GCSE CHEMISTRY

Practice Paper 2 - Higher Tier (Unofficial)

Time Allowed: 1 hour 45 minutes
Total Marks: 100

INSTRUCTIONS TO STUDENTS

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page with your details if required.
- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.
- A Periodic Table is provided as a separate insert if required.
- Calculators may be used.

Information for Candidates

This practice paper is designed to support student revision for the GCSE Chemistry examinations. It contains questions covering atomic structure, bonding, quantitative chemistry, chemical changes, and energy changes. The marks for individual questions and parts of questions are shown in round brackets.

Turn over →

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Question 1 [4 Marks]

For many years, scientists accepted the plum pudding model of the atom before the nuclear model was proposed.

Compare the plum pudding model of the atom and the nuclear model. In your comparison, highlight both similarities and differences between the two models. **(4)**

Question 2 [12 Marks]

The position of elements in the periodic table is determined by their atomic structure and electronic configuration.

(a) Magnesium has an atomic number of 12, and calcium has an atomic number of 20. **(6)**
Write the electronic configurations of magnesium and calcium. Explain, in terms of subatomic particles and configuration, why both magnesium and calcium are placed in Group 2 of the periodic table.

(b) Chlorine, bromine, and iodine are halogens in Group 7 of the periodic table. **(6)**
Explain, in terms of electronic configurations and shielding, why the reactivity of these Group 7 elements decreases down the group.

Question 3 [6 Marks]

Silicon dioxide (SiO_2) is a giant covalent structure found in quartz, while diamond is an allotrope of carbon.

Compare the structure and bonding of silicon dioxide and diamond. Explain why both substances have high melting points and do not conduct electricity. **(6)**

Question 4 [6 Marks]

Water (H2O) is a simple molecular compound that is essential for life.

(a) Draw a dot-and-cross diagram to show the covalent bonding in a water molecule (H2O). You only need to show the outer shell electrons. Explain how the covalent bonds are formed in terms of electrostatic attractions. **(4)**

(b) Explain, in terms of structure and bonding, why water has a relatively low boiling point (100 °C) compared to magnesium oxide, even though the covalent bonds within the water molecule are very strong. **(2)**

Question 5 [6 Marks]

A student is given a table containing physical properties of three unidentified substances: A, B, and C.

Substance	Melting Point / °C	Boiling Point / °C	Electrical Conductivity as Solid	Electrical Conductivity as Liquid	Solubility in Water
Substance A	1083	2562	Conducts	Conducts	Insoluble
Substance B	1713	2950	Does not conduct	Does not conduct	Insoluble
Substance C	601	1420	Does not conduct	Conducts	Soluble

The student claims that Substance A is giant covalent, Substance B is simple molecular, and Substance C is giant ionic.

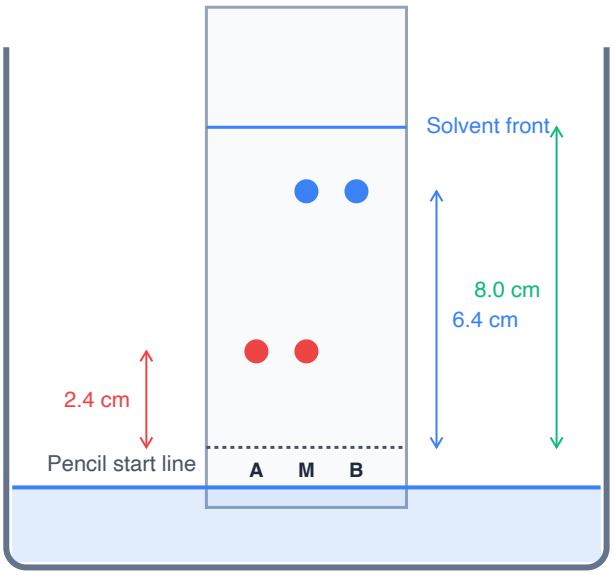
Evaluate the student's claims. For each substance, state whether the claim is correct or incorrect, and explain your reasoning by analyzing the data in the table. **(6)**

