PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



EXAM QUESTION PACK

SECTION 1: PRINCIPLES OF CHEMISTRY (PACK 6)

SCORE	PERCENTAGE
/188	%

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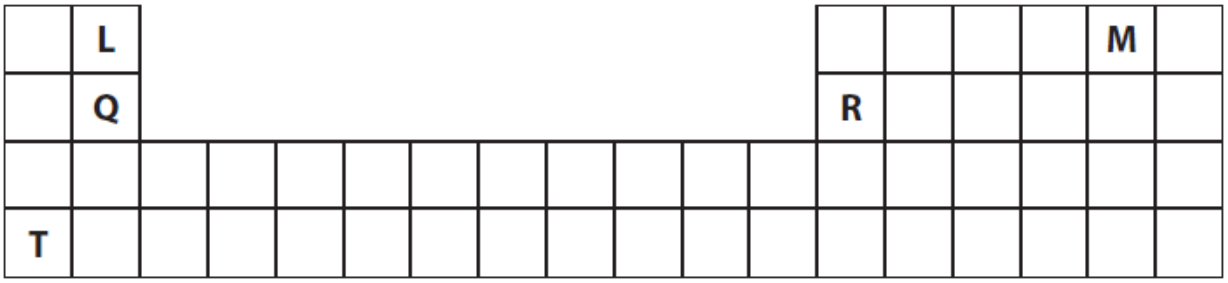
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Q1.

(a) The diagram shows part of the Periodic Table, with elements represented by the letters L, M, Q, R and T.

The letters in the diagram represent elements but are not their chemical symbols.

Use the Periodic Table to help you answer this question.



(i) Give the letter that represents the element that is a non-metal.

(1)

.....

(ii) Give the letter that represents the element with the greatest number of protons.

(1)

.....

(iii) Give the formula of the compound that forms when element L reacts with element M.

(1)

.....

(iv) Give a reason why elements L and Q react in a similar way.

(1)

.....

.....

(b) A sample of element Q contains three different types of atom.

The table gives the mass number of each atom, and the percentage of each type of atom in the sample.

Mass number	Percentage of atom in the sample
24	79.0
25	10.0
26	11.0

(i) State the name given to atoms of the same element that have different mass numbers.

(1)

.....

(ii) Calculate the relative atomic mass (A_r) of element Q.

Give your answer to one decimal place.

(2)

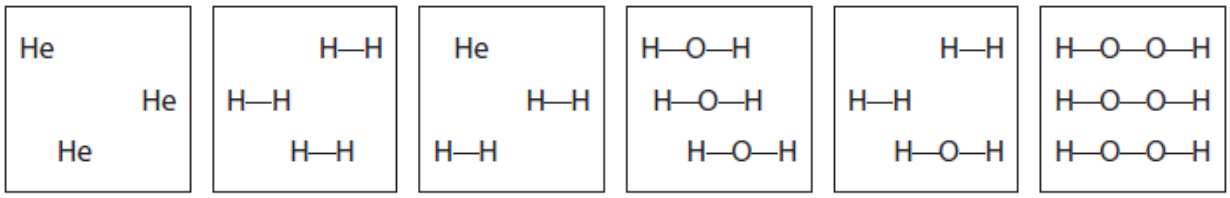
A_r = ...

(Total for question = 7 marks)

Q2.

Substances can be classified as elements, compounds or mixtures.

(a) Each of the boxes in the diagram represents either an element, a compound or a mixture.



box 1 box 2 box 3 box 4 box 5 box 6

(i) Explain which **two** boxes represent an element.

(2)

.....

.....

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.....

(ii) Explain which **two** boxes represent a mixture.

(2)

.....

.....

.....

.....

(b) The list gives the names of some methods used in the separation of mixtures:

- chromatography
- crystallisation
- distillation
- filtration

Use names from the list to choose a suitable method for each separation.

Each name may be used once, more than once or not at all.

(i) Separating water from sodium chloride solution.

(1)

.....

(ii) Separating the blue dye from a mixture of blue and red dyes.

(1)

.....

(iii) Separating potassium nitrate from potassium nitrate solution.

