

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0 Group

| | | | | | | | | | | | | | | | | | | |
|---|-----------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|---------------------------|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | | | | | | | | | | |
| 1 | 1 | | | | | | | | | | | | | | | | | |
| 2 | 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | 20 Ne Neon 10 | | | | | | | | | | |
| 3 | 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | 40 Ar Argon 18 | | | | | | | | | | |
| 4 | 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 48 Ti Titanium 22 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 63.5 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 5 | 86 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | 99 Tc Technetium 43 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 |
| 6 | 133 Cs Caesium 55 | 137 Ba Barium 56 | 139 La Lanthanum 57 | 179 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 |
| 7 | 223 Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 | | | | | | | | | | | | | | | |

1
H
Hydrogen
1

4
He
Helium
2

Key

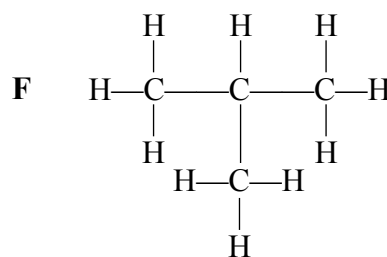
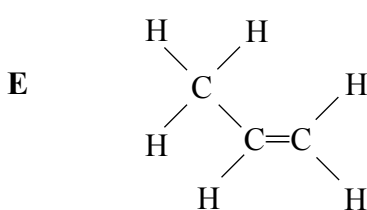
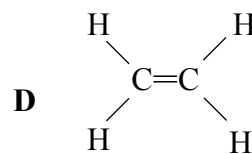
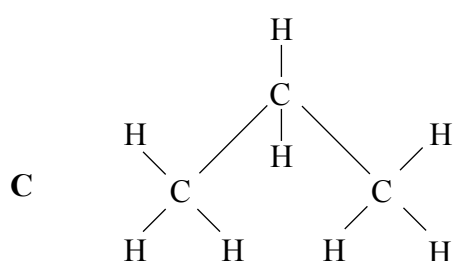
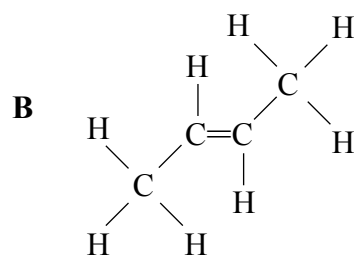
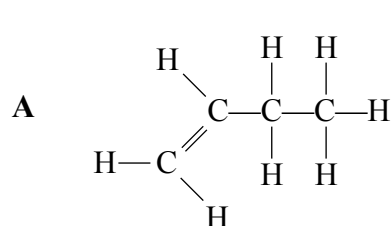
Relative atomic mass
Symbol
Name
Atomic number



H 2 9 1 7 7 A 0 2 1 6

SECTION A

1. These are the structures of six hydrocarbons.



(a) Use the letters of the hydrocarbons to answer these questions.

(i) Give the letter of a hydrocarbon which is **not** an alkene. (1)

(ii) Which structure is propene? (1)

(b) Hydrocarbon **D** forms a polymer. Draw a diagram to represent the structure of the polymer.

Structure of polymer

(2)

Q1

(Total 4 marks)



2. (a) Atoms contain smaller particles. Complete the table to show the relative mass and relative charge of each particle.

| Particle | Relative mass | Relative charge |
|----------|---------------|-----------------|
| electron | | |
| neutron | 1 | |
| proton | | +1 |

(4)

(b) Use the Periodic Table on page 2 to name an element whose atoms

(i) contain equal numbers of protons and neutrons (1)

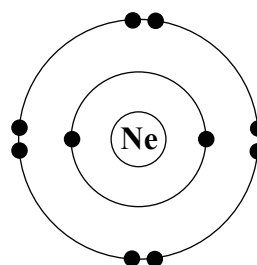
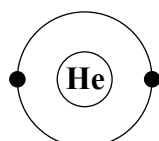
(ii) have the electronic configuration 2.8.4 (1)

(iii) have no neutrons. (1)

(c) Scientists think they will soon make an element that will go directly below astatine in the Periodic Table. Suggest how many electrons an atom of this element would have in its outer electron shell.

