**AS LEVEL CHEMISTRY**

**PAPER 1**

**PRACTICE PAPER 4**

Answer all questions

Max 80 marks

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

**Note – the multiple choice questions used in this paper are recycled from the assessed homeworks, tests and assessment points for the AS-level/1st Year course**

**1.**      (a)     (i)      Define the term *relative atomic mass* (*A*r) of an element.

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**(2)**

(ii)     A sample of the metal silver has the relative atomic mass of 107.9 and exists as two isotopes. In this sample, 54.0% of the silver atoms are one isotope with a relative mass of 107.1

Calculate the relative mass of the other silver isotope.

State why the isotopes of silver have identical chemical properties.

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**(4)**

(b)     The isotopes of silver, when vaporised, can be separated in a mass spectrometer.

Name the **three** processes that occur in a mass spectrometer before the vaporised isotopes can be detected.

State how each process is achieved.

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 **(6)**

(c)     State the type of bonding involved in silver.

Draw a diagram to show how the particles are arranged in a silver lattice and show the charges on the particles.

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**(3)**

(d)     Silver reacts with fluorine to form silver fluoride (AgF).

Silver fluoride has a high melting point and has a structure similar to that of sodium chloride.

State the type of bonding involved in silver fluoride.

Draw a diagram to show how the particles are arranged in a silver fluoride lattice and show the charges on the particles.

Explain why the melting point of silver fluoride is high.

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 **(5)**

**(Total 20 marks)**

 **2.** (a)     A mixture of 1.50 mol of hydrogen and 1.20 mol of gaseous iodine was sealed in a container of volume V dm3. The mixture was left to reach equilibrium as shown by the following equation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| H2(g) | + | l2(g) |  | 2Hl(g) |

At a given temperature, the equilibrium mixture contained 2.06 mol of hydrogen iodide.

(i)      Calculate the amounts, in moles, of hydrogen and of iodine in the equilibrium mixture.

Moles of hydrogen ................................................................................

Moles of iodine ......................................................................................

**(2)**

(ii)     Write an expression for the equilibrium constant (*K*c) for this equilibrium.

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**(1)**

(iii)    *K*c for this equilibrium has no units.
State why the units cancel in the expression for *K*c

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**(1)**

(iv)     A different mixture of hydrogen, iodine and hydrogen iodide was left to reach equilibrium at the same temperature in a container of the same volume.
This second equilibrium mixture contained 0.38 mol of hydrogen, 0.19 mol of iodine and 1.94 mol of hydrogen iodide.

Calculate a value for *K*c for this equilibrium at this temperature.

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 **(2)**

(b)     This question concerns changes made to the four equilibria shown in parts (b)(i) to (b)(iv).
In each case, use the information in the table to help you choose from the letters **A** to **E** the best description of what happens as a result of the change described. Write your answer in the box.

Each letter may be used once, more than once or not at all.

|  |  |  |
| --- | --- | --- |
|   | **Position of equilibrium** | **Value of equilibrium constant, *K*c** |
| **A** | remains the same | same |
| **B** | moves to the right | same |
| **C** | moves to the left | same |
| **D** | moves to the right | different |
| **E** | moves to the left | different |

(i)      Change: increase the temperature of the equilibrium mixture at constant pressure.

H2(g)     +     I2(g)          2Hl(g)∆*H*ϴ = +52 kJ mol–1   

**(1)**

(ii)     Change: increase the total pressure of the equilibrium mixture at constant temperature.

3H2(g)     +     N2(g)          2NH3(g)∆*H*ϴ = -92 kJ mol–1   

**(1)**

(iii)    Change: add a catalyst to the equilibrium mixture at constant temperature.

CO(g)   +   H2O(g)      CO2(g)   +   H2(g)∆*H*ϴ = -41 kJ mol–1   

**(1)**

(iv)    Change: add chlorine to the equilibrium mixture at constant temperature.

PCl5(g)          PCl3(g)     +     Cl2(g)∆*H*ϴ = +93 kJ mol–1   

**(1)**

**(Total 10 marks)**

**3.** The elements in Group 2 from Mg to Ba can be used to show the trends in properties down a group in the Periodic Table.

(a)     State the trend in atomic radius for atoms of the elements down Group 2 from Mg to Ba

Give a reason for this trend.

Trend ..............................................................................................................

Reason ...........................................................................................................

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**(2)**

(b)     The Group 2 elements react with water.

(i)      State the trend in reactivity with water of the elements down Group 2 from Mg to Ba

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**(1)**

(ii)     Write an equation for the reaction of strontium with water.

