

AS LEVEL CHEMISTRY

PAPER 1

PRACTICE PAPER 20

(structured questions only)

Answer all questions

Max 80 marks

Name		
Mark/80%	Grade

Note – this paper only contains structured questions

1.

(a) Complete the following table.

	Relative mass	Relative charge
Proton		
Electron		

(2 marks)

(b) An atom has twice as many protons and twice as many neutrons as an atom of ^{19}F . Deduce the symbol, including the mass number, of this atom.

.....
(2 marks)

(c) The Al^{3+} ion and the Na^+ ion have the same electron arrangement.

(i) Give the electron arrangement of these ions.

.....

(ii) Explain why more energy is needed to remove an electron from the Al^{3+} ion than from the Na^+ ion.

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

(3 marks)

(d) In a mass spectrometer, gaseous atoms are ionised. These ions are then accelerated.

(i) Explain how atoms are ionised in a mass spectrometer.

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

(ii) State what is used to accelerate ions in a mass spectrometer.

.....

(3 marks)

(e) The table below shows the relative abundance of each isotope in a sample of platinum.

m/z	194	195	196	198
Relative abundance (%)	32.8	30.6	25.4	11.2

Use the data in the table to calculate the relative atomic mass of this sample of platinum.

Give your answer to **one** decimal place.

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

(2 marks)

(Total 12 marks)

2.

(a) State and explain the trend in atomic radius of the elements Na to Cl in Period 3.

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

(4)

- (b) State the meaning of the term *first ionisation energy* of an atom.
State the general trend in the first ionisation energy of the Period 3 elements Na to Ar.
Identify and explain **one** deviation from this general trend.

.....

.....

.....

.....

.....

.....

.....

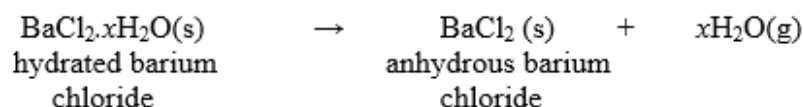
.....

(5)
(Total 9 marks)

3. A solution containing sodium hydroxide, with a small amount of barium hydroxide, can be used as a varnish remover. Safe disposal of the varnish remover after use involves neutralising the excess alkali and removal of paint and varnish residues.

Neutralisation with hydrochloric acid forms a solution containing sodium chloride and barium chloride. Barium chloride can be obtained as a hydrated salt by crystallisation.