(1)

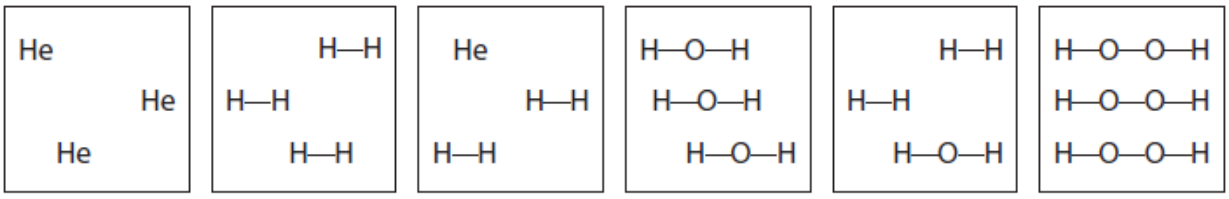
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(Total for question = 7 marks)

Q3.

Substances can be classified as elements, compounds or mixtures.

(a) Each of the boxes in the diagram represents either an element, a compound or a mixture.



box 1 box 2 box 3 box 4 box 5 box 6

(i) Explain which **two** boxes represent an element.

(2)

.....

.....

.....

.....

(ii) Explain which **two** boxes represent a mixture.

(2)

.....

.....

.....

.....

(b) The list gives the names of some methods used in the separation of mixtures:

- chromatography
- crystallisation
- distillation
- filtration

Use names from the list to choose a suitable method for each separation.

Each name may be used once, more than once or not at all.

(i) Separating water from sodium chloride solution.

(1)

.....

(ii) Separating the blue dye from a mixture of blue and red dyes.

(1)

.....

(iii) Separating potassium nitrate from potassium nitrate solution.

(1)

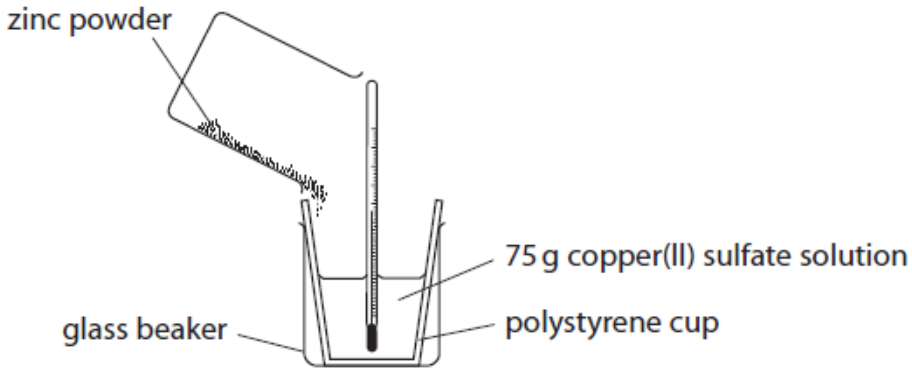
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(Total for question = 7 marks)

Q4.

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)

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(Total for question = 10 marks)

Q5.

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)

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(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 $CuSO_4.5H_2O$

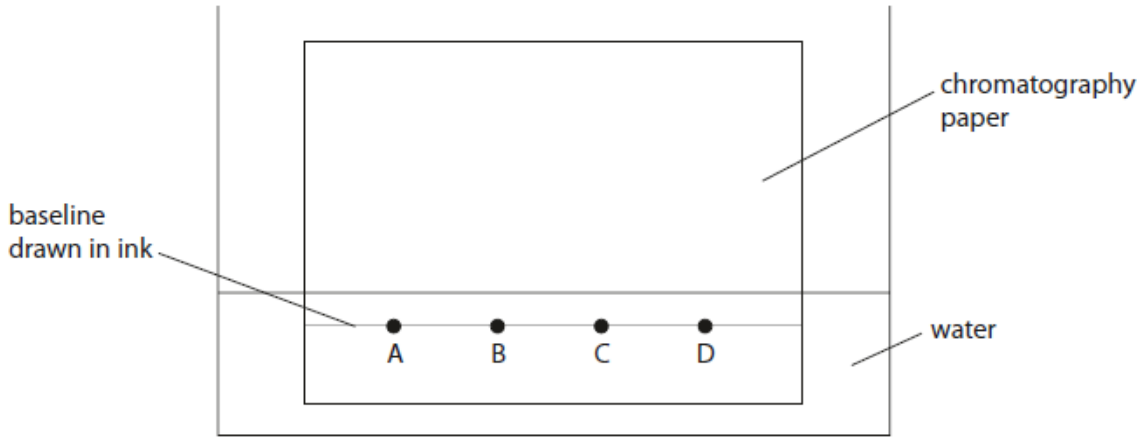
(2)

percentage yield = ... %

(Total for question = 14 marks)

Q6.

