Scholarship

2011 Assessment Report

Chemistry

COMMENTARY

The format of the examination this year was similar to previous years with five questions. The first two questions required candidates to show their ability to provide correct, coherent discussions of chemical principles linked to the data provided. It is the quality of the answers and the links to the data that determine outstanding performance. In these discussions, it is expected that chemical vocabulary will be used; but candidates need to indicate that they know what the terms mean as well as use them correctly. For example, the term 'effective nuclear charge' was frequently used in discussions about atomic size, but it was obvious that some candidates were confused about the meaning of this term.

The calculations required for Questions Three and Four proved challenging for some candidates, particularly Question Four (b).

At this level, it is expected that candidates will write balanced equations where appropriate without the need to be instructed to do this. Some candidates were unable to write balanced oxidation-reduction equations or recognise the products of oxidation-reduction reactions, as required for Level 3.

SCHOLARSHIP WITH OUTSTANDING PERFORMANCE

Candidates who were awarded Scholarship with Outstanding Performance typically:

- provided a coherent, correct discussion of the forces of attraction and repulsion within atoms and ions that contribute to their size and used these ideas to explain **all** aspects of the data provided
- used equilibrium principles to identify / justify the reactions occurring in a chimney stack and correctly calculated the temperature of the given reaction
- recognised that increasing electron cloud (molar mass) contributed to the boiling point trend
- linked solubility to the relative strengths of the forces between solute and solvent particles
- recognised that an overall enthalpy change depends on both the number and type of bonds broken and made
- balanced oxidation-reduction equations correctly, both in the reaction of Tollens' reagent with an aldehyde, and in the quantitative analysis of a mixture
- calculated the mass fractions correctly using appropriate balanced equations
- chose appropriate half-equations in the discussion of oxidation-reduction reactions
- linked correct E°_{cell} values to spontaneity of the reactions, as well as the occurrence of disproportionation reactions
- identified the variables needed to solve quantitative problems
- used the evidence provided to determine the functional groups in organic molecules
- demonstrated understanding of the nature of structural isomers and stereoisomers (both geometric and optical isomers)
- discussed the formation of polymers.

SCHOLARSHIP

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

- discussed the forces of attraction and repulsion within atoms and ions that contribute to their size, and linked these to the data provided

- identified the products of the exothermic reaction correctly and linked this to the relevant equilibrium
- recognised that bond breaking is an endothermic, rather than exothermic process
- calculated enthalpies of combustion using total bonds broken minus total bonds made
- explained the relationship between polarity and boiling point
- recognised the effect of hydrogen bonds on both melting point and water solubility
- used correct procedures to calculate the masses of substances in a quantitative analysis of a mixture
- chose relevant $E°$ data, and used it correctly, to determine whether reactions were spontaneous
- calculated buffer ratios using the information provided and linked this to the effectiveness of the buffer
- determined the solubility product from the data given and used this to calculate the concentration needed for precipitation
- used the information provided to determine the nature of the functional groups in the unknown compounds
- demonstrated understanding of how intramolecular hydrogen bonds form in organic molecules
- drew structural isomers with explanation as to why these were valid.

OTHER CANDIDATES

Candidates who were not awarded Scholarship typically:

- confused intermolecular hydrogen bonds with intra-molecular attractive forces
- did not write a balanced equation for the combustion of the fuels
- did not correctly match the bond energies with the appropriate bonds
- made careless mathematical errors in the calculations
- did not write balanced half-equations with correct products
- showed evidence of having misinterpreted the acid-base and oxidation-reduction titration data
- did not choose relevant $E°$ data or use it correctly
- confused the terms solubility and solubility product
- showed evidence of having assumed that uric acid fully dissociated and incorrectly calculated a solubility product as if uric acid was an ionic solid
- stated that only one species was present in a buffer solution e.g. HCO_3^- or CO_3^{2-}
- did not recognise that geometric isomers are stereoisomers
- did not identify the formulae for some or all of the reactants or products in the reaction of compound E with Tollens' reagent
- assumed that Compound D must have an aldehyde group as this would be the only way it could appear in the products of a reaction with periodate
- drew both structural isomers of compound A with the correct molecular formulae but without one of them keeping the same functional groups as was present in A
- discussed the formation of condensation polymers as a result of reaction of compound C, with other organic reagents carrying two functional groups.