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**(1)**

(c)     Give the **formula** of the hydroxide of the element in Group 2 from Mg to Ba that is most soluble in water.

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**(1)**

**(Total 5 marks)**

**4.**      (a)     Concentrated sulphuric acid can be reduced by some solid sodium halides to H2S

(i)      Give the oxidation state of sulphur in H2S

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(ii)     Give **one** solid sodium halide which will reduce concentrated sulphuric acid, forming H2S

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(iii)     State **one** way in which the presence of H2S could be recognised.

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(iv)    Write a half-equation for the formation of H2S from sulphuric acid.

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**(4)**

(b)     A different solid sodium halide reacts with concentrated sulphuric acid without reduction forming a halogen-containing product **X**.

(i)      Suggest an identity for **X**.

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(ii)     Identify the solid sodium halide which produces **X**.

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(iii)     State the role of sulphuric acid in the formation of **X**.

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(iv)    Write an equation for the reaction with concentrated sulphuric acid in which **X** is formed.

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**(4)**

**(Total 8 marks)**

**5.** A vinegar solution was obtained from a leading supplier. The label gave the concentration of ethanoic acid as 56.1 gdm-3. A student was asked to check the concentration of the acid using standard sodium hydroxide solution.

 The student decided to use a measuring cylinder to obtain 25.0 cm3 of the supplier’s solution. This was poured into a 250 cm3 graduated flask and the liquid level was made up to the mark with de-ionised water. The student filled a burette with the acid solution. The following results were obtained when 25.0 cm3 portions of sodium hydroxide solution of concentration 0.100 moldm-3, measured by pipette, were titrated against the acid solution using phenolphthalein as indicator.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Titration number | 1 | 2 | 3 | 4 | 5 |
| Final burette reading/cm3 | 28.60 | 28.00 | 28.25 | 28.15 | 40.75 |
| Initial burette reading/cm3 | 0.05 | 0.05 | 0.05 | 0.10 | 12.75 |

(a) Assume that the only acid present in vinegar is ethanoic acid (Mr = 60). Representing ethanoic acid as HA, write an equation for the reaction of HA with sodium hydroxide

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(b) Use all of the concordant results in the table above to determine an average titre.

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(c) Determine the concentration in moldm-3, of the diluted acid solution.

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(d) Use your answer from part 3, determine the concentration in gdm-3, of the acid in the original solution.

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(e) Assume the maximum errors for the apparatus used in this experiment were

 25 cm3 measuring cylinder = +- 0.5 cm3

 250 cm3 volumetric flask = +- 0.5 cm3

 25 cm3 pipette = +- 0.05 cm3

 burette total error = +- 0.15 cm3

 Estimate the percentage maximum errors for the apparatus used in this experiment, and hence the maximum overall apparatus error.

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(f) By analysis of results given, comment on the consistency of the titration results.

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(g) Calculate the difference between the concentration determined by the student and the value given by the supplier. Express this as percentage of the supplier’s value.

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(h) Assuming that the supplier’s analysis was correct, comment on the magnitude of the difference between the value provided by the supplier and your calculated value.

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(i) State how the student’s method of preparing the diluted acid solution could be improved and explain why this would improve the accuracy of the experiment.

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**(Total 14 marks)**

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**(Total 8 marks)**

**7.** Which change requires the largest amount of energy?

**A**        He+(g)      He2+(g) + e–          

**B**        Li(g)        Li+(g) + e–             

**C**        Mg+(g)    Mg2+(g) + e–           

**D**        N(g)       N+(g) + e–               

**(Total 1 mark)**

**8.** A sample of 2.18 g of oxygen gas has a volume of 1870 cm3 at a pressure of 101 kPa.

What is the temperature of the gas?
The gas constant is *R* = 8.31 J K–1 mol–1.

**A**        167 K                  

**B**        334 K                  

**C**        668 K                  

**D**        334 000 K           

**(Total 1 mark)**

**9.** A saturated aqueous solution of magnesium hydroxide contains 1.17 × 10–3 g of Mg(OH)2 in 100 cm3 of solution. In this solution, the magnesium hydroxide is fully dissociated into ions.

What is the concentration of Mg2+(aq) ions in this solution?

**A**        2.82 × 10–2mol dm–3        

**B**        2.01 × 10–3mol dm–3        

**C**        2.82 × 10–3mol dm–3        

**D**        2.01 × 10–4mol dm–3        

**(Total 1 mark)**

**10.** When one mole of ammonia is heated to a given temperature, 50% of the compound dissociates and the following equilibrium is established.

