

THE PERIODIC TABLE

0

7

6

5

4

3

2

1

Group

Period

4
He
Helium
2

1
H
Hydrogen
1

7	Li Lithium 3	9	Be Beryllium 4	11	Na Sodium 11	12	Mg Magnesium 12	13	Al Aluminium 13	14	N Nitrogen 7	16	O Oxygen 8	19	F Fluorine 9	20	Ne Neon 10																				
23	Na Sodium 11	24	Mg Magnesium 12	25	Mn Manganese 25	26	Fe Iron 26	27	Co Cobalt 27	28	Ni Nickel 28	29	Cu Copper 29	30	Zn Zinc 30	31	Ga Gallium 31	32	Ge Germanium 32	33	As Arsenic 33	34	Se Selenium 34	35	Br Bromine 35	36	Kr Krypton 36										
39	K Potassium 19	40	Ca Calcium 20	41	Sc Scandium 21	42	Ti Titanium 22	43	V Vanadium 23	44	Cr Chromium 24	45	Mn Manganese 25	46	Fe Iron 26	47	Co Cobalt 27	48	Ni Nickel 28	49	Cu Copper 29	50	Zn Zinc 30	51	Ga Gallium 31	52	Ge Germanium 32	53	As Arsenic 33	54	Se Selenium 34	55	Br Bromine 35	56	Kr Krypton 36		
86	Rb Rubidium 37	87	Sr Strontium 38	88	Y Yttrium 39	89	Zr Zirconium 40	90	Nb Niobium 41	91	Mo Molybdenum 42	92	Tc Technetium 43	93	Ru Ruthenium 44	94	Rh Rhodium 45	95	Pd Palladium 46	96	Ag Silver 47	97	Cd Cadmium 48	98	In Indium 49	99	Sn Tin 50	100	Sb Antimony 51	101	Te Tellurium 52	102	I Iodine 53	103	Xe Xenon 54		
133	Cs Caesium 55	137	Ba Barium 56	138	La Lanthanum 57	139	Hf Hafnium 72	140	Ta Tantalum 73	141	W Tungsten 74	142	Re Rhenium 75	143	Os Osmium 76	144	Ir Iridium 77	145	Pt Platinum 78	146	Au Gold 79	147	Hg Mercury 80	148	Tl Thallium 81	149	Pb Lead 82	150	Bi Bismuth 83	151	Po Polonium 84	152	At Astatine 85	153	Rn Radon 86		
223	Fr Francium 87	226	Ra Radium 88	227	Ac Actinium 89	228		229		230		231		232		233		234		235		236		237		238		239		240		241		242		243	

Key

Relative atomic mass
Symbol
Name
Atomic number



SECTION A

1. (a) Complete the table of information about the three types of particle found in an atom.

Name of particle	Relative mass	Relative charge
electron		-1
neutron	1	
proton		

(4)

(b) An atom of chlorine can be represented by the symbol



(i) Explain the meaning of the term **mass number**. State the mass number of this chlorine atom.

.....

.....

.....

.....

(2)

(ii) How many neutrons are in this atom of chlorine?

.....

(1)

(c) There are two types of boron atoms. Some contain 5 protons and 5 neutrons while others contain 6 neutrons.

(i) How many protons do the second type of boron atoms contain?

.....

(1)

(ii) What name is given to atoms of the same element with different numbers of neutrons?

.....

(1)

(Total 9 marks)