Question 6 [4 Marks]

Explain metallic bonding in metals. Describe how this type of bonding explains why metals can conduct electricity and why they are malleable. **(4)**

Question 7 [8 Marks]

A student performs paper chromatography to separate a mixture of food dyes:



(a) Explain how paper chromatography separates different components in a mixture. You must refer to the mobile and stationary phases in your response. **(3)**

(b) State why the starting line on a chromatogram must be drawn in pencil rather than ink. **(1)**

(c) Using the distances shown in the chromatogram on Page 7, calculate the Rf values for Dye A and Dye B. Show your working. **(4)**

Question 8 [5 Marks]

Lithium reacts vigorously with water to form lithium hydroxide and hydrogen gas according to the equation:

$$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

A student reacts 3.50 g of lithium metal with 18.0 g of water.

Show by calculation which reactant is the limiting reactant, and calculate the maximum theoretical mass of lithium hydroxide (LiOH) in grams that can be produced. **(5)**
Relative atomic masses (Ar): H = 1.0; O = 16.0; Li = 7.0

Question 9

[2 Marks]

After completing the reaction from Question 8, the student filters and evaporates the solution. The actual yield of dry lithium hydroxide obtained is 9.00 g.
Calculate the percentage yield of lithium hydroxide. Show your working. **(2)**

Question 10 [4 Marks]

Using the quantities from Question 8, calculate the volume of hydrogen gas (H2) produced in dm3 at room temperature and pressure (RTP). **(4)**

Assume 1 mole of any gas occupies 24.0 dm3 at RTP.

Relative atomic masses (Ar): H = 1.0; O = 16.0; Li = 7.0

Question 11 [6 Marks]

Barium hydroxide solution reacts with nitric acid according to the equation:

$$Ba(OH)_2(aq) + 2HNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + 2H_2O(l)$$

A student titrates 20.0 cm3 of barium hydroxide (Ba(OH)2) solution against a standard nitric acid (HNO3) solution.

The student finds that exactly 25.0 cm3 of 0.050 mol/dm3 nitric acid is required to completely neutralise the 20.0 cm3 sample of barium hydroxide. **(6)**

Calculate the concentration of the barium hydroxide solution in mol/dm3 and in g/dm3. Give your answer to 3 significant figures.

Relative atomic masses (Ar): H = 1.0; N = 14.0; O = 16.0; Ba = 137.0

Question 12 [10 Marks]

A student carries out the electrolysis of aqueous potassium bromide (KBr) using inert carbon electrodes.

(a) State all four chemical ions that are present in an aqueous solution of potassium bromide. **(2)**

(b) Identify the product formed at the positive electrode (anode), write a half-equation for this process, and explain why this product forms preferentially to any other potential products. **(4)**

(c) Identify the product formed at the negative electrode (cathode), write a half-equation for this process, and explain why this product forms preferentially to any other potential products. **(4)**

Question 13 [4 Marks]

A solution of hydrochloric acid (HCl) is diluted, causing its pH to increase from 1.0 to 3.0. Show by calculation and explanation how this change in pH is related to the hydrogen ion concentration, [H+], in the solution. You must include a base-10 logarithmic relationship in your proof. **(4)**

Question 14 [9 Marks]

A student investigates the temperature change during a displacement reaction. They add varying masses of zinc powder to 25.0 cm3 of 0.50 mol/dm3 copper(II) sulfate (CuSO4) solution in a polystyrene cup.