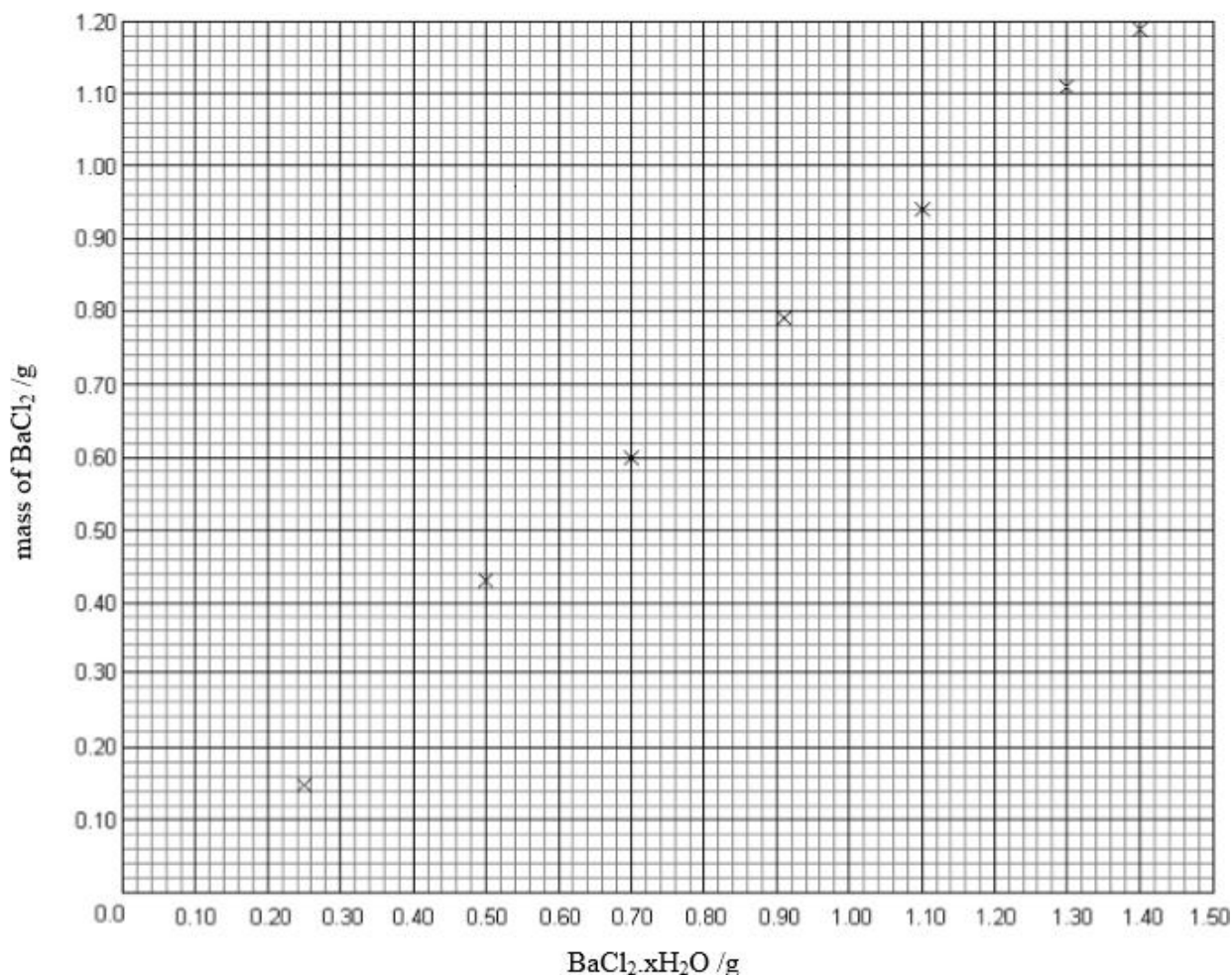
The water of crystallisation in barium chloride crystals can be removed as water vapour by heating as shown in the following equation:



A student weighed a clean dry crucible. The student transferred 0.25 g of hydrated barium chloride to the crucible. The crucible was then heated. When the crucible and its contents had reached constant mass the mass was recorded.

The experiment was repeated using different masses of hydrated barium chloride.

For each experiment the student recorded the original mass of hydrated barium chloride and the mass of anhydrous barium chloride left after heating. The student's results are shown on the graph below.



(a) Draw a straight line of best fit on your graph. (2 marks)

(b) Use the graph to determine the mass of hydrated barium chloride which would have formed 1.00 g of anhydrous barium chloride.

Mass of hydrated barium chloride

(1 mark)

(c) Calculate the number of moles of BaCl_2 present in 1.00 g of anhydrous barium chloride.

.....

.....

(1 mark)

(d) Use your answers to (b) and (c) to calculate the M_r of hydrated barium chloride. Give your answer to the appropriate precision.

.....

.....

.....

(2 marks)

- (e) Use your answer to question 6 to calculate the value of x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$

.....

.....

.....

(1 mark)

- (f) The maximum total error in weighing 0.25 g on the balance was 0.01 g. This error takes into account multiple measurements. Estimate the maximum percentage error in using the balance.

.....

.....

(1 mark)

- (g) Explain why it was unnecessary to use a more precise balance.

.....

.....

(1 mark)

- (h) To remove old varnish a table-top is immersed in hot alkali solution for several hours. Apart from the use of eye protection, suggest **one** appropriate safety precaution.

.....

.....

(1 mark)

- (i) Consider your graph on page 5 and comment on the results obtained by the student. Is your line of best fit good enough for you to use it with confidence? Identify any anomalous results.

.....

.....

.....

(2 marks)

- (j) Explain why it was necessary for the student to heat the crucible to constant mass.

.....

.....

(1 mark)

(k) Pure hydrated barium chloride has the formula $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

(a) Calculate the M_r of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

.....