A student uses this apparatus to investigate the colours in four different inks, A, B, C and D.



(a) Explain two mistakes the student made when setting up his experiment.

(4)

1 .....

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2 .....

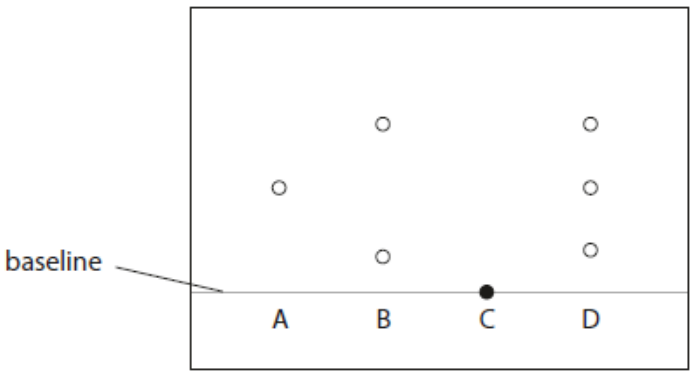
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(b) Another student does the experiment but does not make any mistakes.

The diagram shows her results.



(i) State how many colours ink D contains.

(1)

.....

(ii) State which of the inks tested could be mixed together to make ink D.

(1)

.....

(iii) Explain which of the inks tested is insoluble in water.

(2)

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(Total for question = 8 marks)

Q7.

Some sugar is added to cold water in a beaker.

After some time, all the sugar dissolves and spreads throughout the water.

(a) (i) Name the process that occurs which causes the sugar to spread throughout the water.

(1)

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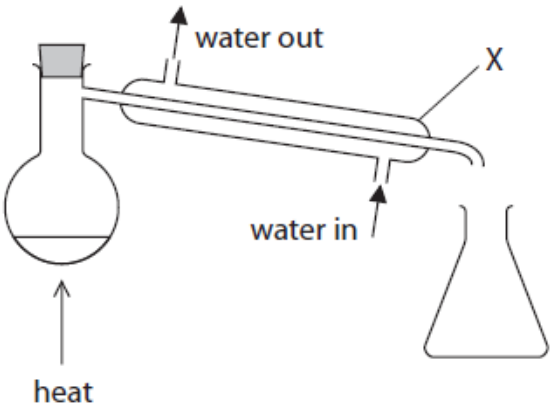
(ii) State two ways to make the sugar dissolve more quickly.

(2)

1 .....

2 .....

(b) Pure water can be obtained from the sugar solution using this apparatus.



(i) Name the process used to obtain pure water from the sugar solution.

(1)

.....

(ii) Explain the purpose of the piece of apparatus labelled X.

(2)

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(Total for question = 6 marks)

Q8.

This question is about ionic compounds.

(a) The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Mg^{2+}	Al^{3+}	NH_4^+
S^{2-}	MgS	Al_2S_3	
NO_3^-		$Al(NO_3)_3$	NH_4NO_3
CO_3^{2-}	$MgCO_3$		$(NH_4)_2CO_3$

(i) Complete the table by giving the three missing formulae.

(3)

(ii) Give the name of the compound with the formula NH_4NO_3

(1)

.....

(b) Sodium oxide, Na_2O, is an ionic compound.

The sodium and oxide ions are held together by ionic bonds.

(i) State the meaning of the term **ionic bond**.