..... (1)

(d) The diagrams show the electronic configuration of helium and of neon.



(i) What is the similarity in the outer electron shells of these two atoms?
 (1)

(ii) What effect does this similarity have on the chemical reactivity of helium and neon?
 (1)

(Total 10 marks)

Q2



3. Use information from the table to answer this question.

|  increasing reactivity | Name of metal | Colour of solid metal | Colour of a solution of the metal(II) sulphate |
|--|---------------|-----------------------|--|
| | magnesium | grey | colourless |
| | zinc | grey | colourless |
| | iron | dark grey | green |
| | copper | pink-brown | blue |

(a) When zinc is added to magnesium sulphate solution, no reaction occurs. Explain why.

.....

 (1)

(b) When iron filings are added to copper(II) sulphate solution, a reaction takes place.

(i) Write a chemical equation for this reaction.

.....
 (2)

(ii) Describe the colour changes during this reaction.

Colour change of solid

.....

Colour change of solution

.....
 (4)

(c) When copper is added to dilute sulphuric acid, no reaction occurs. When iron is added to dilute sulphuric acid, hydrogen gas and iron(II) sulphate solution are formed. What does this show about the reactivity of hydrogen compared to the reactivity of copper and the reactivity of iron?

.....

 (2)

(Total 9 marks)

Q3



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blank

4. Hydrogen chloride, HCl, is a covalent compound. It is a colourless gas and is soluble in a number of solvents.

(a) (i) Draw a dot and cross diagram to show the covalent bonding in a molecule of hydrogen chloride. Show outer shell electrons only.

(2)

(ii) Hydrogen chloride has a low boiling point. Put a cross (☒) in the correct box to show the reason for this.

The covalent bonds are strong

The covalent bonds are weak

There are weak forces between the ions

There are weak forces between the molecules

(1)

(b) Chlorine exists as two isotopes. Why do these isotopes have identical chemical properties?

.....
(1)

(c) Iron forms two chlorides, iron(II) chloride and iron(III) chloride. Describe a chemical test that you could use to distinguish between these compounds.

Test

.....

Result with iron(II) chloride

Result with iron(III) chloride

(3)

Q4

(Total 7 marks)

TOTAL FOR SECTION A: 30 MARKS



SECTION B

5. This question is about three elements, **X**, **Y** and **Z**, in Period 3 of the Periodic Table.

X bleaches damp red litmus paper.

Y reacts vigorously with water to form hydrogen gas and an alkaline solution.

The oxide of **Z** reacts with both acids and alkalis to form a solution of a salt.

(a) Using the information above, identify elements **X**, **Y** and **Z**.

X is

Y is

Z is

(3)

(b) Which **two** of the elements **X**, **Y** and **Z** form positive ions in their reactions?

.....

(1)

(c) The solution formed when **Y** reacts with water is alkaline.

State the colour of methyl orange in this solution.

.....

(1)

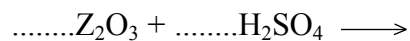
(d) Describe a test to show that the gas formed in the reaction of **Y** with water is hydrogen.

.....

.....

(1)

(e) Complete the chemical equation for the reaction of the oxide of **Z** with sulphuric acid.



(2)

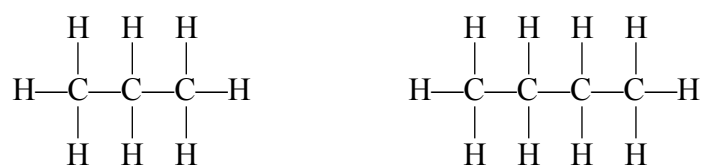
(Total 8 marks)

Q5



6. The alkanes are a homologous series of saturated hydrocarbons.

These are the displayed formulae of two alkanes:



(a) What is the general formula of the alkanes?