Q1



2. Propanone and water are both covalently bonded compounds. The table shows their boiling points.

Compound	Boiling point (°C)
propanone	56
water	100

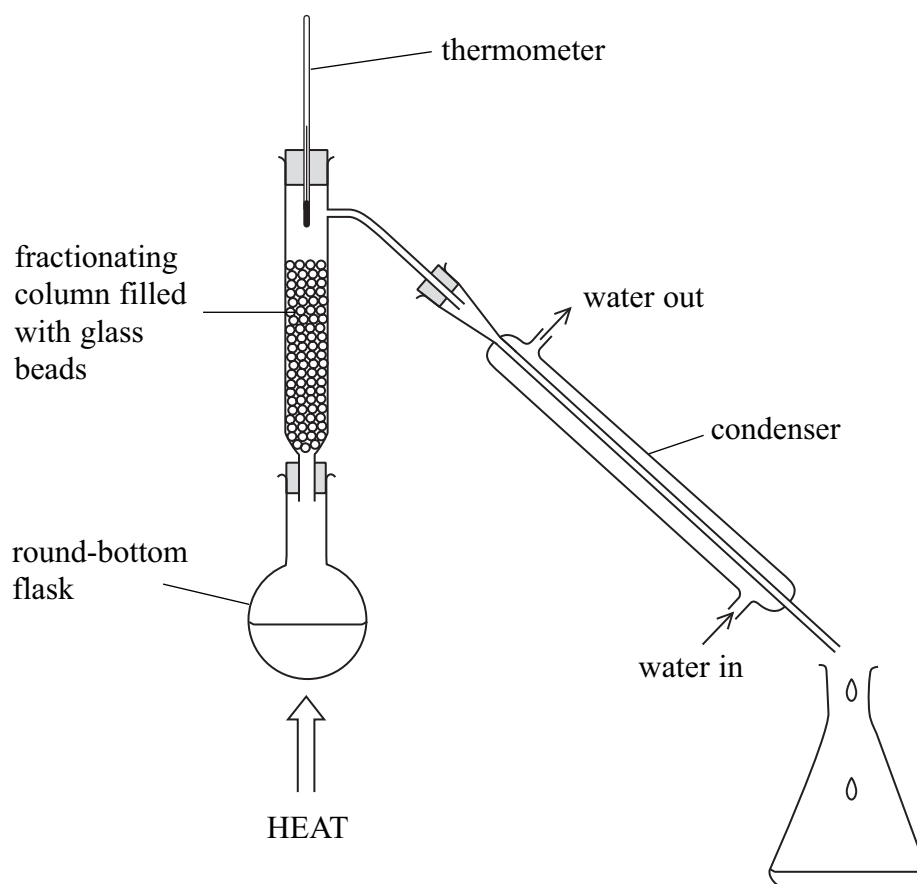
(a) Some anhydrous copper(II) sulphate was added to a mixture of propanone and water. What colour change would be seen?

Colour at start

Colour at end

(2)

(b) Propanone can be obtained from a mixture of propanone and water using the apparatus shown.



(i) Name the method of separation carried out using this apparatus.

.....

(2)



(ii) Why can propanone and water be separated by this method?

..... (1)

(iii) Outline how a sample of pure propanone can be obtained from the mixture.

.....

 (3)

(c) Propanone and water both have simple molecular structures. They have low boiling points. Place a cross (☒) in **one** box from **each** column of statements to explain why they have low boiling points.

the covalent bonds between their atoms are strong ☒

the covalent bonds between their atoms are weak ☒

the attractive forces between their molecules are strong ☒

the attractive forces between their molecules are weak ☒

AND

these require a lot of energy to be overcome ☒

these require little energy to be overcome ☒

these get weaker as the temperature increases ☒

(2)

Q2

(Total 10 marks)

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3. A sodium atom has the electronic configuration 2.8.1
An oxygen atom has the electronic configuration 2.6

(a) State, in terms of electrons, what happens to a sodium atom when it reacts with oxygen. Give the symbol of the sodium species formed.

.....
.....
.....

(2)

(b) State, in terms of electrons, what happens to an oxygen atom when it reacts with sodium. Give the symbol of the species formed from the oxygen atom.

.....
.....
.....

(2)

(c) State the name and formula of the compound formed when sodium reacts with oxygen.

Name

Formula

.....

(2)

(Total 6 marks)

