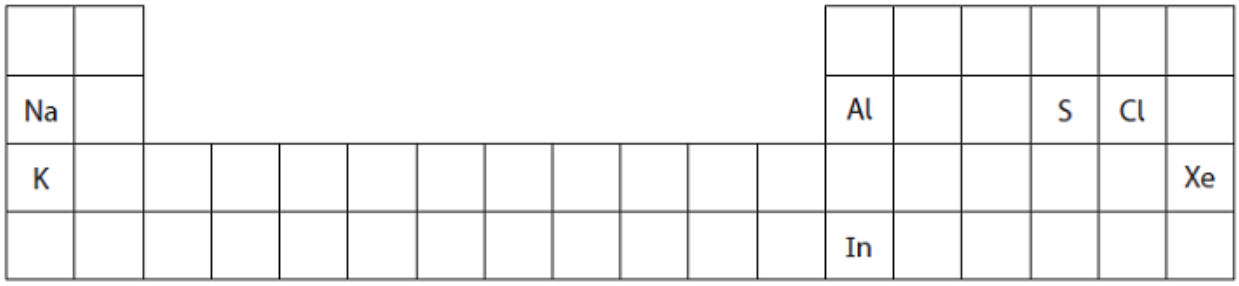
(1)

$Na_2O \rightarrow$

(Total for question = 9 marks)

Q18.

The diagram shows the positions of some elements in part of the Periodic Table.



(a)(i) Give the symbol of a metal from the diagram.

(1)

.....

(ii) Give the symbol of an element from the diagram that forms an acidic oxide.

(1)

.....

(b) Give a similarity in the electron configurations of Al and In.

(1)

.....

.....

(c) Explain which element in the diagram is unreactive.

(2)

.....

.....

.....

.....

(d) A teacher adds a small piece of sodium to a glass trough containing water and universal indicator.

The universal indicator changes colour.

The equation for the reaction is

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

(i) Explain the final colour of the universal indicator.

(2)

.....

.....

.....

.....

(ii) The teacher repeats the experiment with potassium instead of sodium.

Give one similarity and one difference observed with potassium.

(2)

similarity

.....

.....

difference

.....

.....

(iii) The reaction with sodium produces 0.036g of hydrogen gas.

One mole of hydrogen gas contains 6.0×10^{23} molecules.

Calculate the number of molecules of hydrogen gas produced in the reaction with sodium.

Give your answer to two significant figures.

(3)

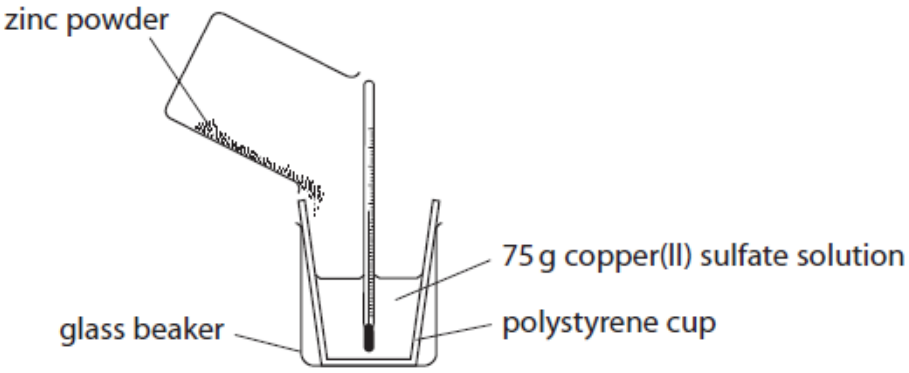
number of molecules of hydrogen gas = ...

(Total for question = 12 marks)

Q19.

This question is about exothermic reactions.

(a) A student uses this apparatus to measure the temperature increase when an excess of zinc powder is added to copper(II) sulfate solution.



(i) Complete the word equation for the reaction.

(1)

zinc + copper(II)
sulfate → ..... + ...

(ii) Give a reason why the student uses a polystyrene cup inside a glass beaker.

(1)

.....

.....

(iii) State why zinc reacts with copper(II) sulfate solution.

(1)

.....

.....

(iv) The temperature at the start of the reaction is 19.7 °C.

The temperature at the end of the reaction is 48.3 °C.

Calculate the heat energy change, in joules, for the reaction.

[for the mixture, c = 4.2 J/g/°C]

(2)

heat energy change = ... J

(b) (i) The reaction between zinc and silver nitrate solution is exothermic.

A mass of 0.65 g of zinc is added to excess silver nitrate solution.

The heat energy change is 800 J.

Calculate the molar enthalpy change, ΔH, in kJ/mol.

Include a sign in your answer.

(3)

ΔH = ... kJ/mol

(ii) This is the ionic equation for the reaction between zinc and silver nitrate solution.

$$Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$$

Explain, in terms of electrons, why this is a redox reaction.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 10 marks)

Q20.

A salt can be made by reacting an acid with an insoluble base.

A student has a sample of copper(II) oxide.

The student uses this method.

Stage 1 pour 50 cm^3 of dilute sulfuric acid into a beaker

Stage 2 warm the acid using a Bunsen burner

Stage 3 add a small amount of copper(II) oxide to the warm acid and stir the mixture

Stage 4 add further amounts of copper(II) oxide until copper(II) oxide is in excess

Stage 5 filter the mixture

Stage 6 obtain crystals from the filtrate

(a) State why the acid is warmed in stage 2.

(1)

.....

.....

(b) State how the student would know that the copper(II) oxide is in excess in stage 4.

(1)

.....

.....

(c) State why the mixture is filtered in stage 5.

(1)

.....

.....

(d) State the colour of the filtrate obtained in stage 5.

(1)

.....

(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

(3)

mass = ... g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.

Calculate the percentage yield of $CuSO_4.5H_2O$

(2)

percentage yield = ... %

(Total for question = 14 marks)