
A-LEVEL CHEMISTRY

7405/3

Report on the Examination

7405

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General

As in previous series the most common reason for failing to gain marks was a lack of precision and of a clear application of chemical terminology. In particular, question 5 caused many confusions when it came to describing what was oxidising or reducing what or what was being oxidised or reduced.

Relatively few students were able to access Level 3 in the Levels of Response question – usually due to a failure properly to describe the methods for the tests for the ions. Students are encouraged to be as organised as possible when answering the Levels of Response question and, although it is not appropriate to lay out the answer as a list, students are encouraged to think about making a sequence of clear, precise, linked points to put across their ideas with the aim of ‘ticking off’ as much of the indicative content as possible.

Section A

Question 1

01.1 was intended to give a relatively straightforward start to the exam but, instead, it proved to be the first example of a situation where greater clarity was needed in giving a definition. Repeated references to standard conditions were seen and, although they did not affect the marks awarded, were not necessary as the question did not ask for a definition of a ‘standard’ enthalpy change. Marking point 1 (M1) was sometimes missed as a result of students failing to refer to an ionic compound and M2 was often missed when students referred to the formation of one mole of gaseous ions – the number of moles of ions formed will depend on the formula of the compound so the only quantity needed in the definition is that of one mole of the ionic compound.

In 01.2 there was a mark awarded specifically for a properly labelled diagram which, as a minimum, needed correct formulae and state symbols at all three ‘corners’ of the cycle. It is recommended that arrows in cycles are always drawn in the direction that matches the enthalpy change term being represented and any adjustments (e.g. of sign and direction) are left to the algebra.

01.3 was generally done well although some students failed to recognise the need to convert to a molar quantity and stopped after M1 while others failed to convert from J to kJ.

01.4 was expected to be easy but many students still forgot to multiply the apparatus uncertainty by two, as two readings are being taken.

01.5 was done well although there was occasionally confusion between a larger mass/amount of the solid and a larger volume of the water. Some students ignored the instruction in the question about the same apparatus being used and suggested a different thermometer or the addition of insulation.

In 01.6 the commonest error was to refer to heat loss – this is an endothermic reaction, so it is heat gain that is a potential source of error in an un-insulated container.

In 01.7 most students gained two or three marks, but the conversion of the entropy change into kJ was often forgotten.

01.8 was well done although there were again some issues with the need to convert units between J and kJ for consistency in the calculation.

Question 2

This levels of response question was expected to be more accessible than some in the past but a lack of accuracy in describing the tests for the anions meant that Level 3 was rarely attained. The need to warm after adding NaOH when testing for NH_4^+ was often missing as was the need to acidify the BaCl_2 when testing for sulfate. Many students also stopped their description of the test for Al^{3+} at the stage of forming a white precipitate and failed to mention that it redissolves in excess NaOH.

The equations for the test for Al^{3+} should preferably have been those with the hydrated ion but the simpler versions were allowed from the point of view of indicative content. The equation for the redissolving of the solid was often shown as $\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3 + \text{OH}^- \rightarrow \text{Al}(\text{OH})_4^- + 3 \text{H}_2\text{O}$ which implies a combination of ligand replacement and acid-base behaviour, but the product anion should be shown with two water ligands still present in this case.

In stage 1 the empirical formula of $\text{NH}_{28}\text{AlS}_2\text{O}_{20}$ was sometimes not actually shown even though the calculation was done. Some students seemed confused that, in this case, the empirical formula mass is equal to the relative formula mass and they thought that meant that $x = 0$. It was hoped that students would recognise that $1 \times \text{N}$ meant one NH_4^+ and $2 \times \text{S}$ meant two SO_4^{2-} ions – from which the number of waters could be found.

Question 3

03.1 was recalled by most students although ‘nucleophilic elimination’ was incorrectly suggested by some for the mechanism to form the alkenes.

Clarity of description was again somewhat lacking in 03.2 – which is a definition best learnt by rote as “molecules with the same structural formula but a different spatial arrangement of atoms”. ‘Molecular’ was often substituted for ‘structural’ and the phrase ‘different spatial arrangement’ often lacked a reference to atoms (or bonds or groups).