Q3



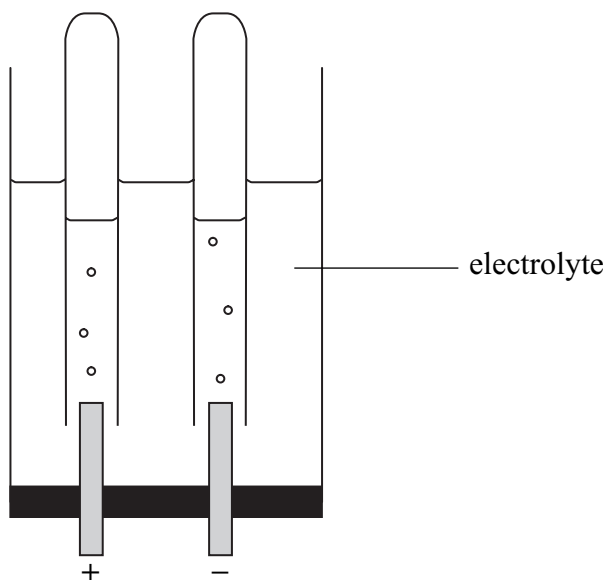
4. This question is about chlorine and other elements in Group 7 of the Periodic Table.

(a) Complete the table to show the colours and states of some elements in Group 7.

Name of element	Colour	State at room temperature
chlorine	green	gas
bromine	brown	
iodine		solid

(2)

(b) The diagram shows the electrolysis of an aqueous solution of a compound. The electrolysis produces chlorine and another gas.



(i) Add a label to the diagram to show the chlorine gas.

(1)

(ii) Identify the other gas produced during the electrolysis.

.....

(1)

(iii) What is the electrolyte used in the industrial production of chlorine?

.....

(1)



(c) When chlorine gas is bubbled into colourless sodium bromide solution a reaction takes place. The solution becomes brown.

(i) Write a word equation for the reaction which takes place.

.....
(2)

(ii) What name is given to this type of reaction?

.....
(1)

(iii) What does this reaction indicate about the reactivity of chlorine compared to bromine?

.....
(1)

(Total 9 marks)

Q4



5. The table shows the structures of some organic compounds.

$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $ <p style="text-align: center;">A</p>	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} $ <p style="text-align: center;">B</p>
$ \begin{array}{c} \text{H} \quad \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \quad \text{H} \\ \quad \quad \quad \diagdown \quad \diagup \\ \quad \quad \quad \text{C} \\ \quad \quad \quad \diagup \quad \diagdown \\ \quad \quad \quad \text{H} \quad \quad \quad \text{H} \end{array} $ <p style="text-align: center;">C</p>	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{Br} \quad \text{Br} \end{array} $ <p style="text-align: center;">D</p>
$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $ <p style="text-align: center;">E</p>	$ \begin{array}{c} \text{H} \quad \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \quad \text{H} \end{array} $ <p style="text-align: center;">F</p>

(a) Explain why compound **C** is not a saturated hydrocarbon.

.....

 (1)

(b) Explain why compound **D** is not a hydrocarbon.

.....

 (1)

(c) Give the letters of two compounds that are isomers of each other.

.....
 (1)



(d) Give the letters of two compounds that are members of the same homologous series but have different molecular formulae.

.....
(1)

(e) Name and give the general formula of the homologous series to which compound E belongs.

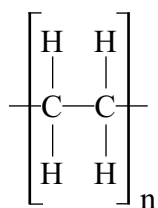
Name of homologous series

General formula
(2)

(f) What colour change is seen when bromine water is added to compound F?

.....
.....
(2)

(g) A polymer has the structure:



(i) Give the letter of the monomer which is used to make this polymer.

.....
(1)

(ii) Give the name of the polymer.

.....
(1)

(iii) What type of polymer is this?

.....
(1)

(Total 11 marks)

Q5

TOTAL FOR SECTION A: 45 MARKS



SECTION B

6. Lithium and sodium are metals in Group 1 of the Periodic Table. They react in a similar way with water, producing hydrogen gas and an alkaline solution.

(a) A student added a piece of lithium to a trough of water. A piece of platinum wire is dipped into the solution formed and then held in a hot Bunsen flame.

(i) What colour does the flame become?

.....
(1)

(ii) What is the formula of the ion responsible for this colour?

.....
(1)

(b) State the colour of methyl orange in the alkaline solution formed in (a) and give the formula of the ion which causes the solution to be alkaline.

Colour of methyl orange

Formula of ion

(2)

(c) A piece of sodium is added to another trough of water.

(i) Give two observations, other than the sodium floating, that you could make during the reaction.

1

2

(2)

(ii) Write a chemical equation for the reaction.

.....

.....

(2)



(d) Rubidium is another Group 1 metal. A piece of rubidium is added to a different trough of water.