..... (1)

(b) State **two** features of the members of a homologous series, other than having the same general formula.

1

.....

2

..... (2)

(c) Why are alkanes described as **saturated**?

.....

..... (1)

(d) Ethanol has the molecular formula $\text{C}_2\text{H}_6\text{O}$.
Why is it not a hydrocarbon?

.....

..... (1)



Leave
blank

(e) Draw the displayed formulae of two isomers which have the molecular formula C_5H_{12} . Give the name of each.

| | |
|----------|--|
| Isomer 1 | |
| Name | |

| | |
|----------|--|
| Isomer 2 | |
| Name | |

(4) Q6

(Total 9 marks)

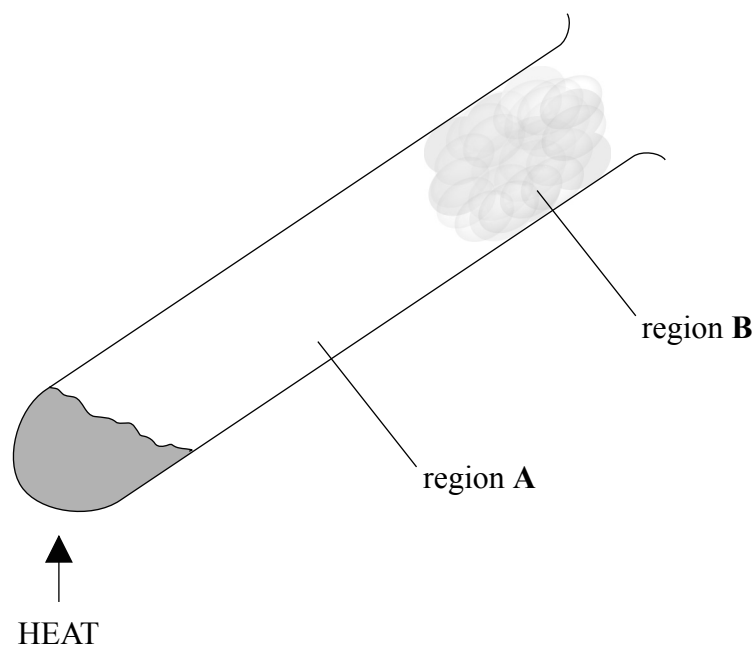
9

Turn over



7. A student carries out some experiments on ammonium chloride, NH_4Cl .

- (a) A sample of ammonium chloride is heated gently in a test tube as shown in the diagram.
A reversible reaction occurs.



What are the names of the **two** substances present in the test tube in region **A**?

- 1
- 2
- (2)**

- (b) The student removes the white solid from region **B** in the test tube.
She heats some of this solid with aqueous sodium hydroxide and tests the gas given off with damp red litmus paper. The litmus paper turns blue.

- (i) Which gas is given off in this reaction?
-
- (1)**

- (ii) What is the formula of the positive ion present in the white solid?
-
- (1)**

- (iii) Write the chemical equation for the reaction that occurs when the white solid is heated with aqueous sodium hydroxide.
-
- (2)**



Leave
blank

(c) The student dissolves some of the white solid in water.
She adds silver nitrate solution and dilute nitric acid. A white precipitate forms.

(i) What is the name of the white precipitate?

.....
(1)

(ii) What is the formula of the negative ion present in the white solid?

.....
(1)

(iii) Complete the chemical equation for the reaction that occurs. Include state symbols.

$\text{NH}_4\text{Cl}(\text{.....}) + \text{AgNO}_3(\text{.....}) \longrightarrow$
(2)

(Total 10 marks)

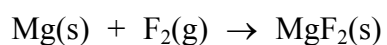
Q7

11

Turn over



8. Magnesium and fluorine react together to form magnesium fluoride:



(a) Give the electronic configuration of

a fluorine atom

a fluoride ion.....

