

## **PART 4 (18marks = % of paper)**

Answer the following extended answer question. Where applicable use equations, diagrams and illustrative examples of the chemistry you are describing.

Marks are awarded principally for the relevant chemical content of your answer, and also for coherence and clarity of expression. Your answer should be presented in about 1½ to 2 pages on the lined paper after the questions.

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1. One of the most important techniques in analytical chemistry is **volumetric analysis where titrations are used** to find the concentrations of unknown solutions. Much care has to be exercised as the amounts of active reagents are generally extremely small.  
**Choose ONE of the following titration examples and use it to describe the experimental techniques used in a typical volumetric titration.**
  - (a) Finding the percentage of iron in steel wire.
  - (b) Finding the amount of ethanoic acid in vinegar.

Set out your answer using the following sub-headings:

*Cleaning glassware.*

*Steps and techniques used.*

*List of calculation steps used to work out your answer – there is no need to use any numerical data.*

A1. Pure substances are often classified into one of the four types of solids:

- |                   |                     |
|-------------------|---------------------|
| a) ionic solids   | c) metals           |
| b) network solids | d) molecular solids |

Describe with EXAMPLES, the NATURE of the bonding present and relate this to their physical properties.

A2. Consider the elements of the PERIODIC TABLE in the row from Sodium to Argon. For each of these elements discuss the relationship that exists between ELECTRONIC CONFIGURATION, VALENCY and TYPE of bonding exhibited by the element.

A3. Write an essay on the chemistry of water. Include:

- a) bonding within the H<sub>2</sub>O molecule
- b) bonding between H<sub>2</sub>O molecules
- c) special properties of water, related to its bonding and structure
- d) the role of H<sub>2</sub>O as a SOLVENT

A4. "An understanding of the three dimensional structure of a covalent molecule enables its polarity and intermolecular forces to be predicted". Expand on this statement, discussing the following topics:

- |                                   |                           |
|-----------------------------------|---------------------------|
| i) electron pair repulsion theory | iii) molecular polarity   |
| ii) shapes of molecules           | iv) intermolecular forces |

Use water, methane, carbon dioxide and ammonia, and other molecules as examples.

A5. Discuss the chemistry of water.

A6 Describe and explain, in terms of forces between species such as molecules and ions, the factors governing the solubilities of solids in the following liquids:

heptane  
water  
dilute acids  
water solutions of salts

**(NOTE: Expressions such as “like dissolves like” are not explanations”).**

A7. Bonds range from pure covalent through polar covalent to ionic.

Discuss this statement using binary compounds (compounds of two elements) as examples. In your discussion:

- clearly state how and why the progression from pure covalent to ionic bonding occurs, and
- explain how bonding type influences the properties of the compounds.

A8 *Why substances dissolve.*

Discuss this topic, illustrating your answer with examples.

**C      *ACIDS and BASES***

- C1. Fertilisers are a group of chemicals essential to agriculture. Describe the chemical composition and use of different types of fertiliser and discuss the use of trace elements. (1 page).
- C2. Describe how, starting with a standardised solution of  $0.100 \text{ mol L}^{-1}$  hydrochloric acid and a few pellets of sodium hydroxide, you would determine the concentration of ethanoic (acetic) acid in a commercial brand of vinegar which is known to be approximately  $1 \text{ mol L}^{-1}$ . Your answer should cover the following points:
- a) the procedures for preparing the necessary solutions.
  - b) the essential practical details for performing the titrations.
  - c) techniques employed for washing and rinsing the apparatus.
  - d) suitable indicators and their colour changes.
  - e) care taken to ensure accuracy.
- C3. Discuss the chemistry of acids and bases using the following topics as a guide to the development of your answer.
- i) theories of acidity and basicity

- ii) strong and weak acids and gases
- iii) amphoteric substances
- iv) the pH scale
- v) uses of acids and bases

C4. Describe the commercial and industrial importance of the strong inorganic acids  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  and  $\text{HCl}$ . As the central aspects of your essay, build your discussion about:

- i) the industrial syntheses of ( $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  only).
- ii) the chemistry of chemical and/or industrial uses of the acids.
- iii) the physical and chemical properties of the acids which cause their use to be hazardous and the precautions which must be taken in their handling.

C5. A batch of solid sodium chloride has become contaminated with sodium hydroxide. Rough analytical tests show that the impure sodium chloride contains between 3% and 5% sodium hydroxide by weight,.

You are provided with pure anhydrous sodium carbonate and concentrated hydrochloric acid. You also have available to you the apparatus normally available in a high school laboratory together with any indicators that you require. Describe how you would determine accurately the percentage purity of the sodium chloride.

Besides experimental procedure, your answer should contain information about the quantities of materials that you would use, and details of the steps you would take to obtain an accurate answer.

C6. Describe how you would prepare a 0.050M standard solution of sodium carbonate. Then describe how this solution can be used to standardise an approximately 0.10M hydrochloric acid solution.

C7. Describe briefly the commercial and industrial importance of the bases  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$  and  $\text{NH}_3$ . Describe the chemical properties of bases and industrial uses related to these properties. (1 page only).

2. Consider the following table

Substance	Melting point ( $^{\circ}\text{C}$ )
$\text{H}_2\text{O}$	0
$\text{O}_2$	-218
$\text{Fe}$	1230
$\text{Br}_2$	-7
$\text{SiO}_2$	1980
$\text{H}_2\text{S}$	-54
$\text{NaCl}$	1450

Using the above examples, discuss in detail the relationship between the melting points and the structures of these solids.

	87	88	89	90	91	92	93	94	95	96
Metal extraction	Aluminium production		Aluminium production	Extraction of a metal		Aluminium production				
Redox	Redox - definitions & electricity production	Production of electricity	Corrosion					Corrosion	Electrochemical & electrolytic cells	!/? question - electron transfer reactions
Rate of reaction & equilibrium			Lab prep H <sub>2</sub> factors influencing rate of production			Factors affecting rate of reaction		Rate & equilibrium in the production of NH <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> , Au & soap		
Acid / base		Standardising HCl solution			Standardising an acid		Purity of NaOH by titration			1/? question - proton transfer
Bonding		factors affecting solubility		Intermolecular forces	Melting point & structure	Solubility in aq. & organic solvents			Bonding - covalent to ionic	Why substances dissolve
Periodic table	Predicting properties from position on table						Periodic table & properties of elements	What is a non-metal		Transition metal chemistry
Chemistry				Chemistry of water	Identifying aq. solutions &		Chemistry of water		Chemistry of carbon compounds	

					organic liquids				unds	
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[illegible]















