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Chemistry CHEM5

(Specification 2420)

Unit 5: Energetics, Redox and Inorganic Chemistry

Report on the Examination

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General Comments

The standard of this paper proved to be similar to the unit 5 papers in 2010. Examiners were generally pleased by the performance of candidates.

Question 1

Answers to part (a) were disappointing. Very few candidates scored all four marks and the average score was less than half marks. Typical errors were a failure to mention the formation of one mole of atoms and also to omit to state that the atoms and ions formed should be gaseous. In part (b), only the best candidates gained full marks. Most candidates either failed to use the correct enthalpy change for the formation of one mole of chlorine atoms, using the bond enthalpy without halving it, or incorrectly doubled the electron affinity of chlorine. In part (c)(i), very few candidates were able to give a full explanation of the term *perfect ionic model* but answers to parts (c)(ii) and (c)(iii) were usually correct.

Question 2

This question proved to be easier than Question 1. Most candidates scored full marks in part (a) but part (b) was answered less well and was not attempted by a significant number of candidates. Parts (c) and (d) were answered correctly by almost all candidates. A majority of candidates scored full marks for part (e). The most common error was, as usual, a failure to convert the entropy term into kJ, the same units as the enthalpy change. In part (f), over half of the candidates did not recognise that this question was concerned with rate of reaction and hence the activation energy and they attempted to argue incorrectly in terms of thermodynamics. Just over half of all candidates gained full marks for part (e). A common error was to give a value with the wrong sign for the enthalpy change or for the entropy change.

Question 3

Part (a) was answered quite well, especially for Na_2O. For SiO_2 candidates too often spoiled their answers by referring to molecules and intermolecular forces or in some cases to ions. Quite often, such references appear to be careless use of contradictory terms rather than a completely false understanding of the structure and bonding. Answers to part (b) were very disappointing and the average score for this question was only one out of three. In the Specification, candidates are expected to understand that the melting point and lattice enthalpy of an ionic crystal depend on the size of the ions and on their charges. Answers to part (c)(i) were generally good but in part (c)(ii), candidates often failed to mention 'between molecules'. Part (d) produced the expected range of answers and a pleasing 60% of candidates scored full marks. As expected part (e) was much harder and only a very few candidates were able to write a correct equation.

Question 4

This question proved to be discriminating with a facility for most parts of only about 50%. In part (c), as expected, the hardest example to recall was that of a square planar complex but it was also surprising to find that a common error in part (c)(iii) was to show an octahedral complex. In part (d)(i), many candidates gave an incorrect equation using O instead of O_2 but other parts were answered quite well. It was disappointing to find that in part (e)(i) about one third of candidates could not give the correct meaning of the term *multidentate*. In part (e)(ii), it was pleasing to note that about half of candidates scored full marks. In part (e)(iii), only the best candidates were able to explain clearly that the cyanide ion is bound strongly to the cobalt so it is not toxic when complexed in vitamin B_{12}.

Question 5

Redox questions involving electrochemical cells are usually found to be very difficult. It was therefore very pleasing to find that this question was answered well in all parts except for parts (a)(iv) and (b)(i). In part (a)(iv) candidates were expected to recall from Unit 1 that lithium reacts with water but only about 20% were able to do this and these were not necessarily the best candidates. As expected, part (b)(i) proved to be discriminating. Although about one third of candidates scored both marks, others failed to include platinum or put the various ions in the wrong order.

Question 6

The general standard of answers to this question was very disappointing. It was clear to examiners that a large majority of students could not recall what should be observed and what happens in the various reactions given. In part (a), only 8% of candidates scored full marks. Examiners hoped that candidates would understand that the action of carbonate ions on a metal ion with a 3+ charge always leads to a hydroxide precipitate and evolution of carbon dioxide gas, but most candidates were unable to give a full answer. In part (b) most candidates suggested either the formation of a hydroxide precipitate or a complex $[Al(OH)_6]^{3-}$ (or $[Al(OH)_4]^-$) ion but only the best candidates knew that one would be formed first followed by the other. The same sort of responses were common in part (c) with only the best candidates explaining correctly that a blue hydroxide precipitate would be followed by a deep blue solution containing $[Cu(H_2O)_2(NH_3)_4]^{2+}$ ions. Answers to part (d) were more often correct.

Question 7

This question also proved to be discriminating. In questions similar to part (a), candidates may need to be reminded that when the question asks for a description of the colour change, the colours of the initial and final solutions are required. Part (b)(ii) proved to be very demanding. Only 3% of candidates scored all four marks. Most candidates did not recognise that the equation should start with the $[Cr(H_2O)_6]^{3-}$ ion and even when they did, they could not usually write a balanced equation for the reaction with hydrogen peroxide. Most candidates made a reasonable attempt at part (c) and the average score for this question was about half marks. However, only about 7% of candidates scored full marks. The most difficult mark to gain was for the reaction equation. The second most difficult mark was the final one awarded for a correct conversion of moles of hydrogen peroxide in 5 cm^3 of the original solution into a concentration.

Mark Ranges and Award of Grades

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