(2)

(b) Draw a diagram to show the arrangement of electrons in a magnesium ion, showing its charge.

(2)

(c) The reaction between magnesium and fluorine is described as a redox reaction because both reduction and oxidation occur.

Identify the substance in the reaction that undergoes reduction and give a reason for your choice.

Substance

Reason

(2)

(d) Magnesium fluoride is an ionic compound.

Why are the magnesium ions attracted to the fluoride ions?

.....

.....

(1)



Leave
blank

- (e) Explain why the melting point of fluorine is much lower than that of magnesium fluoride.

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

(2)

- (f) A sample of magnesium contains three isotopes. The percentages of two isotopes are shown in the table.

| Isotope | ^{24}Mg | ^{25}Mg | ^{26}Mg |
|------------|------------------|------------------|------------------|
| Percentage | 78.6 | 10.1 | |

- (i) Calculate the percentage of ^{26}Mg in the sample.

(1)

- (ii) Calculate the relative atomic mass of this sample of magnesium. Give your answer to one decimal place.

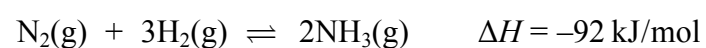
(2)

Q8

(Total 12 marks)



9. The equation for the reaction used to manufacture ammonia in the Haber process is



A temperature of 450°C and a pressure of 200 atmospheres are often used.

(a) Complete the table to show what happens to the rate of reaction and yield of ammonia if the conditions are changed as shown.

| Change | Effect on | |
|-------------------------|------------------|------------------|
| | Rate of reaction | Yield of ammonia |
| decrease in temperature | | |
| addition of catalyst | | |

(4)

(b) State and explain, using the kinetic theory, the effect on the rate of reaction of increasing the concentration of nitrogen in the Haber process.

.....

.....

.....

.....

.....

(3)

(c) Under the conditions used in the Haber process the yield of ammonia is about 15%. What happens to the unreacted nitrogen and hydrogen?

.....

.....

(1)



Leave
blank

(d) Ammonia is used to manufacture nitric acid. The word equations for the process are:

Reaction 1 ammonia + oxygen → nitrogen monoxide + water

Reaction 2 nitrogen monoxide + oxygen → nitrogen dioxide

Reaction 3 nitrogen dioxide + oxygen + water → nitric acid

(i) The same type of reaction occurs in Reactions 1, 2 and 3.

Name this type of reaction.

.....
(1)

(ii) Write a chemical equation for Reaction 2.

.....
(2)

(e) An important fertiliser is made by reacting ammonia with nitric acid.

Give the formula for this fertiliser.

.....
(1)

(f) Name the elements, other than nitrogen, that an NPK fertiliser must contain.

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

Q9

(Total 14 marks)

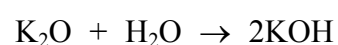
PLEASE TURN OVER FOR QUESTION 10



10. Some reactions of potassium compounds are shown in this sequence.



The chemical equation for Reaction 1 is



- (a) Give the name of a reagent that can be added to potassium hydroxide in Reaction 2 and write a chemical equation for the reaction.

Name

Equation

(2)

- (b) An 18.8 g sample of potassium oxide, K_2O , is used in Reaction 1.

- (i) Calculate the relative formula mass of

K_2O

KOH

(2)

- (ii) Calculate the maximum mass, in g, of potassium hydroxide, KOH , that can be formed from 18.8 g of potassium oxide, K_2O .

(2)

- (c) A student carries out similar reactions involving rubidium compounds. When rubidium hydroxide reacts with hydrochloric acid the products are rubidium chloride and water. Write a chemical equation for this reaction.

.....

(1)

Q10

(Total 7 marks)

TOTAL FOR SECTION B: 60 MARKS

TOTAL FOR PAPER: 90 MARKS

END