(2)

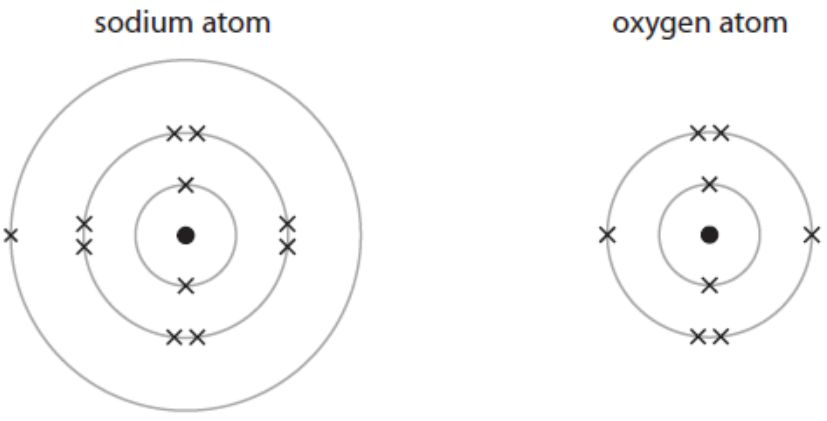
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(ii) The diagram shows the arrangement of the electrons in a sodium atom and in an oxygen atom.



Draw diagrams in the boxes to show the arrangement of the electrons in the ions of sodium oxide.

Include the charges on the ions.

(3)

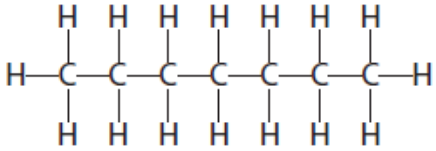
sodium ion	oxide ion	sodium ion

(Total for question = 9 marks)

Q9.

(a) Two of the fractions obtained from crude oil are gasoline and bitumen.

(i) This is the displayed formula for one of the alkanes in the gasoline fraction.



Determine the molecular formula of this alkane.

(1)

.....

(ii) Give a use of bitumen.

(1)

.....

(iii) Describe the differences between the gasoline and bitumen fractions, in terms of colour, boiling point
and viscosity.

(3)

colour .....

.....

boiling point .....

.....

viscosity .....

.....

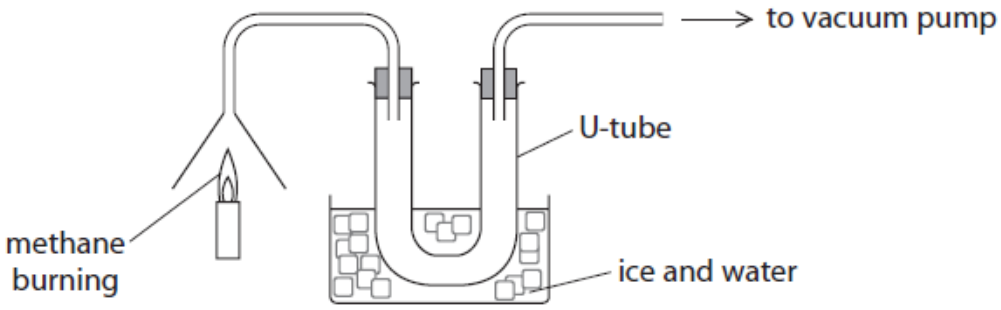
(b) Methane is an alkane used as a fuel.

When methane burns in a plentiful supply of air, carbon dioxide and water vapour form.

The equation for the reaction is

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

The diagram shows how water can be collected when methane burns in the air.



(i) Water freezes at 0 °C and boils at 100 °C.

Carbon dioxide sublimes at −78 °C.

Explain why water collects in the U-tube, but carbon dioxide does not.

(4)

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(ii) Describe how anhydrous copper(II) sulfate can be used to show that the U-tube contains water.

(2)

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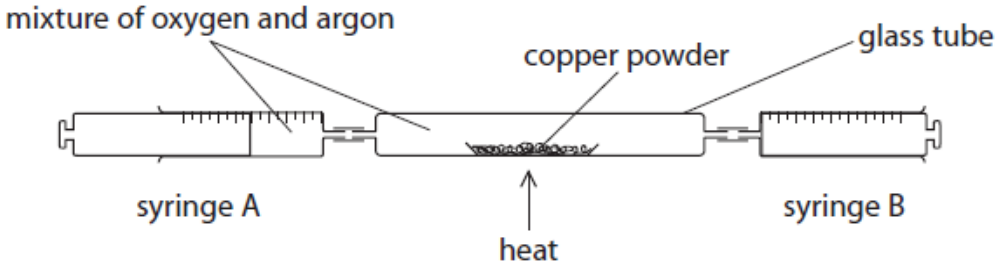
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(Total for question = 11 marks)

Q10.