(a) Explain why a polystyrene cup is used rather than a glass beaker to perform this experiment. **(2)**

(b) Write the ionic equation for the displacement reaction that occurs between zinc and copper(II) ions. You must include state symbols. **(2)**

(c) Explain why the temperature of the reaction mixture increases when zinc is first added, and explain why the temperature eventually stops rising as more zinc is added. **(3)**

(d) Write the half-equation to show the oxidation of zinc atoms during the displacement reaction. **(2)**

Question 15 [8 Marks]

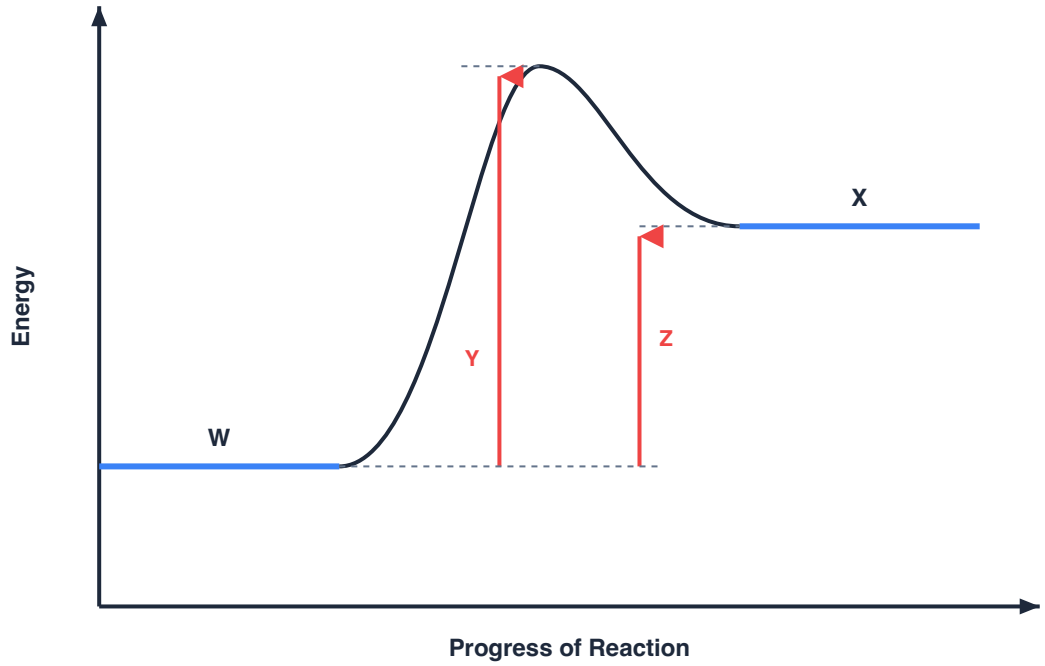
Thermal decomposition of calcium carbonate is a chemical process represented by the equation:

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

The energy changes of this reaction are shown on the energy profile diagram below.

(a) State what is meant by an **endothermic reaction** in terms of energy exchange with the surroundings. **(1)**

(b) Identify the labels on the energy profile diagram below. Specify the chemical species or terms representing labels: W, X, Y, and Z. **(4)**



(c) Explain the thermal decomposition of calcium carbonate as an endothermic reaction in terms of bond breaking and bond making. **(3)**

Question 16 [6 Marks]

Hydrogen gas reacts with bromine vapour to produce hydrogen bromide gas according to the equation:

$$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$$

(a) Calculate the overall enthalpy change (ΔH) in kJ/mol for this reaction using the following bond energies: **(3)**

H-H = 436 kJ/mol; Br-Br = 193 kJ/mol; H-Br = 366 kJ/mol

(b) Explain, in terms of bond breaking and bond making, why the reaction of hydrogen and bromine is exothermic. **(3)**

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Periodic Table

END OF QUESTION PAPER

Group 1				Group 2			
Symbol	Name	Mass	Atomic number	Symbol	Name	Mass	Atomic number
H	Hydrogen	1	1				
Li	Lithium	7	3	Be	Beryllium	9	4
Na	Sodium	23	11	Mg	Magnesium	24	12
K	Potassium	39	19	Ca	Calcium	40	20
Rb	Rubidium	85.5	37	Sr	Strontium	88	38
Cs	Cesium	133	55	Ba	Barium	137	56
Fr	Francium	223	87	Ra	Radium	226	88

Symbol	Name	Mass	Atomic number
Sc	Scandium	45	21
Y	Yttrium	89	39
La*	Lanthanum	139	57
Ac**	Actinium	227	89

* Lanthanides

** Actinides

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