AQA

A-level
CHEMISTRY

CHEM5 Energetics, Redox and Inorganic Chemistry
Report on the Examination

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General Comments

Students were able to access all of the marks on the paper and there were no 'dead' marks. The overall standard of responses showed that there was a clear understanding of most of the chemistry involved. Students lost marks in equations by not checking that they balanced in terms of the number of atoms and the charges, especially the charges on complex ions. There was no evidence from scripts to suggest that students had been short of time to complete the paper.

Handwriting was often very small or faint introducing the possibility of ambiguity especially with state symbols. Students should be reminded to cross out work that has been replaced so that contradictions between answers are not seen. Often answers not crossed out on the script were contradicted by answers given on additional sheets and this caused marks to be lost. Many additional sheets were also used by students to rewrite answers neatly when the marks had already been gained on the paper; this practice should be discouraged.

Question 1

This question was generally high scoring especially by the more able students. The types of bonding were generally well known. Common errors included sulfur in part (a), magnesium in part (b) and silicon in part (c) and therefore the equations could not gain credit. The correct equation between aluminium oxide and sodium hydroxide (or other alkalis) was not common in part (c) whilst the equation between aluminium oxide and an acid was better known.

Question 2

The Born Haber cycle in part (a)(i) was completed well by the majority of students; common errors included use of the symbol K_2 for elemental potassium, missing state symbols and missing electrons. The calculation in part (a)(ii) was not straightforward; many students failed to multiply the enthalpy changes for potassium by 2 and some included a x2 factor for the atomisation of oxygen. The explanation in part (b) was quite a challenge for many students. Many commented on the relative size of the atoms rather than the ions and a common incorrect explanation referred to attraction between the nucleus and the electrons.

Question 3

The equation in part (a) was generally well known but common errors included the formation of Mg^+, the formation of one mole of chloride ions and the inclusion of water as a reagent. The calculation in part (b) was well done by many students; a common error was a failure to use 2x the enthalpy of hydration of the chloride ion. Students generally used their answer to part (b) to give a good explanation in part (c).

Question 4

The correct answer was given by the majority of the students in part (a)(i). Part (a)(ii) was well done although a few students could not state the correct units of concentration. In part (b) the two half-cells were generally identified but the cell was often reversed as was the equation given. In part (c) the correct cobalt species was generally identified as the oxidising agent but the equation was often not balanced and the oxidation product given as Co^{2+} or H^+. Students found part (d) challenging. Very few gave $E^\ominus$ with the correct terminology; very often this was given the wrong way round e.g. $E^\ominus$ Au/Au^+. Most students thought, incorrectly, that the reaction was between gold and water. The $E^\ominus$-values should have indicated to them that a redox reaction between gold and water is not feasible.

Question 5

Only the more able students scored well in part (a)(i). Many students failed to give the correct equations at the electrodes and the overall equation was often not cancelled down to the simplest form. Most students scored the first mark in part (a)(ii) but only a very few students referred to an equation to score M2. Most students could draw the correct line on the graph in part (b) although several assorted incorrect curves were seen. The effect of changing the surface area was well known in part (c)(i). Some students failed to gain credit in part (d) because their answers were vague and did not identify pollutants. In part (e) a statement about carbon dioxide being released in the generation of hydrogen was required to score the mark; some students did not identify hydrogen as the fuel in the fuel cell and described general ways that carbon dioxide would be released when the fuel-cell was made e.g. transportation of hydrogen etc.

Question 6
Most students scored highly in part (a). Incorrect units for entropy change were often seen in part (b). Students generally understood the concept of disorder and scored the mark in part (c). The majority of students could use their own values to calculate the free-energy change in part (d); common errors included incorrect units, failure to convert temperature into Kelvins and using a mixture of joules and kilojoules in their calculation. The relationship between ΔG and feasibility was well known in part (e). The meaning of heterogeneous was well known in part (f)(i) and the equations in part (f)(ii) were generally well known. Students answered part (f)(iii) well although in part (f)(iv) a few referred to impurities being produced without any reference to poisoning of the catalyst.

Question 7
The equation in part (a) was well done by most students although some thought that chlorine was a product. Part (b) was generally well attempted although many students lost marks for giving an incomplete reagent or an unbalanced equation. Many students who suggested ammonia as the reagent followed on to give an ammine complex instead of the correct hydroxide. In part (c) several students gave chromium hydroxide as Q even though it was identified as a gas in the question. There were a few examples of insoluble carbonates given as the reagent and many cases of a soluble carbonate with an incorrect formula. The equations often contained the correct species but were unbalanced. Students generally gave the alkali route for part (d) and many scored all the marks. In part (e) the majority of students could give the colour of the chromium(II) hexaaqua ion but could not give complete reagents for the reaction.

Question 8
Students generally knew the characteristic features of cobalt chemistry in part (a) but the electron configuration of Co^{2+} was often incorrect. In part (b) many students did not state that a bidentate ligand has two lone pairs, each on a different atom. The formula of the ligand was usually correct; errors included CH rather than CH_2 and NH_3 rather than NH_2 as the amine group. In the equation many students gave an incorrect number of ligands or an incorrect charge on the complex formed or gave an incorrect mole ratio of reagents. The increase in disorder was generally well known although weaker students failed to link this to ΔG. The structure was usually correct if the ligand was correct but some students lost marks by not drawing the ligand carefully enough and missing out hydrogen atoms.

Question 9
In part (a) most students could identify the autocatalyst in the reaction however some students thought that an autocatalyst was a reagent and identified the catalyst as MnO_4^-. Many students correctly identified the acid in part (b). Most students knew that two negative ions would repel in part (c) but did not link this to high activation energy. Some students did not state that the reaction was initially slow or would only speed up when the catalyst was produced. The equation in part (d) was generally well done. Some students had the correct ratio of reagents but missed charges on the ions or did not produce the correct amount of CO_2. Many students scored the first few marks but then failed to divide by 3 or multiplied by the wrong M_r. In part (e) many students described a colorimeter and the absorbance of visible light but did not answer the question as set and hence

could not score the marks. Most students who used a series of concentrations knew that a calibration curve was used but often did not give correct labels for the axes. Those that did use a calibration curve mostly scored the last mark. A few very good students drew a diagram of the graph, with labelled axes, and showed how this would be used to find the concentration.

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