A teacher uses this apparatus to find the percentage of oxygen in a gaseous mixture of oxygen and argon.



This is the teacher's method.

Step 1 heat the copper powder

Step 2 push the plunger on syringe A to pass the mixture of oxygen and argon over the hot copper so that the mixture moves into syringe B

Step 3 push the plunger on syringe B to pass the mixture of oxygen and argon over the hot copper so that the mixture moves into syringe A

Step 4 record the reading on syringe A

Step 5 repeat Steps 2, 3 and 4 a number of times

The volume of gas decreases as the oxygen reacts with the copper.

Argon is unreactive so does not react with the copper.

The copper powder turns black.

(a) (i) Give a reason why the copper powder is heated.

(1)

.....

.....

(ii) State why argon is unreactive.

(1)

.....

.....

(iii) Give the name of the black powder that forms when the oxygen reacts with the copper.

(1)

.....

(b) The table shows the teacher's results.

Reading number	Reading on syringe A in cm^3
Start	78
1	70
2	67
3	65
4	63
5	61
6	60
7	59
8	58
9	58
10	58

(i) State how the results show that all the oxygen has reacted.

(1)

.....

.....

(ii) The volume of gas in the glass tube and connecting tubes is 175 cm^3.

Use this value and the results table to calculate the percentage of oxygen in the mixture of

oxygen and argon.

(3)

percentage of oxygen = ... %

(iii) Suggest one reason why the calculated percentage of oxygen in the mixture may not be accurate.

(1)

.....

.....

(Total for question = 8 marks)

Q11.

This question is about gases in the atmosphere.

(a) A student adds a piece of burning magnesium ribbon to a gas jar containing oxygen.

(i) State an observation that the student could make.

(1)

.....

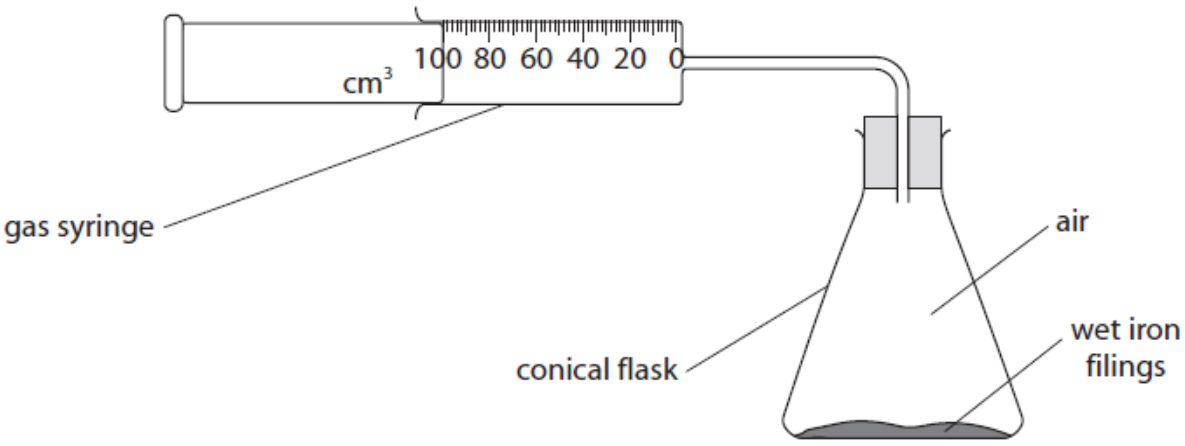
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(ii) Write a chemical equation for the reaction of magnesium with oxygen.

(1)

.....

(b) The student uses this apparatus to find the percentage by volume of oxygen in a sample of air.



The student leaves the apparatus until there is no further decrease in the volume of gas in the syringe.

These are the student's results.

volume of gas in conical flask and connecting tube	275 cm^3
volume of gas in syringe at start	100 cm^3
volume of gas in syringe at end	28 cm^3

Calculate the percentage by volume of oxygen in the sample of air.

Give your answer to two significant figures.

(4)

percentage of oxygen = ... %

(c) Carbon dioxide is another gas in the atmosphere.

