**AS LEVEL CHEMISTRY**

**PAPER 1**

**PRACTICE PAPER 8**

Answer all questions

Max 80 marks

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|  | Name …………………………………………………………….. |  |
|  | Mark ……../80 ……....% Grade ……… |  |

**Note – this paper only contains 5 multiple choice questions**

**1.**          The following diagram shows the first ionisation energies of some Period 3 elements.



(a)     Draw a cross on the diagram to show the first ionisation energy of aluminium.

**(1)**

(b)     Write an equation to show the process that occurs when the first ionisation energy of aluminium is measured.

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**(2)**

(c)     State which of the first, second or third ionisations of aluminium would produce an ion with the electron configuration 1s2 2s2 2p6 3s1

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**(1)**

(d)     Explain why the value of the first ionisation energy of sulfur is less than the value of the first ionisation energy of phosphorus.

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**(2)**

(e)     Identify the element in Period 2 that has the highest first ionisation energy and give its electron configuration.

Element .......................................................................................................

Electron configuration ..................................................................................

**(2)**

(f)      State the trend in first ionisation energies in Group 2 from beryllium to barium.
Explain your answer in terms of a suitable model of atomic structure.

Trend …........................................................................................................

Explanation ..................................................................................................

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**(3)**

**(Total 11 marks)**

**2.** Chlorine is an important industrial chemical.

(a)     Chlorine is formed when KMnO4 reacts with hydrochloric acid.

The ionic equation for this redox reaction is

16H+   +   2MnO4−   +   10Cl−      2Mn2+   +   8H2O   +   5Cl2

(i)      Deduce the half-equation for the oxidation of chloride ions to chlorine.

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**(1)**

(ii)     Give the oxidation state of manganese in the MnO4− ion.

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**(1)**

(iii)    Deduce the half-equation for the reduction of the MnO4− ions in acidified solution to manganese(II) ions and water.

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**(1)**

(b)     Chlorine behaves as an oxidising agent in the extraction of bromine from seawater.

In this process, chlorine gas is bubbled through a solution containing bromide ions.

(i)      Write the **simplest ionic** equation for the reaction of chlorine with bromide ions.

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**(1)**

(ii)     Give **one** observation that would be made during this reaction.

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**(1)**

(iii)    In terms of electrons, state the meaning of the term **oxidising agent**.

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**(1)**

(c)     In sunlight, chlorine can also oxidise water slowly to form oxygen.

Write an equation for this reaction.

Give the oxidation state of chlorine in the chlorine-containing species that is formed.

Equation

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Oxidation state of chlorine in the species formed ...........................................

**(2)**

(d)     Explain why chlorine has a lower boiling point than bromine.

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**(2)**

**(Total 10 marks)**

**3.** (a)     The following is an equation for a redox reaction.

2NO   +   12H+   +   10I–   →   2NH4+   +   2H2O   +   5I2

(i)      Define *oxidation* in terms of electrons.

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(ii)     Deduce the oxidation state of nitrogen in NO and of nitrogen in NH4+

*Oxidation state of nitrogen in NO* .......................................................

*Oxidation state of nitrogen in NH4+* ......................................................

(iii)     Identify the species formed by oxidation in this reaction..........................

**(4)**

(b)     When chlorine gas is bubbled into an aqueous solution of sulphur dioxide, hydrogen ions, sulphate ions and chloride ions are formed.

(i)      Write a half-equation for the formation of chloride ions from chlorine.

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(ii)     Write a half-equation for the formation of hydrogen ions and sulphate ions from sulphur dioxide and water.

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(iii)     Hence, deduce an overall equation for the reaction which occurs when chlorine is bubbled into aqueous sulphur dioxide.

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**(3)**

**(Total 7 marks)**

**4.**      (a)     Lead(II) nitrate may be produced by the reaction between nitric acid and lead(II) oxide as shown by the equation below.