(b) Calculate the difference between the M_r of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ and the M_r determined in question 6 of the Analysis. Express this as a percentage of the M_r of the literature value.

If you could not complete question 6 of the Analysis section, you should assume that the M_r determined from the graph is 253.2. This is not the correct value.

Difference

Percentage

(2 marks)

(l) Suggest **one** reason in each case why

(a) small amounts of hydrated barium chloride, such as 0.100 g, should **not** be used in this experiment.

.....

.....

(b) large amounts of hydrated barium chloride, such as 50 g, should **not** be used in this experiment

.....

.....

(2 marks)

(m) Barium chloride solution is used to detect the presence of the sulphate ion in a solution. Describe what you would see if the test was positive.

.....

(1 mark)

(n) Barium compounds are toxic but barium sulphate is sometimes given to a patient before an x-ray is taken in hospital. Explain why the patient is not poisoned by the barium sulphate.

.....

(1 mark)

- (o) Anhydrous barium chloride can also be made by reaction of barium and chlorine. Calculate the atom economy of this reaction.

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

(1 mark)

- (p) Use the results of **this** experiment, shown on the graph, to explain why the student was wise to repeat the experiment using different masses of hydrated barium chloride.

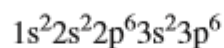
.....
.....
.....

(2 marks)

(Total 22 marks)

4.

- (a) A Period 3 element, E, forms an ion E^{2-} which has the electron arrangement shown below.



Give the electron arrangement of an atom of element E and identify this element.

Electron arrangement of an atom of E

Identity of E

(2 marks)

(b) There is a trend in the electronegativity of the Period 3 elements Na to Cl

(i) Define the term *electronegativity*.

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

(ii) State and explain the trend in the electronegativity of the Period 3 elements Na to Cl

Trend

Explanation

.....
.....

(5 marks)

(c) Some electronegativity values are given below.

	H	F	Cl	Br	I
Electronegativity value	2.1	4.0	3.0	2.8	2.5

(i) Explain why the covalent bond in HF is polar.

.....
.....

(ii) State and explain the trend in polarity of the covalent bonds in the hydrogen halides HF, HCl, HBr and HI

Trend

Explanation

.....

(3 marks)

(d) The boiling points of some hydrogen halides are shown in the table below.

Hydrogen halide	HF	HCl	HBr	HI
Boiling point / K	293	188	206	238

Explain, in terms of the intermolecular forces present, why

(i) the boiling point of HF is much higher than those of the other hydrogen halides.

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

(ii) the boiling points increase from HCl to HI

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

(6 marks)

(Total 16 marks)

5.

The compound HClO decomposes according to the following equation.



(a) (i) Deduce the oxidation states of chlorine in the following species

HClO

Cl₂

ClO₃⁻

(ii) Comment on the redox behaviour of HClO in this reaction.

.....
.....

(4 marks)

- (b) (i) Write the half-equation to show how HClO is converted, in acid solution, into chlorine gas.

.....

- (ii) Write the half-equation to show how aqueous HClO is converted into ClO₃⁻ ions and H⁺ ions.

.....

(2 marks)

(Total 6 marks)

6.

- (a) State the trend in the reducing ability of the halide ions from fluoride to iodide.

..... (1)

- (b) Concentrated sulphuric acid reacts with solid potassium iodide to form a mixture of products. These products include sulphur dioxide and iodine.

Write half-equations for the formation of iodine from iodide ions, and for the formation of sulphur dioxide from sulphuric acid. Hence write an overall equation for the formation of these products from iodide ions and sulphuric acid.

Identify one other reduction product formed in the reaction between sulphuric acid and solid potassium iodide.

.....
.....
.....
..... (4)

- (c) State what you would observe when aqueous bromine reacts with a solution of potassium iodide. Write an equation for the reaction. State the role of bromine in the reaction.

.....
.....
..... (3)

- (d) Give a reagent which could be used to distinguish between separate solutions of potassium bromide and potassium iodide. State what would be observed when this reagent is added to each of the separate solutions of potassium bromide and potassium iodide. Write an equation for **one** of the reactions.

Identify a reagent which could be added to the mixtures from the first test to confirm the identity of the halide ions. State what would be observed in each case.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(7)

(Total 15 marks)