(i) Describe a test for carbon dioxide.

(2)

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.....

.....

.....

(ii) Explain why an increase in the percentage of carbon dioxide in the atmosphere may cause an environmental problem.

(2)

.....

.....

.....

.....

(Total for question = 10 marks)

Q12.

This question is about gases in the atmosphere.

(a) The box gives the names of some gases in the atmosphere.

argon	carbon dioxide	helium	nitrogen	oxygen

Choose gases from the box to answer these questions.

Each gas may be used once, more than once or not at all.

(i) Identify a noble gas.

(1)

.....

(ii) Identify a gas that makes up about 78% of the atmosphere.

(1)

.....

(iii) Identify a greenhouse gas.

(1)

.....

(iv) Identify a gas produced by the thermal decomposition of calcium carbonate.

(1)

.....

(b) Sulfur reacts with oxygen to produce sulfur dioxide gas.

(i) Write a chemical equation for this reaction.

(1)

.....

(ii) State an environmental problem caused when sulfur dioxide gas dissolves in water in the atmosphere.

(1)

.....

.....

(Total for question = 6 marks)

Q13.

This question is about the elements in Group 1 of the Periodic Table and their reactions with water.

(a) State why sodium and potassium are in Group 1 of the Periodic Table.

(1)

.....

.....

(b) A reaction occurs when a small piece of sodium is added to a large volume of water in a trough.

(i) Give **two** observations that you would make during this reaction.

(2)

1 .....

.....

2 .....

.....

(ii) After the reaction has finished, a few drops of universal indicator are added to the solution in the trough.

Explain the final colour of the universal indicator.

(2)

.....

.....

.....

(iii) What is the most likely pH value of the solution in the trough after the reaction is complete?

(1)

☒ **A** 2

☒ **B** 5

☒ **C** 8

☒ **D** 12

(c) Give the name of a Group 1 metal that is less reactive than sodium.

(1)

.....

(d) A small piece of potassium is added to a large volume of water in a trough.

Give **one** observation that is made when potassium is added to water that is **not** made when sodium is added to water.

(1)

.....

.....

(e) Complete the equation for the reaction of rubidium with water.

State symbols are not required.

(1)

..... Rb + ... H_2O → ..... RbOH + ... H_2

(Total for question = 9 marks)

Q14.

This question is about some of the Group 1 elements and their compounds.

(a) A teacher adds a small piece of lithium to water in a trough.

(i) Give three observations that are made when lithium reacts with water.

(3)

1 .....

2 .....

3 .....

(ii) After the reaction has finished, the teacher adds a few drops of universal indicator to the solution in the trough.

Explain the colour of the universal indicator after it is added to the solution.

(2)

.....

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(iii) Write a chemical equation for the reaction of lithium with water.

(2)

.....

(b) A student does a flame test to see if a white solid contains sodium ions.

She cleans a platinum wire before using it for the flame test.

(i) Explain why the student needs to clean the platinum wire.

(2)

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.....

(ii) Which of these is the colour of the flame if the solid contains sodium ions?

(1)

☒ **A** green

☒ **B** lilac

☒ **C** red

☒ **D** yellow

(c) Potassium sulfate (K_2SO_4) is an ionic compound.

(i) Give the formula of each ion in potassium sulfate.

(1)

potassium ion ..... sulfate ion .....

(ii) The melting point of potassium sulfate is 1069 °C.

Explain why potassium sulfate has a high melting point.

Refer to structure and bonding in your answer.

(4)

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(Total for question = 15 marks)

Q15.

Lithium, sodium and potassium are the first three elements in Group 1 of the Periodic Table.

(a) Suggest why these three elements are all stored in paraffin oil.

(1)

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.....

.....

(b) Caesium, Cs, is below potassium in Group 1.

(i) Give a similarity and a difference between the reactions of potassium with water and caesium with water.

(2)

similarity.....

.....

difference.....

.....