In 03.3 most students were able to correctly name but-1-ene but explanations for its lack of stereoisomerism were often unclear. It is not enough to refer to ‘two Hs on the same side of the $\text{C}=\text{C}$ ’ as the word ‘side’ is ambiguous here. The best way to be clear is to refer to the fact that one of the C atoms involved in the double bond has two atoms the same bonded to it.

In 03.4 ‘error carried forward’ was applied for any student who had mistakenly identified the product as but-2-ene in 03.3, so full marks were still available to those students for the mechanism. It is recommended that students should draw clearly displayed structures and draw them a bit larger than if just showing the structure – this allows more space so that the positioning of curly arrows is clear.

03.5 was well answered.

03.6 showed that more practice is needed by some students at drawing 3D representations in a conventional manner. The recommended style is:



There was a wide variety of misconceptions evident in the answers to 03.7 with various references to halide ions in the halogenoalkane molecules, to sizes of ions or atoms and to electronegativity. As stated in the specification, all that is needed to explain the relative rates of hydrolysis is to refer to the relative bond strengths of C–I, C–Br and C–Cl.

Question 4

Most students accessed M1 in 04.1 but M2 was often not awarded due to the absence of ‘frequency’ or of ‘successful’. Just referring to ‘more collisions’ is not enough.

Drawing tangents by eye is not an exact science so a reasonable range of answers was accepted here with the key factors being that the tangent needed to touch the curve at 0.05 and not cross the curve at any point. Students are encouraged to choose a reasonable range for the δx and δy used in the calculation of gradient and to read the scales carefully.

Most students were able to select the appropriate values for the calculation in 04.3 although reading the scale was a pitfall for some, with 0.83 often seen as the initial concentration.

In 04.4, apart from some continued issues with reading of the scales, the plots were mostly accurate.

In 04.5, the plots in 04.4 should have led to the statement that the reaction is first order – and this was seen in most answers, but M2 was less often awarded. To fully justify first order, the line needs to be referred to as ‘straight’ **and** ‘through the origin’. If, instead, students choose to refer to ‘doubling the concentration causing a doubling in rate’ they need to select and quote data from the graph to support this.

Question 5

05.1 was well answered by most students.

In 05.2 many students either did not notice that there were six marks available or were not able to work out how to access them as many answers were very brief and generic. The question specifically asked for suitable equations to be included but these were often left out of answers.

05.3 saw the greatest evidence of confusion in the use of correct terminology. One of the key aspects of the topic on electrochemistry and electrode potentials is its reliance on conventional terms of reference. When referring to an electrode potential it is advised that students stick to the conventional form.

e.g. $E^\ominus \text{S}_2\text{O}_8^{2-}/\text{SO}_4^{2-}$ is greater than $E^\ominus \text{Co}^{3+}/\text{Co}^{2+}$

Therefore any references to electrode potentials and half-cell equations should follow the convention of showing (or implying) a reduction in the forward direction.

A commonly seen example of a lack of clarity was “The electrode potential for Co^{2+} is less than that for $\text{S}_2\text{O}_8^{2-}$ but more than for iodide so it can oxidise one and reduce the other.”

Apart from the reference to “The electrode potential for Co^{2+} ” being incorrect it is not clear from this what is oxidising or reducing what. This is a particular example of a situation where references to ‘it’ are likely to be ambiguous.

Many answers were also difficult to mark because of carelessness with CO instead of Co and confusion between subscripts and superscripts e.g. CO_3^+

Section B – Multiple Choice

Some students need to pay more careful attention to the instructions given at the start of Section B about how to complete the answers by shading in the lozenge, crossing out an incorrect answer and then circling a crossed-out answer if it is then decided to be correct.

There were quite a few instances of crossed-out and circled answers alongside shaded lozenges – which has to be treated as two answers and so marked incorrect.

Questions students found particularly straightforward, with correct answers from at least 80% of the cohort, were B32, B34, B18, B25, B23.

Questions that proved to be particularly challenging were B10, B33, B28, B7.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.