(i) Predict one observation that would be different using rubidium instead of sodium.

.....

.....

(1)

(ii) Predict a possible pH value for the solution formed in the reaction between rubidium and water.

.....

(1)

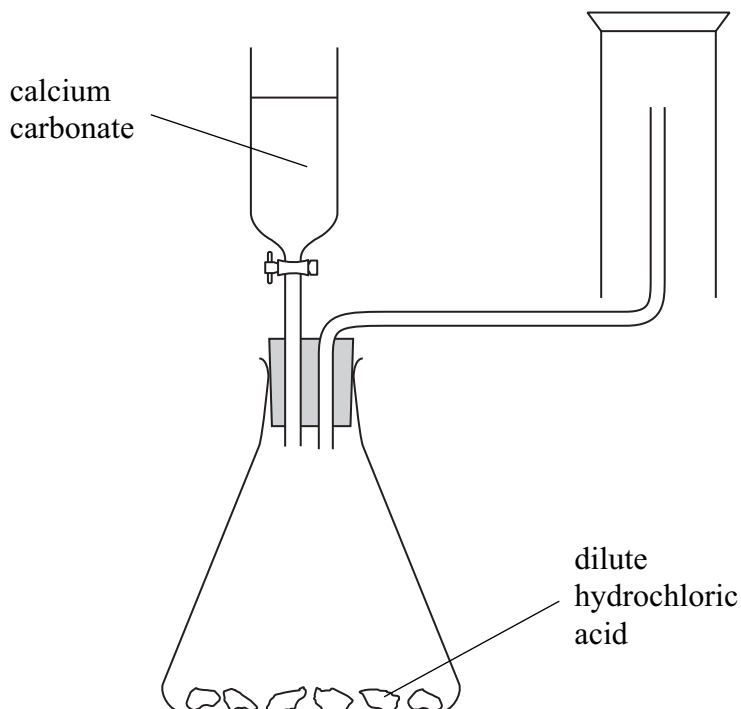
Q6

(Total 10 marks)

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7. (a) A student was asked to draw a diagram to show apparatus he would use to prepare carbon dioxide gas in the laboratory. This is the diagram he drew.



- (i) State how the diagram is labelled incorrectly.

.....

 (1)

- (ii) Why is the method of collection of carbon dioxide unsuitable?
 How could the carbon dioxide be collected?

.....

 (2)

- (iii) Write a chemical equation, including state symbols, for the reaction that occurs in the conical flask.

.....

 (3)



- (b) A teacher prepares a gas jar of oxygen.
She then lights a piece of magnesium ribbon and places it in the gas jar.
A vigorous reaction occurs.

Give two observations she could make during the reaction between magnesium and oxygen.

1

2

(2)

- (c) The ionic compound formed during the reaction in the gas jar is magnesium oxide.
The melting point of magnesium oxide is 2857 °C.
The melting point of sodium chloride is 801 °C.

- (i) Explain why both magnesium oxide and sodium chloride have high melting points.

.....
.....
.....
.....

(2)

- (ii) Explain why the melting point of magnesium oxide is much higher than that of sodium chloride.

.....
.....
.....
.....

(2)

Q7

(Total 12 marks)

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8. Iron is extracted from iron ore in a blast furnace using three raw materials, **J**, **K** and **L**.

J is a black solid, **K** is a white solid composed mostly of calcium carbonate, and **L** is a colourless mixture of gases.

(a) Give the names of these raw materials.

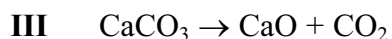
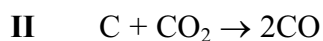
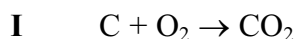
J

K

L

(3)

(b) The chemical equations for three reactions that occur in the blast furnace are:



(i) Explain why reaction **I** is important in the blast furnace.

.....

(1)

(ii) State the function of the product of reaction **II**.

.....

(1)

(iii) The function of the CaO formed in reaction **III** is to remove impurities in the iron ore. Write a chemical equation to show the reaction that occurs.

.....

(2)

(c) Two molten substances, **M** and iron, collect at the bottom of the blast furnace. Give the name of **M** and suggest why it floats on top of the molten iron.