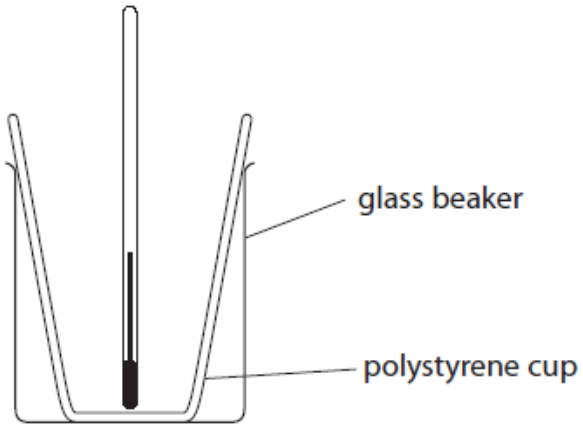
(ii) Give the chemical equation for the reaction between caesium and water.

(2)

.....

(c) A student investigates the temperature change in the reaction between dilute acids and solutions of Group 1 hydroxides.

He uses this apparatus.



This is the student's method.

- measure the temperature of 50 cm^3 of hydrochloric acid
- pour the acid into a polystyrene cup
- add 50 cm^3 of sodium hydroxide solution to the acid
- measure the maximum temperature of the mixture

(i) Suggest what could be added to the apparatus to improve the experiment.

(1)

.....

.....

(ii) Explain a change to the method that would improve the accuracy of the experiment.

(2)

.....

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.....

.....

(d) These are the student's results.

temperature of hydrochloric acid = 19.9 °C

maximum temperature of mixture = 26.5 °C

(i) Calculate the energy change, Q, in joules for this reaction.

[mass of 1.0 cm^3 of mixture = 1.0 g]

[for the mixture, c = 4.2 J/g/°C]

(3)

Q = ... J

(ii) In the student's reaction between hydrochloric acid and sodium hydroxide, 0.050 mol of water forms.

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

(2)

ΔH = ... kJ/mol

(Total for question = 13 marks)

Q16.

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

This question is about the elements in Group 1 of the Periodic Table.

(a) State the name given to the elements in Group 1.

(1)

.....

(b) A scientist adds a small piece of potassium to a trough of water.

(i) Which observation is **not** correct when potassium is added to water?

(1)

☒ **A** a colourless solution forms

☒ **B** a lilac flame is seen

☒ **C** effervescence occurs

☒ **D** potassium sinks

(ii) Give a reason why the scientist does not use a large piece of potassium.

(1)

.....

.....

(iii) After the reaction stops, the scientist adds a few drops of universal indicator solution to the trough.

The universal indicator solution turns purple.

Give the formula of the ion that causes the universal indicator solution to turn purple.

(1)

.....

(iv) Complete the chemical equation for the reaction of potassium with water.

(2)

.....K + ...H_2O → ..... +

.....

(c) Sodium reacts with oxygen to form the ionic compound sodium oxide, Na_2O

Explain, in terms of structure and bonding, why sodium oxide has a high melting point.

(4)

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(Total for question = 10 marks)

Q17.

This question is about some compounds of the elements in Group 4 of the Periodic Table.

(a) When carbon dioxide dissolves in water, a weak acid forms.

(i) Which of these could be the pH of this weak acid?

(1)

☒ **A** 1

☒ **B** 5

☒ **C** 7

☒ **D** 9

(ii) Which of these is a correct statement about acids?

(1)

☒ **A** acids contain OH^- ions

☒ **B** acids are electron donors

☒ **C** acids are proton acceptors

☒ **D** acids are proton donors

(b) When lead(II) carbonate is heated, lead(II) oxide and carbon dioxide form.

(i) Give the name of this type of reaction.

(1)

.....

(ii) Complete the equation for this reaction.

(1)

$PbCO_3 \rightarrow$ ..... + ...

(c) Silicon dioxide, SiO_2, and silicon(IV) chloride, $SiCl_4$, are both covalently bonded compounds.

The table shows the melting and boiling points of these two compounds, and the physical state of silicon dioxide at room temperature.

Compound	Melting point in °C	Boiling point in °C	Physical state at room temperature
SiO_2	1710	2230	solid
$SiCl_4$	−69	58	

(i) Complete the table by giving the physical state of silicon(IV) chloride at room temperature.

(1)

(ii) Explain, in terms of structure and bonding, why silicon dioxide has a much higher melting point than
silicon(IV) chloride.

(6)

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(Total for question = 11 marks)

Q18.

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

This question is about the elements in Group 7 of the Periodic Table.

(a) (i) State the name given to Group 7.