PbO + 2HNO3 → Pb(NO3)2 + H2O

An excess of lead(II) oxide was allowed to react with 175 cm3 of 1.50 mol dm–3 nitric acid. Calculate the maximum mass of lead(II) nitrate which could be obtained from this reaction.

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**(4)**

(b)     An equation representing the thermal decomposition of lead(II) nitrate is shown below.

2Pb(NO3)2(s) → 2PbO(s) + 4NO2(g) + O2(g)

A sample of lead(II) nitrate was heated until the decomposition was complete. At a temperature of 500 K and a pressure of 100 kPa, the total volume of the gaseous mixture produced was found to be 1.50 × 10–4 m3.

(i)      State the ideal gas equation and use it to calculate the total number of moles of gas produced in this decomposition.
(The gas constant *R* = 8.31 J K–1 mol–1)

*Ideal gas equation* ...............................................................................

*Total number of moles of gas* ..............................................................

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(ii)     Deduce the number of moles, and the mass, of NO2 present in this gaseous mixture. (If you have been unable to calculate the total number of moles of gas in part (b)(i), you should assume this to be 2.23 × 10–3 mol. This is not the correct answer.)

*Number of moles of NO*2 ......................................................................

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*Mass of NO*2........................................................................................

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**(7)**

**(Total 11 marks)**

**5.**          The table below shows the electronegativity values of some elements.

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| --- | --- | --- | --- | --- | --- | --- |
|   | Fluorine | Chlorine | Bromine | Iodine | Carbon | Hydrogen |
| Electronegativity | 4.0 | 3.0 | 2.8 | 2.5 | 2.5 | 2.1 |

(a)     Define the term *electronegativity*.

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**(2)**

(b)     The table below shows the boiling points of fluorine, fluoromethane (CH3F ) and hydrogen fluoride.

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| --- | --- | --- | --- |
|   | F–F |  | H–F |
| Boiling point/K | 85 | 194 | 293 |

(i)      Name the strongest type of intermolecular force present in:

Liquid F2 ..............................................................................................

Liquid CH3F ........................................................................................

Liquid HF ............................................................................................

(ii)     Explain how the strongest type of intermolecular force in liquid HF arises.

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**(6)**

(c)     The table below shows the boiling points of some other hydrogen halides.

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| --- | --- | --- | --- |
|   | HCl | HBr | HI |
| Boiling point / K | 188 | 206 | 238 |

(i)      Explain the trend in the boiling points of the hydrogen halides from HCl to HI.

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(ii)     Give **one** reason why the boiling point of HF is higher than that of all the other hydrogen halides.

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**(3)**

**(Total 11 marks)**

 **6.** There are many uses for compounds of barium.

(a)     (i)      Write an equation for the reaction of barium with water.

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**(1)**

(ii)     State the trend in reactivity with water of the Group 2 metals from Mg to Ba

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**(1)**

(b)     Give the formula of the **least** soluble hydroxide of the Group 2 metals from Mg to Ba

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**(1)**

(c)     State how barium sulfate is used in medicine.
Explain why this use is possible, given that solutions containing barium ions are poisonous.

Use .................................................................................................................

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Explanation ....................................................................................................

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 **(2)**

**(Total 5 marks)**

**7.** (a)     Anhydrous strontium chloride is not used in toothpaste because it absorbs water from the atmosphere. The hexahydrate, SrCl2.6H2O, is preferred.

A chemist was asked to determine the purity of a sample of strontium chloride hexahydrate. The chemist weighed out 2.25 g of the sample and added it to 100 cm3 of water. The mixture was warmed and stirred for several minutes to dissolve all of the strontium chloride in the sample. The mixture was then filtered into a conical flask. An excess of silver nitrate solution was added to the flask and the contents swirled for 1 minute to make sure that the precipitation was complete.

The silver chloride precipitate was separated from the mixture by filtration. The precipitate was washed several times with deionised water and dried carefully. The chemist weighed the dry precipitate and recorded a mass of 1.55 g.

