

# AS LEVEL CHEMISTRY

## PAPER 1

### PRACTICE PAPER 24

**(structured questions only)**

Answer all questions

Max 80 marks

Name	.....		
Mark	...../80	.....%	Grade .....

**Note – this paper only contains structured questions**

1. (a) The two isotopes normally found in a sample of nitrogen are  $^{14}\text{N}$  and  $^{15}\text{N}$ . Compare these two isotopes in terms of their fundamental particles. State and explain the difference, if any, in the chemical properties of these two isotopes.

.....

.....

.....

.....

.....

(4)

- (b) State the block in the Periodic Table to which nitrogen belongs and explain your answer.

Give the electron arrangement of the  $\text{N}^{3-}$  ion.

.....

.....

.....

.....

(3)

(Total 7 marks)

2. (a) Acceleration and detection are two processes involved in obtaining the mass spectrum of a vaporised sample of a metal.

Name the other two main processes involved. In each case, identify the part of the mass spectrometer responsible for that process.

.....

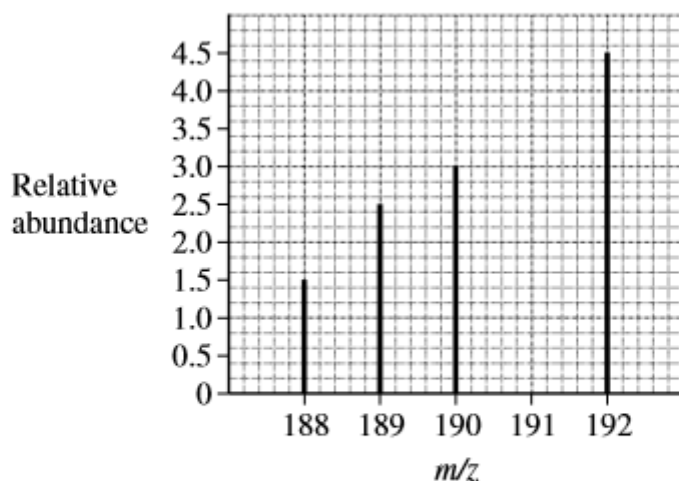
.....

.....

.....

(4)

(b) The diagram below shows the mass spectrum of a gaseous sample of a metal **Z**.



Use the spectrum to calculate the relative atomic mass of **Z**. Give your answer to one decimal place.

Deduce the identity of **Z**.

.....

.....

.....

.....

.....

(4)  
(Total 8 marks)

3. (a) Ammonium carbamate contains 15.38 % of carbon, 7.69 % of hydrogen, 35.90 % of nitrogen and 41.03 % of oxygen by mass.

Use these data to confirm that the empirical formula of ammonium carbamate is  $\text{CH}_6\text{N}_2\text{O}_2$

.....

.....

.....

.....

(2 marks)

(b) When heated, ammonium carbamate,  $\text{H}_2\text{NCOONH}_4$ , decomposes as shown below.



In a closed container, a 7.50 g sample of ammonium carbamate was heated. The solid decomposed completely into ammonia and carbon dioxide at 473 K and 98.7 kPa.

- (i) Calculate the number of moles of ammonium carbamate used and the total number of moles of gas produced.

*Moles of ammonium carbamate used* .....

.....

*Total moles of gas produced* .....

.....

- (ii) State the ideal gas equation and use it, together with your answer from part (b)(i), to calculate the total volume of gas produced at 473 K and 98.7 kPa. Include units in your final answer.

(The gas constant  $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ )

(If you have been unable to obtain an answer to part (b)(i), you should assume that the total number of moles of gas produced is 0.253 mol. This is not the correct answer.)

*Ideal gas equation* .....

*Calculation* .....

.....

.....

.....

(7 marks)

(Total 9 marks)

4. The melting points of the Period 3 elements silicon, sulphur and chlorine are 1683 K, 386 K and 172 K, respectively. Explain, in terms of the structure and bonding present, why the melting point of silicon is very high, and why the melting point of chlorine is lower than that of sulphur.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 7 marks)

5. Diamond and graphite are both giant covalent (macromolecular) forms of carbon. State how the structures of diamond and graphite are different. Briefly explain why diamond is very hard, and why graphite is able to act as a lubricant and as an electrical conductor.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

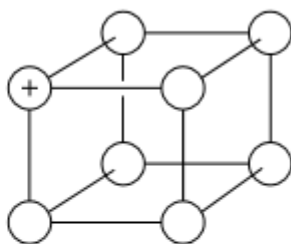
.....

.....

.....

