

# AS LEVEL CHEMISTRY

## PAPER 1

### PRACTICE PAPER 23

#### (structured questions only)

Answer all questions

Max 80 marks

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

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

1. (a) Define the term *atomic number* of an element.

.....  
(1 mark)

(b) Give the symbol, including mass number and atomic number, for an atom of an element which contains 12 neutrons and 11 electrons.

.....  
(2 marks)

(c) In terms of s and p sub-levels, give the electronic configuration of an aluminium atom.

.....  
(1 mark)

(d) How many neutrons are there in one  $^{27}\text{Al}$  atom?

.....  
(1 mark)

(e) Define the term *relative atomic mass* of an element.

.....  
.....  
(2 marks)

- (f) A meteorite was found to contain three isotopes of element **X**. A mass spectrometer gave the following information about these isotopes.

<i>m/z</i>	24.0	25.0	26.0
Relative abundance	64.2	20.3	15.5

- (i) Calculate the relative atomic mass of **X**.

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 .....  
 .....

- (ii) Using the Periodic Table, suggest the most likely identity of element **X**.

.....

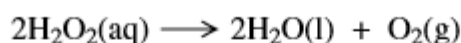
- (iii) Suggest **one** reason why the relative atomic mass of **X**, given in the Periodic Table, differs from your answer to part (g)(i).

.....  
 .....

(5 marks)

(Total 12 marks)

2. (a) Oxygen may be prepared by the decomposition of hydrogen peroxide,  $\text{H}_2\text{O}_2$ , as shown in the equation below.



A  $150 \text{ cm}^3$  sample of  $2.72 \text{ mol dm}^{-3}$  aqueous hydrogen peroxide was decomposed completely.

Calculate the number of moles of hydrogen peroxide in the  $150 \text{ cm}^3$  sample and hence deduce the number of moles of oxygen gas produced.

*Moles of  $\text{H}_2\text{O}_2$  in sample* .....

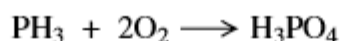
.....

*Moles of  $\text{O}_2$  produced* .....

.....

(3 marks)

- (b) Phosphine,  $\text{PH}_3$ , and oxygen can react to form phosphoric acid,  $\text{H}_3\text{PO}_4$ , as shown in the equation below.



An excess of oxygen was mixed with 1.43 g of phosphine in a sealed container and allowed to react.

- (b) (i) Calculate the number of moles of  $\text{PH}_3$  in 1.43 g of phosphine.

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.....

- (b) (ii) Calculate the number of moles of oxygen which reacted with this amount of phosphine.

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.....

- (b) (iii) Calculate the mass of phosphoric acid formed in this reaction.

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(4 marks)

- (c) After the reaction in part (b) was complete, 0.166 mol of oxygen was left unreacted. The final temperature was 300 K. The volume of the sealed container was  $1725 \text{ cm}^3$ .

State the ideal gas equation and use it to calculate the pressure of the oxygen in the container after the reaction was complete.

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

*Ideal gas equation* .....

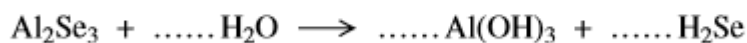
*Pressure* .....

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

(4 marks)

(Total 11 marks)

3. (a) Balance the equation, given below, for the reaction in which  $\text{H}_2\text{Se}$  is formed from  $\text{Al}_2\text{Se}_3$



(1 mark)

- (b) (i) Draw the shape of an  $\text{H}_2\text{Se}$  molecule and the shape of an  $\text{NH}_3$  molecule. In each case show any lone pairs of electrons.



(2 marks)

- (b) (ii) Name the shape produced by the arrangement of **atoms** in an  $\text{H}_2\text{Se}$  molecule.

.....

(1 mark)

- (b) (iii) State the bond angle in an  $\text{NH}_3$  molecule and explain why the bond angle in an  $\text{H}_2\text{Se}$  molecule is smaller than this.

*Bond angle in  $\text{NH}_3$*  .....

*Explanation for smaller bond angle in  $\text{H}_2\text{Se}$*  .....

.....

.....

(3 marks)

- (c) Describe how the covalent bonds are formed in an  $\text{H}_2\text{Se}$  molecule.

.....

.....

.....

(2 marks)

(Total 9 marks)



5. (a) Define the term *standard enthalpy of formation*.

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(3 marks)

(b) Write an equation, including state symbols, for the reaction with an enthalpy change equal to the standard enthalpy of formation of liquid nitric acid, HNO<sub>3</sub>

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.....

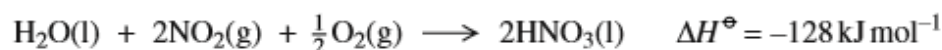
(2 marks)

(c) State Hess's Law.

.....  
.....

(1 mark)

(d) Nitric acid can be made by reacting water, nitrogen dioxide and oxygen according to the following equation.



Some standard enthalpies of formation,  $\Delta H_f^\ominus$ , are given in the table below.

Substance	H <sub>2</sub> O(l)	NO <sub>2</sub> (g)	O <sub>2</sub> (g)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-286	+34	0

(i) State why the standard enthalpy of formation of O<sub>2</sub>(g) is zero.

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.....

(1 mark)

(ii) Use the data above to calculate a value for the standard enthalpy of formation of nitric acid.

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.....

(4 marks)

(Total 11 marks)





- (c) (i) A naturally occurring compound of calcium contains by mass 23.29% of calcium, 18.64% of sulphur and 2.32% of hydrogen, the remainder being oxygen. Determine the empirical formula of this compound.

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- (ii) For any compound, what is the relationship between empirical and molecular formula? What additional information is required to determine a molecular formula from an empirical formula?

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(5)  
(Total 17 marks)

7. (a) Identify the halogen that is the strongest oxidising agent.

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(1 mark)

- (b) Give the formula of the halide ion that is the strongest reducing agent.

.....  
(1 mark)

- (c) Describe what you would observe in each case when aqueous silver nitrate is added separately to dilute aqueous sodium fluoride and to dilute aqueous sodium iodide. Write an equation, including state symbols, for the reaction between aqueous sodium iodide and aqueous silver nitrate.

*Observation with NaF(aq)* .....

*Observation with NaI(aq)* .....

*Equation* .....

(3 marks)

- (d) Describe what you would observe when concentrated sulphuric acid is added to solid sodium chloride. Write an equation for the reaction that occurs.

*Observation* .....

*Equation* .....

(2 marks)

- (e) Describe two observations that you would make when concentrated sulphuric acid is added to solid sodium iodide. Write an equation for a reaction that occurs in which iodide ions are oxidised by the sulphuric acid.

*Observation 1* .....

*Observation 2* .....

*Equation* .....

.....

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*(4 marks)*

**(Total 11 marks)**