.....

.....

.....

(2)



(d) Iron has many uses.

Suggest one property of iron, different in each case, that makes it suitable for:

making railway lines

.....

using in the Haber process

.....

(2)

(e) One problem with using iron to make objects is rusting.

Galvanising is a method of preventing rusting that involves coating iron with zinc.

(i) Give the chemical name of rust.

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(1)

(ii) Explain how zinc is able to prevent iron from rusting even when the coating is scratched.

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(2)

Q8

(Total 14 marks)

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9. Iron and copper are both examples of transition metals.

(a) One property of transition metals is variable valency.

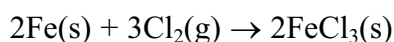
This can be shown by the formation of two different chlorides of iron.

(i) When iron is heated in hydrogen chloride gas, iron(II) chloride is formed. Write a chemical equation for this reaction.

.....

(2)

(ii) The equation for the formation of iron(III) chloride is:



Explain, in terms of electrons, why this reaction involves both oxidation and reduction.

.....

(2)

(b) Separate solutions of the chlorides formed in part (a) can be identified using sodium hydroxide solution.

Describe the observation you would make when sodium hydroxide solution is added to:

iron(II) chloride solution

iron(III) chloride solution

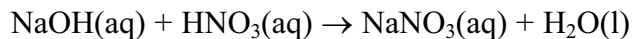
(2)



10. A student wanted to find the concentration of a solution of nitric acid.

She placed a 25.0 cm³ sample of the nitric acid solution in a conical flask and titrated it with 0.200 mol dm⁻³ sodium hydroxide solution, using phenolphthalein as an indicator. The phenolphthalein changed colour after she added a total of 21.05 cm³ of the sodium hydroxide solution.

The equation for the reaction is:



(a) State the colour change of the phenolphthalein.

.....

.....

(2)

(b) (i) Calculate the amount, in moles, of sodium hydroxide used in the titration.

(2)

(ii) Calculate the concentration, in mol dm⁻³, of the nitric acid.

(2)



(c) (i) Calculate the relative formula mass of sodium nitrate.

(1)

(ii) Calculate the mass of sodium nitrate formed in the titration.

(2)

(d) A solution of sodium nitrate was formed by neutralising some dilute nitric acid with aqueous sodium hydroxide.
Outline how you could obtain a dry sample of sodium nitrate crystals from the solution formed.

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(3)

Q10

(Total 12 marks)

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11. The sequence shows the steps that can be used to obtain ethanol from crude oil.



(a) Step 1 is fractional distillation, which takes place in a fractionating column. Crude oil vapour is pumped in just above the bottom of the column.

(i) Describe how the fractions are separated in the fractionating column.

.....

.....

.....

.....

(2)

(ii) Explain why the hydrocarbons in the fuel oil fraction are obtained from the column below the hydrocarbons in the diesel fraction.

.....

.....

.....

.....

(2)

(iii) One of the hydrocarbons in the diesel fraction has the formula $C_{16}H_{34}$. Suggest the formula of a hydrocarbon found in the gasoline fraction.

.....

(1)

(iv) Name the fraction that is more viscous than fuel oil.

.....

(1)



(b) Step 2 is cracking, which is carried out by heating the diesel fraction with a catalyst.

(i) During cracking, one molecule of $C_{16}H_{34}$ is converted into one molecule of ethene and one molecule of hydrocarbon **X**.
State the formula of **X**.

.....
.....
(1)

(ii) Describe, in terms of the bonds broken and formed, what happens during cracking.

.....
.....
(2)

(c) Step 3 is hydration, which is carried out by heating ethene and steam at a temperature of about $300\text{ }^{\circ}\text{C}$ and a pressure of about 65 atm.

(i) Identify one other condition used in Step 3.

.....
(1)

(ii) Write a chemical equation for the reaction occurring in Step 3.

.....
.....
(2)

QUESTION 11 CONTINUES OVERLEAF



(d) The ethanol formed in Step 3 can be converted into compound Y by heating it with acidified potassium dichromate(VI) solution.

(i) Identify the type of reaction occurring during this conversion.

.....
(1)

(ii) Name compound Y.

.....
(1)

Q11

(Total 14 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

END

