



A-level **CHEMISTRY**

CHEM2 Chemistry in Action
Report on the Examination

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General comments

The mean mark for this paper was lower than last year's CHEM2 paper and there were no raw marks above 94 so the paper was more challenging than last year. With familiar types of question, students were able to score reasonably highly. However, questions which required more explanation or working in several steps or application to unfamiliar situations were found more difficult.

Students should again be reminded to use black ink so that scripts can be scanned successfully and be clearly and accurately read by examiners. Pencil should not be used and then written over as this often produces an unclear double image. There was also an increase this year in the number of questions answered both in the examination booklet and also on supplementary sheets but with neither attempt crossed out. Students should be aware that if two answers contradict each other, marks will be lost. Where answers were continued on supplementary sheets, these additional sheets were often unnecessary as there was space in the original section of the paper. There was often no reference made to the continuation in the original script making the examiners' job to mark consistently and fairly much more difficult.

Question 1

This question involved recall of Group 2 Chemistry and was generally well answered. In part (a) the key thing for students to remember was the need for the response to make a comparison between Ba and Ca. In part (b) there was quite a lot of confusion between the reaction with steam and with water with many students referring incorrectly to effervescence and to a precipitate forming. In part (c) state symbols were sometimes omitted from the ionic equation.

Question 2

Two-thirds of the marks in this enthalpy-based question involved students being able to carry out calculations based on Hess' Law and, as always, there was a divide between those who could cope with such questions and those who couldn't.

In part (a) the importance of learning definitions was illustrated. Many students failed to make clear that all reactants and products need to be in their standard states.

In questions such as part (b) students are strongly advised to start with a clear and complete indication of the expression relating the enthalpy change of the reaction to the data given or to draw out a clearly labelled cycle. Students who relied on the use of a learned expression often got this wrong way round, possibly due to confusion with the use of enthalpies of formation whereas, in this case, the data provided were enthalpies of combustion.

In a question like part (c) students are strongly advised to sketch out the displayed formulae of all reactants and products when working with bond energies. Failing to do so in many cases meant that bonds were omitted or miscounted (3 x C-C in propan-1-ol was often seen) by students.

Question 3

This question was generally answered well throughout.

The commonest mistakes seen were for the propagation steps in the mechanism where CH_3Cl was used instead of CH_2Cl_2 and for dots to be missing from radicals in parts (b)(i) and (b)(ii).

Question 4

In part (b) students needed to read the question carefully and organise their thinking clearly to avoid confusing **A** with **P** and **B** with **Q** in their answers. A significant minority of students got the identities of **A** and **B** wrong way round or thought that they were carbonyls – despite having got part (a) correct in most cases.

In part (c) most students correctly identified **C** but many lost the mark for the displayed formula through not showing the O–H bond. Many students seemed to confuse the dehydration of an alcohol with the elimination reaction of a halogenoalkane and incorrectly chose ethanolic KOH as the reagent needed for the conversion of **C** into **R**.

In questions on IR spectra it is important for students to be aware that any reference to a wavenumber of an absorption must be linked to the bond responsible for that absorption.

Question 5

In part (a) most students were able to sketch an appropriate curve, although some made the mistake of joining the end of their curve to the original curve or to the horizontal axis. The explanation depended on it being clear that many more molecules would have $E > E_a$ and that therefore the frequency of successful collisions would greatly increase. Too many answers simply referred to an increase in energy leading to an increase in collisions.

The first part of (b) was generally well answered although, when applying le Chatelier's principle to a specific situation, students must be clear that the shift in position of an equilibrium is in order to oppose a specific change. In this case the shift is to oppose the increase in pressure. In part (b)(ii) quite a lot of answers were expressed in a confused manner. Students are advised to tailor their answer to the actual question rather than repeat generic responses related to the idea. In this case the phrase in the question 'rather than at a higher temperature' was key, with the expectation being that students would suggest that, although a higher temperature would increase the rate, it would decrease the yield so the chosen value was a compromise. Students who introduced the idea of lower temperatures could still earn credit but a mention of compromise or optimum conditions was required in order to score the second mark.

Question 6

In a definition of electronegativity students must make it clear that they are referring to the attraction between the nucleus and the shared pair of bond electrons. Most students were awarded the first mark but many answers were too vague in their references to gain the second mark.

Most of the rest of this question was well answered although there were some issues with balancing charges in the redox equations.

Very few students showed the acids formed in part (d)(i) as being dissociated and this, in turn, seemed to make part (d)(ii) harder than expected because many students failed to spot that addition of acid would shift the equilibrium to the left and so produce toxic chlorine gas. Although there was no specific reference to le Chatelier in the question (which would have given a more specific clue) the stem of part (d) did refer to an equilibrium mixture and this was intended to point students in the right direction.

Question 7

The various equations throughout this question were generally done well although some students left out the state symbols in part (c)(i) and the titanium extraction equations caused some problems.

Most students were able to suggest two valid environmental reasons in part (c)(ii) but the economic reason was often not qualified; just 'cheaper' was not enough without a reason. It was however necessary to mention 'cheaper' or words to that effect in order to make clear it was an economic argument.

Question 8

The lack of structure in part (a) caused problems for some students and they needed to be clearer in some cases whether they were referring to reaction 1 or reaction 2. The mechanism was generally done well although showing attack by OH^- at the wrong C-H lost some marks.

In part (b) very few students appreciated the need for two different groups on each C of the $\text{C}=\text{C}$ in addition to the lack of free rotation.

In part (c) it was expected that an experiment based on a 'disappearing cross' approach would be familiar to most students as would the general idea of a 'fair test'. There were, however, many elaborate and often unworkable methods suggested. There was also too much emphasis on things such as 'the same person observing' or 'the same stopwatch being used' instead of making suggestions to ensure that the only variable was the identity of the chloroalkane and that other conditions should be kept constant such as temperature, volumes of solutions and concentration of silver nitrate solution.

Question 9

The mechanism in part (a) was generally done well although not always named correctly with 'elimination' appearing quite frequently – suggesting confusion with halogenoalkanes. Marks were sometimes lost due to incorrect bonding or structure of H_2SO_4 and HSO_4^- . Some students did not realise that the explanation of stability should be based on the relative stabilities of the intermediate carbocations and not on the stabilities of the two possible final products.

In part (b) the conditions were generally well known although phosphoric acid was sometimes omitted and most students were able to suggest two disadvantages. The advantages were often less well known and some students saw the need to exclude oxygen as a disadvantage.

Mark Ranges and Award of Grades

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