(1)

.....

(ii) Which element is a liquid at room temperature?

(1)

☒ **A** astatine

☒ **B** bromine

☒ **C** fluorine

☒ **D** iodine

(iii) What is the colour of chlorine gas?

(1)

☒ **A** brown

☒ **B** colourless

☒ **C** green

☒ **D** red

(iv) Describe a test for chlorine gas.

(2)

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(b) Iron reacts with chlorine to form iron(III) chloride, $FeCl_3$

(i) Use information from the Periodic Table to calculate the relative formula mass (M_r) of iron(III) chloride.

(2)

M_r = ...

(ii) Complete the chemical equation for the reaction of iron with chlorine.

(1)

..... Fe + ... Cl_2 → ..... $FeCl_3$

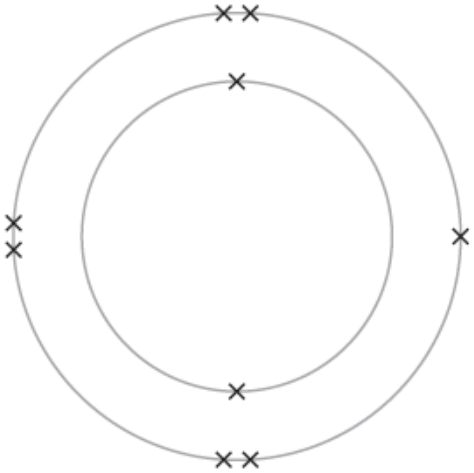
(Total for question = 8 marks)

Q19.

This question is about Group 7 elements and their reactions.

(a) Fluorine has the smallest atoms in Group 7.

The diagram shows the electronic configuration of a fluorine atom.



(i) State why fluorine has the smallest atoms in Group 7.

(1)

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(ii) Which row gives the correct number of occupied electron shells and the correct number of outer shell electrons in an atom of iodine?

Use the Periodic Table on page 2 to help you.

(1)

	Number of occupied electron shells	Number of outer shell electrons
☒ **A**	4	5
☒ **B**	5	6
☒ **C**	5	7
☒ **D**	7	5

(b) (i) The table gives descriptions of the reactions of some Group 7 elements with iron wool.

Complete the table by giving a description of the reaction of fluorine with iron wool.

(2)

Element	Description of reaction with iron wool
fluorine	
chlorine	• does not need heating • reacts quickly
bromine	• needs heating • reacts slowly
iodine	• needs heating • reacts very slowly

(ii) State the relationship between the reactivity of the Group 7 elements and the size of their atoms.

(2)

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(Total for question = 6 marks)

Q20.

This question is about some of the halogens and their compounds.

(a) (i) Which element is a liquid at room temperature?

(1)

☒ **A** astatine

☒ **B** bromine

☒ **C** chlorine

☒ **D** iodine

(ii) Which element has the palest colour?

(1)

☒

A astatine

☒ **B** bromine

☒ **C** chlorine

☒ **D** iodine

(iii) Which element is the least reactive?

(1)

☒ **A** astatine

☒ **B** bromine

☒ **C** chlorine

☒ **D** iodine

(b) A teacher uses displacement reactions to demonstrate the reactivities of some halogens.

She adds solutions of chlorine, bromine and iodine separately to three different sodium halide solutions.

The table shows some of the teacher's results.

	sodium chloride	**sodium bromide**	**sodium iodide**
chlorine solution	not done	solution turns orange	
bromine solution	solution stays orange	not done	solution turns brown
iodine solution		solution stays brown	not done

A change in colour of the solution indicates that a reaction has occurred.

(i) Complete the table by predicting the missing results.

(2)

(ii) State why the teacher does not add bromine solution to sodium bromide solution.

(1)

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(iii) The word equation for the reaction of bromine with sodium iodide is

bromine + sodium iodide → iodine + sodium bromide

Write a chemical equation for this reaction.

(1)

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(c) A technician sees an unlabelled bottle containing a liquid.

He knows that the liquid is a solution of one of these compounds.

- copper(II) chloride
- copper(II) bromide
- iron(II) chloride
- iron(II) bromide

Describe chemical tests that the technician could use to identify the compound in the solution.

(6)

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(Total for question = 13 marks)

		Total for question	7