Pearson

Examiners' Report

Principal Examiner Feedback

January 2018

Pearson Edexcel International Advanced Subsidiary Level

Chemistry (WCH04)

Unit 4: General Principles of Chemistry I – Rates, Equilibria and Further Organic Chemistry

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General

This paper was a reasonable balance of standard and higher demand questions, the latter often requiring candidates to apply their knowledge and understanding in unfamiliar situations. It was similar in style and standard to previous and parallel Unit 4 papers of this specification and a range of skills and knowledge was assessed and the levels of difficulty allowed good discrimination between the different grades, while allowing well-prepared candidates at all levels to demonstrate their abilities. Learners seemed far better prepared for the straightforward questions and those requiring application of knowledge and understanding in unfamiliar contexts proved more demanding.

Multiple Choice Section (Questions 1−19)

This was the highest scoring section of the paper with a mean score across all learners of 60.2%. The multiple choice proved both accessible and discriminating with only one question (16) being answered correctly by more than 80% of candidates and one question (13) being answered correctly by less than 20% of candidates. All the remaining questions were answered correctly by between 40 and 80% of the learners.

Question 20

Item 20(a) was familiar ground and learners at all the grade boundaries were able to access the available marks. The most common reason for not scoring the equation mark was an incorrect state, usually giving benzene carboxylic acid as 's' or 'l'. High marks were obtained for the calculation common errors being the omission of the square root step or using the concentration in g dm^{-3}. It would be helpful to learners if they considered whether the value of the pH was reasonable in the light of the pK_a value. The approximations were well known, with two formulations of the same approximation being rare. In 20(b)(i) the second marking point was usually scored but generally the suggested pH for the equivalence point was too high. The straightforward calculation in 20(b)(ii) was usually completed correctly; sometimes units were omitted while a few candidates attempted a complicated method involving a pH calculation. In 20(b)(iii) most learners used the expected method of assuming that the solution was just sodium hydroxide, although some successfully calculated a value based on a specific volume of alkali added to the mixture at the equivalence point. Learners definitely find the calculation of the pH of an alkali more challenging than that of an acid, but again answers involving unreasonable values (e.g acidic pH) were given without comment. Marks were lost in the definition of a buffer (20(c)(i)) when learners omitted crucial details particularly that buffers are effective on the addition of *small* amounts of acid or alkali, and that pH changes *slightly* rather than not at all. The explanation of the buffer region in the titration curve was often attempted without reference to the graph, with learners simply repeating the definition given in 20(c)(i). The explanation of the buffer provided opportunities across the grade ranges. Most learners could identify the buffering species and the effect on the buffer of the addition of acid was generally well explained. The need for *large* reservoirs was often not specified and explaining the effect of alkali addition proved challenging. The importance of buffers in biochemical systems was not well understood and a number of learners gave detailed descriptions of buffers in the blood without stating their function.

Question 21

The reagents and conditions for the reaction scheme were well-known by the learners although the purpose of the acid in Reaction 1 was only appreciated at the higher grades. While the identity of the mass spectrum species was recognised by most learners, there is still a significant number who omit the charge. The ability of learners to extract relevant infrared data from the Data Booklet is improving. The sequence on the equilibrium constant produced good responses while discriminating effectively at the major grade boundaries. Common errors were the omission of water from the K_c expression, using 0.140 rather than 0.110 as the amount of ester at equilibrium and omitting the volume term from the calculation. The structure of the free radical in 22(d)(ii) caused difficulty in correctly locating the unpaired electron. While the broad requirements of 22(d)(iii) were well-known, marks were frequently lost because learners used a vocabulary appropriate to the familiar nucleophilic addition reactions, referring to carbocations, nucleophiles and planarity about the carbonyl group.

Question 22

22(a) proved to be a high demand item. Weaker learners responded to the word 'titration' and simply described the addition of the alkali or thiosulfate to the reaction mixture using a burette. The first and third marking points were those most frequently awarded with the quenching mark often being negated by the use of an inappropriate reagent. The data processing marks were mostly awarded at the high grade boundaries, with many candidates just taking the concentration (or volume) to time ratio. Although 22(b) has appeared on a number of recent papers, it was answered with generalised responses about the quality of ethanol as a solvent or references to hydrogen bonding. In 22(c)(i), most learners scored at least one for correctly identifying the order with respect to the halogenoalkane but omitted details of their calculations for sodium hydroxide, often just giving it as zero order with no reason or writing the rate equation as rate=k[C_4H_9Br]. Some learners failed to specify the experiments being used to provide the data, while a number also identified ethanol as a reagent. The best learners dealt effectively with the change in total volume in experiment 3. Not converting volumes into concentrations was the most common error in 22(c)(ii) but the marks for the calculation of the rate constant and for the units proved accessible to most. 22(c)(iii) tested familiar ground of the relative rates of reaction of the halogenoalkane and also the link between rate and rate constant. Neither of these ideas seem to be well understood with learners often stating that rate constant was only affected by temperature or suggesting that, because bromine has a higher electronegativity than iodine, the bromoalkane would react faster. The requirements for 22(c)(iv) and (c)(v) were better understood but the link between the rate equation and the rate determining step was often omitted. The persistent issue with the mechanisms given in 22(d) was a lack of precision: curly arrows must originate and terminate in the right places and charges must be consistent.

Advice to learners

Do read questions very carefully and ensure that your answers match their requirements.

Ensure that you have a clear idea of the precise meaning of mechanism curly arrows and that your drawings of mechanisms reflect this.

Check that your answers to calculations make reasonable chemical sense. For example, the pH of a solution of a weak acid is unlikely to be very low and will never be alkaline.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx