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Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International
A level in Chemistry (WCH01)

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General

This paper had many straightforward questions that all candidates could access, but It was also sufficiently challenging for the most able candidates who were given an opportunity to show the extent of their knowledge and understanding of the unit. A number of scripts with a raw mark of 70 or more out of 80 were seen. Several questions produced responses lacking precision, with words such as 'orbital' and 'sub-shell' being used interchangeably.

Question 21

Parts (a) and (b)(i) provided a straightforward start to Q21. Part (b)(ii), however, proved to be far more challenging. Although candidates were able to identify, and name, a branched structure for **Y**, many found drawing the skeletal formula correctly more difficult. In (c)(i), constructing the equation for the cracking of pentadecane invariably scored the mark available. However, in (c)(ii), very few candidates appreciated that any carbon-carbon bond in the chain can break on cracking – hence the reason for a large number of products being formed. In (d)(i), the most frequent response seen was to join the two methyl groups together, rather than adding two carbon-carbon double bonds to the hexagonal ring. In (d)(ii), a good number of well-informed candidates understood the ideas of knocking and efficient burning. Of the candidates who did not answer this item correctly, many did not register the context of being in the 'petroleum industry' and their answers referred, in more general terms, to the usefulness of cyclic hydrocarbons to the chemical industry.

Question 22

Part (a) proved difficult for many. The definition required was often confused with that of the enthalpy change of formation or the enthalpy change of combustion. Parts (b)(i) and (b)(ii) were answered correctly by the majority of candidates. In (b)(iii) however, often, the negative sign for the enthalpy change and the rounding of the final answer to two significant figures were overlooked. Only a very small minority of candidates understood that the enthalpy change of reaction would have to be calculated per two moles of ammonium thiocyanate, as this was the stoichiometry for this substance in the balanced equation for the reaction. In (c)(i), many did not realise that mean bond enthalpies are defined for breaking one mole of bonds in the gaseous state, rather than for making bonds. Some good answers were seen for (c)(ii) and (c)(iii), with many obtaining both marks in (c)(ii) for a diagram that showed the sigma and pi-bonds. Some candidates, however, had difficulty in describing the type of overlap that had occurred. A few gave vague answers in terms of overlap of p-orbitals, without further clarification. A significant minority thought that the carbon-carbon double bond consisted of only a pi-bond. In (c)(iv), a significant number of candidates calculated the enthalpy change correctly. It was encouraging to see that, as a result of the clear working shown by many candidates, some of the available marks could be awarded consequentially for answers that were not fully correct. In (c)(v), many candidates were awarded a mark only for stating that the bond enthalpies used were average values. Those who did realise that the state of water is a liquid under standard conditions omitted to mention that heat energy would be released when it changes from a gas to a liquid.

Question 23

Many completely correct responses were seen for the mechanism of the electrophilic addition reaction described in (a)(i). Some candidates, however, do need to show more clearly where the two curly-arrows start and finish in the first stage of the mechanism. Despite the unfamiliarity of iodine monochloride as a reactant, however, (a)(ii) and (a)(iii) were, in general, very well-answered. In (b)(i), the vast majority of candidates recalled UV light as the essential reaction condition needed for the free-radical substitution of an alkane. In (b)(ii), the full range of marks was seen from zero to seven out of a maximum of seven. A number of candidates stated incorrectly that 'heterolytic' bond fission occurred. The two propagation steps proved to be the most challenging of the scoring points to earn, with a number of candidates suggesting these steps for the reaction of methane with chlorine, Cl_2, rather than methane with iodine monochloride, ICl.

Question 24

Part (a) required recall of the fundamental principles of atomic structure. However, a frequent error was to quote the relative charge of a proton as just '+' and that of an electron as just '−', rather than 1+ or 1−. The charge on the neutron was often described as 'neutral', rather than zero. It was surprising to see that there were quite a few scripts with no attempt made to answer (a). Part (b) was generally well-answered, except when the term 'sub-atomic particles' was ignored. These candidates cited only mass number and atomic number in their responses, with no mention of protons and neutrons. In (c)(i), the first mark was almost always awarded for the idea of electron bombardment. Far fewer answers included any reference to the removal of an electron from each gaseous atom. In (c)(ii), the necessity for candidates to handle information on isotopic abundance presented in a slightly unfamiliar format proved challenging for many. A significant number of candidates suggested relative atomic mass values outside the range of 85.0 to 87.0. The diagram in (d) showing metallic bonding was correctly labelled by the majority of candidates.

Question 25

In (a)(i), the equation showing the second ionization energy of magnesium was often correctly recalled, including the correct state symbol, (g). There were candidates, however, who confused this with the equation showing the sum of the first and second ionization energies of magnesium, namely $Mg(g) \rightarrow Mg^{2+}(g) + 2e^-$. In (a)(ii), many excellent answers were seen. The most frequent errors, however, included comparing the energies required to remove an electron from $Mg^+(g)$ and $Mg^{2+}(g)$, instead of Mg(g) and $Mg^+(g)$. A number of answers also suggested, incorrectly, that the number of protons in the nucleus increases on removal of each electron. In (b)(i), both electronic configurations were often correctly recalled. In (b)(ii), the majority of candidates who scored a mark did so for stating that there was stability associated with a half-filled p sub-shell in phosphorus. Far fewer related the decrease in the first ionization energy of sulfur to spin-pairing of electrons in the same p-orbital, with a resultant increase in electron-electron repulsion.

Hints for revision

- Learn your definitions thoroughly, such as **enthalpy change of reaction**
- Try to practise as many of the different types of calculation question found in this unit
- Try to practise the naming of alkanes and alkenes
- Make your writing clear. If the examiner cannot decide whether you have written
  "s" or "g" when a correct state symbol is required, you will not get the mark
- Practise drawing reaction mechanisms, paying close attention to the accuracy of any 'curly arrows' that are required

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