NH3(g)   N2(g) +  H2(g)

What is the total number of moles of gas present in this equilibrium mixture?

**A**        1.5            

**B**        2.0            

**C**        2.5            

**D**        3.0            

**(Total 1 mark)**

**11.** Magnesium reacts with hydrochloric acid according to the following equation.

Mg + 2HCl  MgCl2 + H2

A student calculated the minimum volume of 2.56 mol dm–3 hydrochloric acid required to react with an excess of magnesium to form 5.46 g of magnesium chloride (*Mr* = 95.3).

Which of the following uses the correct standard form and the appropriate number of significant figures to give the correct result of the calculation?

**A**        4.476 × 10–2 dm3      

**B**        4.48 × 10–2 dm3       

**C**        4.50 × 10–2 dm3       

**D**        44.8 × 10–3 dm3       

**(Total 1 mark)**

**12.** In an experiment to identify a Group 2 metal (X), 0.102 g of X reacts with an excess of aqueous hydrochloric acid according to the following equation.

X + 2HCl  XCl2 + H2

The volume of hydrogen gas given off is 65 cm3 at 99 kPa pressure and 303 K.
The gas constant is *R* = 8.31 J K–1 mol–1.

Which is X?

**A**        Barium              

**B**        Calcium            

**C**        Magnesium       

**D**        Strontium          

**(Total 1 mark)**

**13.** When TiCI4 is reduced with hydrogen under certain conditions, a new compound is produced which contains 68.9% chlorine by mass. Which one of the following could be the formula of the new compound?

**A**       TiH2Cl2

**B**       TiCl

**C**       TiCl2

**D**       TiCl3

**(Total 1 mark)**

**14.** A brand of fluoride tablets, recommended by a dentist to strengthen the enamel on teeth, contains 2.2 × 10−3 sodium fluoride per tablet. The total mass of fluoride ion present in 100 tablets is

**A**       2.2 × 10−3 ×  × 100

**B**       2.2 × 10−3 ×  × 100

**C**       2.2 × 10−3 ×  × 100

**D**       

**(Total 1 mark)**

**15.** A sample of chlorine gas was sealed in a tube, heated and an equilibrium was established.

Cl2(g) **⇌** 2Cl(g)

Which one of the following is **not** true?

**A**       The concentration of chlorine atoms remains the same when a catalyst is added to the tube.

**B**       Increase in temperature causes an increase in the concentration of chlorine atoms.

**C**       Increase in pressure causes an increase in the concentration of chlorine atoms relative to chlorine molecules.

**D**       Addition of more chlorine gas to the tube causes an increase in the concentration of chlorine atoms.

**(Total 1 mark)**

**16.** Which one of the following is the most likely value for the bond angle α shown in the diagram of SF4 below?

 

**A**       118°

**B**       101°

**C**       90°

**D**       88°

**(Total 1 mark)**

**17.** Which one of the following is **not** a correct trend down Group VII?

**A**       The first ionisation energy of the atom decreases.

**B**       The oxidising power of the element increases.

**C**       The electronegativity of the atom decreases.

**D**       The boiling point of the element increases.

**(Total 1 mark)**

**18.** Which one of the following statements is true?

**A**       Bromine liberates iodine from aqueous sodium iodide.

**B**       Chlorine liberates fluorine from aqueous sodium fluoride.

**C**       Silver iodide is soluble in aqueous ammonia.

**D**       Concentrated sulphuric acid liberates chlorine from solid sodium chloride.

**(Total 1 mark)**

**19.** Which atom has an incomplete sub-shell?

**A**       Be

**B**       Ca

**C**       Ge

**D**       Zn

**(Total 1 mark)**

**20.** Photochromic glass contains silver ions and copper ions. A simplified version of a redox equilibrium is shown below. In bright sunlight the high energy u.v. light causes silver atoms to form and the glass darkens. When the intensity of the light is reduced the reaction is reversed and the glass lightens.

Cu+(s) + Ag+(s)  Cu2+(s) + Ag(s)

clear glass          dark glass

Which one of the following is a correct electron arrangement?

**A**       Cu+ is [Ar]3d94s1

**B**       Cu is [Ar]3d104s2

**C**       Cu2+ is [Ar]3d84s1

**D**       Cu+ is [Ar]3d10

**(Total 1 mark)**

**21.** Silver oxide, Ag2O, can be reduced by passing hydrogen gas over the heated oxide. The maximum mass of silver that could be obtained from 2.32 g of silver oxide is

**A**       2.02 g

**B**       2.06 g

**C**       2.12 g

**D**       2.16 g

**(Total 1 mark)**