(i)      Calculate the amount, in moles, of AgCl in 1.55 g of silver chloride (*M*r = 143.4).

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**(1)**

(ii)     The equation for the reaction between strontium chloride and silver nitrate is

SrCl2    +    2AgNO3   2AgCl    +    Sr(NO3)2

Use your answer from part (i) and this equation to calculate the amount, in moles, of SrCl2 needed to form 1.55 g of silver chloride.

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**(1)**

(iii)    Use data from the Periodic Table to calculate the *M*r of strontium chloride hexahydrate. Give your answer to 1 decimal place.

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**(1)**

(iv)    Use your answers from parts (a)(ii) and (a)(iii) to calculate the percentage by mass of strontium chloride hexahydrate in the sample. Show your working.
Give your answer to the appropriate precision.

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**(2)**

(v)     Several steps in the practical procedure were designed to ensure an accurate value for the percentage by mass of strontium chloride hexahydrate in the sample.

1       Explain why the solution of strontium chloride was filtered to remove insoluble impurities before the addition of silver nitrate.

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**(1)**

2       Explain why the precipitate of silver chloride was washed several times with deionised water.

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**(1)**

(b)     Magnesium hydroxide and magnesium carbonate are used to reduce acidity in the stomach. Magnesium hydroxide can be prepared by the reaction of solutions of magnesium chloride and sodium hydroxide.

(i)      Write the **simplest ionic** equation for the reaction that occurs between magnesium chloride and sodium hydroxide.
Include state symbols in your equation.

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**(1)**

(ii)     Other than cost, explain one advantage of using magnesium hydroxide rather than magnesium carbonate to reduce acidity in the stomach.

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**(1)**

(c)     Calcium ethanoate, (CH3COO)2Ca, is used in the treatment of kidney disease.
Thermal decomposition of calcium ethanoate under certain conditions gives propanone and **one** other product.

Write an equation for the thermal decomposition of calcium ethanoate.

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**(1)**

(d)     Salts containing the chromate(VI) ion are usually yellow in colour.
Calcium chromate(VI) is soluble in water.
Strontium chromate(VI) is insoluble in water, but will dissolve in a solution of ethanoic acid.
Barium chromate(VI) is insoluble in water and is also insoluble in a solution of ethanoic acid.

Describe a series of tests using solutions of sodium chromate(VI) and ethanoic acid that would allow you to distinguish between separate solutions of calcium chloride, strontium chloride and barium chloride.
State what you would observe in each test.

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**(3)**

(e)     The strontium salt of ranelic acid is used to promote bone growth. Analysis of a pure sample of ranelic acid showed that it contained 42.09% of carbon, 2.92% of hydrogen, 8.18% of nitrogen, 37.42% of oxygen and 9.39% of sulfur by mass.

Use these data to calculate the empirical formula of ranelic acid.
Show your working.

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**(2)**

**(Total 15 marks)**

**8.** (a)     Suggest **one** reason why sugars are often added to antacid tablets.

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**(1)**

(b)     In one titration, a student added significantly more phenolphthalein than instructed.

The volume of sodium hydroxide solution in this titration was greater than the average value of the concordant titres.

State a property of the indicator that would explain this result.

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**(1)**

(c)     Some other types of antacid tablets contain carbonate ions.

Suggest why this may be a disadvantage when used as a medicine to relieve indigestion.

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**(1)**

**(Total 3 marks)**

**9.** (a)     State why it is necessary to maintain a constant temperature in an experiment to measure an equilibrium constant.

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**(1)**

(b)     Suggest **one** method for maintaining a constant temperature in an experiment.

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**(1)**

**(Total 2 marks)**

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| **10 – 11.** |  |
| **10.** |  |
| **11.** |  |
| **12.** |  |
| **13.** | Which of the following is not a product formed when hydrogen iodide reacts with concentrated sulphuric acid?A SO2B SC H2SD SO3 |

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| **14.** |  |