A-LEVEL
CHEMISTRY

CHEM5 Energetics, Redox and Inorganic Chemistry
Report on the Examination

2420
June 2014

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The standard of this paper proved to be very similar to the unit 5 paper in June 2013.

Question 1

Students found this question difficult. In part (a), answers omitting or giving incorrect state symbols were common. In part (b), weaker students often mixed up electron affinity with ionisation or with electronegativity. Many correct answers to part (c) were seen but too often students omitted to include a half before F_2 on the bottom two lines and also omitted to show an electron on the top two lines. The calculation in part (c)(ii) was often correct but many answers stopped at the value of 79 kJ mol^{-1}, therefore giving the atomisation enthalpy of fluorine rather than the bond enthalpy. Answers to part (d)(i) were usually correct but not succinct. In part (d)(ii), many students lost marks due to a lack of precision in their use of language. Silver chloride does not contain atoms, molecules or intermolecular forces and electronegativity is not relevant to ionic solids.

Question 2

Answers to part (a) usually gained both marks but some students lost a mark because they gave imprecise answers. Most students calculated the enthalpy of hydration correctly for part (b) but part (c) was found to be more challenging and only the highest-scoring students were able to describe the interaction between a chloride ion and a polar water molecule. In part (d), the calculation of temperature was usually correct but most students did not mention that, at this temperature, water would no longer be a liquid. The value for the entropy change in part (e) was usually correct but the units were sometimes missing or incorrect. A number of students omitted the negative sign for this entropy change possibly in the mistaken belief that entropy would always increase when a solid dissolves.

Question 3

Few students scored all three marks for part (a) and even the highest-scoring students often gave only one correct observation. Weaker students often suggested incorrectly that it would be possible to see a gas being evolved and also wrote an incorrect equation showing formation of magnesium hydroxide rather than the oxide. In part (b), metallic bonding was not explained well by most students, often being confused with ionic bonding or intermolecular forces. In part (c), very few students scored more than three marks, often being unable to give a correct second physical property of silicon dioxide. Incorrect answers usually involved misreading the question and giving 'high melting point' or suggesting a chemical property. The formula, structure and bonding for phosphorus(V) oxide were usually correct in part (d) but only the highest-scoring students gave correct equations in parts (e) and (f). In part (e), a very common error was to write an equation with sulfur trioxide rather than sulfur dioxide.

Question 4

This question was answered well and students of all abilities were able to score a reasonable number of marks. The most common errors were to give wrong overall charges for some of the complex ions and a failure to give a complete name or formula for the reagent. In part (b), some students lost the equation mark because an aqueous copper ion rather than the hydroxide precipitate was used as the starting material. Part (c) was answered least well. Some students did not recognise that the green-blue precipitate was copper carbonate and many who did were unable to give a correct formula for sodium carbonate.

Question 5

Few correct answers were seen to part (a). Some students did not comply with the convention of placing the hydrogen electrode on the left when measuring the standard electrode potential. Some failed to include all the phase boundaries, putting a comma between H_2 and H^+ instead of a solidus, whilst other students included too many phase boundaries at the extremities or an incorrect, additional platinum connected to iron. Parts (b) and (c) were answered well. All the elements were chosen by students in part (d)(i) and where the correct answer of chlorine was selected, the oxidation states in part (d)(ii) and the equation in part (e) were usually correct. It was pleasing to find that answers to parts (f)(i) and (f)(ii) were usually correct. Most students identified the positive electrode correctly in part (f)(iii) but only the highest-scoring students used an appropriate electrode potential from the table to explain their answer.

Question 6

Answers to parts of this question were generally disappointing. In part (a)(i), the half-equation for the hydrogen electrode was usually correct but most students gave an incorrect equation for the reaction at the oxygen electrode involving the formation of oxide ions. Part (a)(ii) proved to be difficult and only the highest-scoring students were able to address the question properly by using the half equations to explain how a flow of electrons is generated in the external circuit.

Part (b) was answered well but answers to part (c) were mostly disappointing. Students appeared not to know that the major advantage of a fuel cell over a heat engine is its greater efficiency. It is difficult for examiners to understand why most students thought that the burning of hydrogen in an internal combustion engine would lead to formation of carbon dioxide and hence exacerbate global warming.

Question 7

It was clear from answers to part (a) that most students cannot apply the principle of oxidation states to complex ions. The majority of answers suggested that the chromium in **P** had an oxidation state of 3 whereas that in **Q** had an oxidation state of 2. Consequently, the electron configurations of the ions were also incorrect. Answers explaining why **P** and **Q** are **different** colours were much better but some students did not appear to have read the question carefully and attempted to explain why a transition metal ion is coloured rather than explaining why the colours of the two complexes are different. The higher-scoring students usually gained high marks for part (b). Amongst other students, the most common error was with the equation. Often the amine groups were shown as $–NH_3$ rather than $–NH_2$, the equation was unbalanced or the charge on the complex was incorrect. A reference to the small enthalpy change for this reaction and a reason for it were the most common omissions. Part (c)(i) also proved to be a difficult question. The bond angle of 90^o was usually correct but the charge on the complex was often incorrect and the N–H bonds in the two ammonia ligands were rarely shown as a displayed structure. A consequential mark scheme was used for part (c)(ii) and this enabled many students to gain a mark. The most common error was a failure to show the complex product having a greater positive charge than the student's formula for cisplatin. Parts (c)(iii) and (d) were answered well although most students omitted to mention that the main reason for using vanadium(V) oxide in the Contact Process is to increase the rate of reaction.

Question 8

Many good answers were seen to part (a) in which full marks were scored. However, most students used an incorrect ratio for the amount, in moles, of iron(II) that reacts with one mole of dichromate ions. For these students, the maximum they could score was three out of a possible five marks. In part (b), many students suggested, correctly, that the impurity was likely to be a reducing agent but very few went on to explain that the impurity must react with more moles of dichromate than would the same mass of $FeSO_4.7H_2O$.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator