Scholarship

2012 Assessment Report

Chemistry

COMMENTARY

Many candidates appeared to find the 2012 paper too long to complete in the given time. However, poorly planned answers that used far more lines than those allocated to questions may have contributed to many students' failure to finish the paper. This was particularly an issue in question one with a large number of candidates needing to use extra paper for their answers. The answers to this question also showed poor understanding of all types of bonding and indiscriminate use of chemical vocabulary. When chemical terms are used they should either be defined or used in such a way that it is obvious that the candidate knows what they mean.

Poor planning was also an issue in the organic synthesis and identification questions. It is quite acceptable to show working in non numerical problem solving exercises. This can give markers an insight into the student thinking process even when the final answers may not have been correct. Arithmetic and transcribing errors were common throughout the calculations and, again, when candidates showed their working, the nature of the errors could be recognised by markers.

Many candidates failed to recognise the basic nature of the amine functional group and most were unable to discuss how pH affects the nature of the acid/base species present in solution. Candidates who showed a high level of competency with the calculations were often unable to link their calculations to the species present in solution. There is an expectation that discussions will include balanced equations to support observations and candidates need to understand the importance of writing equations, even when they are not specifically asked for.

Another common problem was the failure of candidates to link their answers to the specific information provided. Often generic answers appeared that did not show any connection to the data supplied.

SCHOLARSHIP WITH OUTSTANDING PERFORMANCE

Candidates who were awarded Scholarship with Outstanding Performance typically:

- wrote clear, succinct answers that followed a logical sequence and that integrated the data provided within the question
- clearly set out calculations in a logical order, showing working and correct units throughout with appropriate use of significant figures
- related the enthalpy change (size and magnitude) to the particles involved in bonding giving accurate and succinct explanations, including an understanding of the effects of electron-electron repulsion ionisation enthalpy
- used bonding principles to give a plausible reason for the potential of Group 18 elements to ionically bond with Group 1 elements
- demonstrated understanding of organic reactions by developing a reaction scheme that provided a sequence that avoided unnecessary side reactions
- Identified organic unknowns using information about reactivity and stereoisomers (both geometric and optical) and incorporating new information about a functional group
- linked titration data and calculations to the change in oxidation state for the vanadium species given and used the results to rank the standard electrode potentials of the species involved
- identified the properties of the side chains in organic molecules, at the pH given, with explanations based on the nature of the bonding in the side chains, the functional

groups and, where appropriate, p*K*a values. Extended explanations to show how the properties of the side chains account for the folding of the proteins in aqueous solution.
- recognised the role of hydrogen bonds in the interaction of urea with base pairs and used diagrams to support their answers
- used pH calculations to draw titration curves
- applied Le Chatelier's principles to determine the change in pH when mixing two different acids
- used equations to justify changes in pH and the different species present during a titration.

SCHOLARSHIP

Candidates who were awarded Scholarship but not Scholarship with Outstanding Performance typically:

- recognised bond breaking and bond forming as requiring or releasing energy and accounted for the relative magnitude of some of the changes, but explanations lacked sufficient detail
- recognised and used Hess's Law to calculate enthalpy change
- identified and used periodic trends for electronegativity and ionisation energy to discuss the formation of covalently bonded compounds of Group 18 elements
- drew Lewis structures to determine the shape of molecules with explanations that included the regions of charge around the central atom
- developed a pathway for the synthesis of an organic compound that showed understanding of functional group reactions, but did not recognise side reactions caused by incorrect order
- used information about reactivity and isomerism to determine some aspects of the structure of unknown organic molecules
- used the electrode potential data to compare relative oxidising and reducing strengths
- attempted to link titration calculations to balanced redox equations
- discussed the nature of side-chains in organic molecules based on the constituent atoms and functional groups
- recognised the relationship between hydrogen bonds and separation temperature of DNA strands, and provided a comprehensive discussion of hydrogen bonding
- showed understanding of solubility equilibria and used this to calculate the concentration of ions in solution
- calculated the pH at some points during a titration
- linked pH to the species present during a titration
- linked the colour changes of an indicator to the species present.

OTHER CANDIDATES

Candidates who were not awarded Scholarship typically:

- gave verbose and confused accounts of bonding to explain enthalpy changes with metals, and ionic solids commonly described as having "intermolecular bonding" as well as covalent bonding often described as being "weak"
- showed a lack of understanding of atomic structure in the descriptions given or used terms such as "effective nuclear charge" of an atom, inappropriately or without explaining the meaning of the term

- did not recognise how to use Hess's Law in determining the enthalpy change and made errors in calculations
- confused trends in the periodic table with explanations for differences in electronegativity and ionisation energy
- used the wrong number of electrons to draw Lewis diagrams or attempted to determine the shape of a molecule or ion without a Lewis diagram, or failed to consider the regions of charge on the central atom when accounting for the shape of a molecule or ion
- tried to convert alcohols directly by reaction them with ammonia
- did not include a logical sequence of steps for the pathway of the organic synthesis
- did not write structural formulae for the reactants and products in organic reactions
- lacked an understanding of stereoisomerism (geometric or optical)
- did not use the data provided when discussing the relative strengths of oxidants and reductants
- did not recognise polar, non-polar, acidic and basic side chains in organic molecules from the structural formulae given
- confused the physical processes involved in the separation of DNA in water, with a chemical reaction
- did not recognise the relative strength of hydrogen bonds compared to other intermolecular forces
- did not know how to use K_a information to calculate the concentration of hydronium ions in sea water at a given pH
- did not recognise that a buffer solution is made up of an acid and its conjugate base (or vice versa)
- could not link pH calculations to the pH at significant points in a titration curve
- failed to make links between the species present in a solution and the calculated, or given pH.