Examiners' Report
Principal Examiner Feedback

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Paper 01 The Core Principles of Chemistry

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Introduction

This paper was similar in style and standard to previous and parallel Unit 1 papers of this specification; a range of skills and knowledge was assessed and the levels of difficulty allowed good discrimination between the different grades, while giving the opportunity to well-prepared students at all levels to demonstrate their abilities. For the most part, candidates seemed far better prepared for the straightforward type of question rather than those requiring application of knowledge and understanding. Many candidates lost marks as a consequence of failure to answer the question that was actually set.

Multiple Choice Section (Questions 1−20)

This was the higher scoring section of the paper with a mean score across all candidates of 64.5%. Questions 6 and 17 were the highest scoring questions, correctly answered by 88%, while 33% of candidates gave the correct answer to question 19, and 37% of candidates gave the correct answer to question 10, the two lowest scoring questions.

Question 21

Most candidates were able to describe the ionisation process required for (a)(i) but very few gave the equation which included the high energy electron on the left-hand side. The processes needed for (a)(ii) were well known and the common errors were using inaccurate terms, such as charged plates or electronic fields, or omitting mention of the electric or magnetic fields altogether. A minority of candidates described the process at **S** in terms of constant velocity rather than acceleration, and there were a number of references to 'velocimeters'; these responses gained no credit. Part (a)(iii) was unfamiliar and, while candidates scored reasonably well, their answers often lacked the desired precision. The calculation in (b)(i) was given a novel twist by using the base peak in the spectrum rather than percentages. There were many excellent responses, but a number of candidates gave 81.88 as their final answer, a clearly incorrect value that should have prompted a review of their method. The calculation in (b)(ii) was unfamiliar and therefore challenging, but produced a good number of correct answers. The equation for (b)(iii) was well known, but candidates often failed to identify the isotope. The commonest error in part (c) was to give uses that did not involve identifying chemical compounds, such as radiocarbon dating.

Question 22

The definitions given for (a) often lacked precision, with references to energy or enthalpy *required* and omission of the requirement for complete combustion. The use of the appropriate general word 'substance' was quite rare and, although the mark scheme allowed a number of alternatives, these should be discouraged. There were many high-scoring responses to the calculations in (b) with most candidates dealing confidently with the stages required. Mistakes were most likely to come from incorrect rounding, the omission of the sign or, more rarely, incorrect units.

Here and elsewhere in the paper some candidates used mol^{-} rather than mol^{-1}. This was not penalised, but it is incorrect. Less than half the candidates calculated the error in (c)(i) correctly, usually giving the percentage accuracy (61.4%) instead. In (c)(ii), very few candidates appreciated that uncertainties are random whereas an experimental value consistently lower (or higher) than the true value must result from a systematic error. Some candidates focused instead on the possible causes of the error but most noted that the uncertainties were too small to account for so large a discrepancy, which scored one mark. Most candidates knew a plausible cause of the low enthalpy of combustion but many ignored both the requirement to give just one factor and the need for a justification. The Hess cycle in (d)(i) produced a full range of responses; common errors were the use of atoms rather than molecules for oxygen or hydrogen, and incorrect coefficients, particularly $4\frac{1}{2}O_2$. Few candidates were able to give the required enthalpy changes in the diagram to the required degree of precision. In contrast, there were many fully correct calculations in (d)(ii), the common errors were giving an endothermic value and using an incorrect multiplier in the equation.

Question 23

A very high proportion of candidates gave the electronic configuration and the dot-and-cross diagram correctly. In (a)(iii) a significant number of candidates described the bond in terms of the octet rule, often quoting the specification definition of covalent bonding. Common errors in the required approach included the omission of the principal quantum numbers and the use of incorrect terminology, particularly referring to subshells rather than orbitals. Some candidates referred to 'sideways overlap' but then correctly described the formation of a sigma bond. Very few candidates mentioned that the resulting bond constitutes a region of high electron density. Despite the information in the stem, the bonding of sodium chloride was often given as covalent. There were many excellent explanations of the lattice energy values but broadly correct responses were often marred by imprecise use of terms. Candidates vaguely referred to sodium chloride being more ionic than silver chloride and described polarisation by silver atoms or even chloride ions.

Question 24

The processes involved in refining crude oil were well known as was the dependence of fractional distillation on boiling point differences, but few students mentioned both evaporation and condensing. The equation for the formation of octane and ethene was usually correct although some students ignored the requirement that the reactant alkane be decane. The commonest error in the cracking equation was the failure to include the hydrogen product. The various ways of describing the effect of adding octane to petrol were much better known than the idea of increasing the octane rating. Some candidates used the abbreviation RON for research octane number, this was not penalised but should be discouraged. Some candidates suggested that octane improve the efficiency of the engine rather than the combustion. The equations for the formation of poly(ethene) often did not balance: the omission of the prefix 'n' on the left-hand side of the equation and the use of repeat units with four or more carbon atoms were the most frequent errors.

Question 25

The use of ultraviolet light in the reaction of chlorine with methane was very well known. In (a)(ii) far too many candidates insisted on describing homolytic fission rather than state what the curly half-arrow represented, responses that at best gained one mark. The propagation equations were well known with many fully correct answers. In some cases, the unpaired electron was placed other than in the standard location to the right of the chemical symbol and occasionally using non-standard symbols. Part (a)(iv) demonstrated that few candidates appreciated the significance of the mechanism of a free radical chain reaction even when they could write the equations. Answers often referred to the propagation reactions being faster than termination without mentioning that they are repeated. Most candidates scored well on both parts of (b), the most common error in (b)(ii) was to give a bromoalkane rather than a dibromoalkane.

Summary

Based on their performance on this paper, candidates should

1. ensure that their answers match the requirements of the questions
2. use the vocabulary of chemistry precisely e.g. correct use of the terms atom, ion, molecule, subshell and orbital
3. avoid premature rounding in calculations. Premature correct rounding is not normally penalised but it is bad practice and often leads to error.
4. consider the feasibility of signs and values obtained from calculations and review their working if appropriate
5. avoid abbreviations and non-standard symbols e.g. RON for research octane number, mol^{-} for mol^{-1} and $\circ CH_3$ for $CH_3^{\bullet}$
6. try to ensure that the steps in organic mechanisms and the significance of curly arrows are understood.

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