(Total 7 marks)

6. (a) The diagram below represents a part of the structure of sodium chloride. The ionic charge is shown on the centre of only one of the ions.



- (i) On the diagram, mark the charges on the four negative ions.
- (ii) What change occurs to the motion of the ions in sodium chloride when it is heated from room temperature to a temperature below its melting point?

.....  
(2 marks)

- (b) Sodium chloride can be formed by reacting sodium with chlorine.

- (i) Write an equation for this reaction.

.....

- (ii) A chloride ion has one more electron than a chlorine atom. In the formation of sodium chloride, from where does this electron come?

.....  
(2 marks)

- (c) (i) What is a covalent bond?

.....

- (ii) What property of the atoms joined by a covalent bond causes the bond to be polar?

.....  
(3 marks)

(Total 7 marks)

7. When hydrogen and iodine gases are allowed to react, an equilibrium is established according to the following equation.



- (a) State and explain the effect of decreasing the temperature on the equilibrium yield of hydrogen iodide.

*Effect on yield of hydrogen iodide* .....

*Explanation* .....

.....

.....

(3 marks)

- (b) State and explain the effect of increasing the pressure on the equilibrium yield of hydrogen iodide.

*Effect on yield of hydrogen iodide* .....

*Explanation* .....

.....

(2 marks)

- (c) Explain why an increase in the concentration of hydrogen gas increases the equilibrium yield of hydrogen iodide.

*Explanation* .....

.....

(1 mark)

- (d) Explain why the addition of a catalyst does not alter the position of equilibrium.

.....

.....

(2 marks)

(Total 8 marks)

8. (a) State which has the larger atomic radius, a sodium atom or a chlorine atom. Explain your answer.

*Atom with larger atomic radius* .....

*Explanation* .....

.....

.....

.....

(4 marks)

- (b) (i) Give the electron arrangement of the sodium atom.

.....

- (b) (ii) State which has the larger radius, a sodium atom or a sodium ion ( $\text{Na}^+$ ). Explain your answer.

*Larger radius* .....

*Explanation* .....

.....

- (b) (iii) Suggest why a chloride ion ( $\text{Cl}^-$ ) has a larger radius than a chlorine atom.

.....

.....

.....

.....

(5 marks)

- (c) Consider the sulphates and the hydroxides of the Group II elements Mg to Ba

- (c) (i) Give the formula of the **least** soluble sulphate .....

- (c) (ii) Give the formula of the **most** soluble hydroxide .....

(2 marks)

(Total 11 marks)



9. (a) In acidic conditions, hydrogen peroxide,  $\text{H}_2\text{O}_2$ , oxidises iodide ions to iodine. The hydrogen peroxide is reduced to water. In  $\text{H}_2\text{O}_2$ , oxygen has an oxidation state of  $-1$ .

(i) Construct a half-equation for the reduction of hydrogen peroxide to water in acidic conditions.

.....

(ii) Construct a half-equation for the oxidation of  $\text{I}^-$  ions to iodine.

.....

(iii) Construct an equation for the overall reaction.

.....

(3 marks)

(b) Chlorine reacts with water as shown in the following equation.



In this reaction, chlorine acts both as an oxidising agent and as a reducing agent.

(i) Construct a half-equation for the reduction of chlorine to chloride ions.

.....

(ii) Deduce the oxidation state of chlorine in  $\text{HClO}$ .

.....

(iii) Construct a half-equation for the oxidation of chlorine, in reaction with water, to form  $\text{HClO}$  and  $\text{H}^+$  ions.

.....

(iv) Give **one** reason why chlorine is used in the water industry.

.....

(4 marks)

(Total 7 marks)

10. (a) (i) State what is observed when aqueous silver nitrate is added to an aqueous solution containing bromide ions. Write an ionic equation for the reaction which occurs.

*Observation* .....

.....

*Ionic equation* .....

- (ii) State what is observed when an excess of concentrated aqueous ammonia is added to the products formed in part (a)(i).

.....

(3 marks)

- (b) (i) State what is observed when chlorine is added to an aqueous solution containing bromide ions. Write an ionic equation for the reaction which occurs.

*Observation* .....

.....

*Ionic equation*

.....

- (ii) Identify one halide ion, other than chloride, which will not react with chlorine and explain why a reaction does not take place.

*Halide ion* .....

*Explanation* .....

.....

(4 marks)

- (c) Bromine reacts with cold aqueous sodium hydroxide. The reaction is similar to the reaction of chlorine with cold aqueous sodium hydroxide.

Write an equation for the reaction of bromine with cold aqueous sodium hydroxide.

.....

(2 marks)

(Total 9 marks)