



Examiners' Report Principal Examiner Feedback

Summer 2024

Pearson Edexcel GCE
In Chemistry (8CH0)
Paper 02: Core Organic and Physical Chemistry

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Introduction

This paper proved accessible to candidates, with many demonstrating good knowledge and understanding of the topics covered and there was no evidence that candidates did not have sufficient time to complete their answers.

The usual errors of exam technique were seen. It is vital that candidates read the questions with great care, noting, in particular, any bold text indicating particularly important information.

Question 1

The first question concerned the titration of a dicarboxylic acid.

The first two multiple choice questions in (a) and (b)(i) were accessible to most candidates.

In (b)(ii) the calculation of the volume of sodium hydroxide was also well answered. The use of the rough titration in (b)(iii) was not as well understood with relatively few candidates scoring this mark.

In (c), the final calculation was often well done, although some candidates forgot to consider the factor of 10 associated with using 25 cm³ samples of the 250 cm³ solution.

Question 2

Chemical equilibria was considered in this question. The equilibrium between dichromate(VI) and chromate(VI) ions in (a) is often encountered in practical lessons by candidates. The equilibria in (b) involved the nitrogen dioxide and dinitrogen tetroxide equilibrium, is also often encountered both as a demonstration or practical activity in lessons and in examinations.

(a)(i) proved challenging with only 10 percent of candidates scoring 3 marks. Common mistakes were to consider the added water as the most significant aspect, despite the fact that the question said that only a small volume was added. Another common error, which occurred on other items in this question, is to mistake the use of the phrase 'the equilibrium shifts to the right' (or left). Some candidates seemed very confused as to what this phrase, which is used commonly in explanations of equilibrium shift, actually means. Excellent answers used different wording such as 'the equilibrium shifts so that more of the products are formed and less of the reactants.'

The multiple-choice question in (a)(ii) concerned a heterogeneous equilibria, with more than half of candidates scoring this mark.

In (b)(i) the initial observation of the decreasing concentration of nitrogen dioxide, and hence the lightening of the colour of the gas, was very rarely seen in answers. This suggests that this demonstration is not as frequently carried out as it was in the relatively recent past. The remaining two marks were much more commonly seen, with over 50% of candidates scoring some marks here.

Candidates had less difficulty with the effect of temperature on the equilibrium in (b)(ii), with nearly half of candidates scoring both marks.

Question 3

The chemistry of alkenes was tested in Q3.

(a) tested candidate's knowledge and understanding of molecular and empirical formulae. Over 80% of candidates scored this mark.

The addition of hydrogen bromide was tested in (b), with (b)(i) being the name and type of this reaction. Again, over 80% knew this was an electrophilic addition reaction.

The mechanism of the reaction, in (b)(ii) was extremely well answered. There are a large number of things to consider in this mechanism, but candidates seemed well drilled with 44% scoring full marks. Four marks was the most common score achieved here.

The minor product in (b)(iii) proved a little more challenging. Candidates found difficulty expressing themselves with sufficient accuracy to secure full marks, often referring to the stability of halogenoalkanes rather than the carbocation intermediates.

Descriptions in (b)(iv) also lacked sufficient detail to score the mark. It was quite common to see that the arrow represented the movement of an electron, or electrons rather than the pair of electrons which was required for the mark.

In (c)(i) most candidates recognised the structures of the two isomers and were able to name them, but some needed more care when drawing these structures out. The attachment of methyl groups was often seen via a hydrogen rather than the carbon and this did not score the mark in this question. A fully displayed structure almost invariably scored the mark here as this type of attachment does not occur in these types of structures.

The need for two different groups attached to the carbon as well as restricted rotation was not often seen in (c)(ii).

The conversion of alkenes to alcohols and subsequent oxidation was examined in (d), and three quarters of candidates recognised the tertiary alcohol in (d)(i)

The relative stability of tertiary alcohols to oxidation was not well understood. Those candidates who knew that the carbon with the oxygen attached required a hydrogen attached as well to allow oxidation often scored two marks.

Question 4

Q4 was concerned with bond enthalpy calculations and with Hess' Law cycles. The bond enthalpy calculation in (a)(i) was very well answered, with most candidates scoring full marks, and over 90% scoring at least 2 out of 3.

The difference between mean bond enthalpies and bond enthalpy values examined in (a)(ii) was not as well understood, but still scored full marks for almost one quarter of papers.

The Hess' law calculation in (b) proved more challenging. Some candidates continued looking at the formation of cyclobutene, which was tested in (a), rather than the combustion of cyclobutene. Candidates must read the questions with care. There were a number of different approaches to the labelling of the cycle which were able to score marks. The result was a fairly even spread of marks.

In (b)(ii) the calculation was often scored by those who scored well in (b)(i), perhaps unsurprisingly, but some candidates who had not been able to work out how to complete the table still knew how to do the calculation.

Question 5

The conversion of butan-1-ol to 1-bromobutane is often examined at this level. However, the practical requirements, tested in (a) and (b) proved one of the more challenging parts of the paper.

In (a)(i) the use of the condenser was well understood, but the reason for the still head was less often scored.

The oxidising agent responsible for the unwanted side reactions in (a)(ii) was sulfuric acid, but this was recognised by less than 20% of candidates.

The presence of side reactions is often an answer to questions about low yield. In (a)(iii) the identity of the unwanted side products was considered. The inorganic product was produced by the sulfuric acid, and consequently relatively few answers scored this mark. The formation of butanal or butanoic acid was more commonly suggested, but only 15% of candidates scored a mark here.

(a)(iv) was the highest scoring item in (a), with over 40% scoring this mark.

In (b) the set-up of a distillation apparatus was considered, and unusually a description was asked for rather than a diagram. Candidates should not be afraid, however, to use diagrams in their answers. Those that did often clarified their writing and so found it easier to score marks. The position of three pieces of apparatus, the still head, condenser, and thermometer were tested. Often the still head was the piece of apparatus which did not score the mark associated with it.

The separation of the aqueous and organic layers in Steps 5, 6 and 7 were tested in the final part. Over 50% of candidates scored at least half the marks in these final three parts. Again, it appeared that candidates had not read the question and procedure with sufficient care as separating funnels were often drawn in (c)(i), when, in Step 5, the liquids are in a beaker.

Question 6

The rate of the reaction between sodium thiosulfate and hydrochloric acid should be familiar to candidates. As a practical activity it is often encountered both at A level and GCSE.

In (a) there were a wide variety of reasons given for the solution becoming cloudy. The formation of sulfur dioxide was a common incorrect answer.

The multiple-choice question in (b)(i) was one of the two hardest multiple-choice question on the paper (along with Q6(d)). Only one quarter of candidates scored the mark in both of these multiple-choice questions. (b)(ii) proved much harder than expected with only 1 in 5 candidates scoring this mark.

The graph in (c) was slightly unusual as it was already plotted for candidates. The calculation of time taken, though in bold in the question, proved difficult as many just read off the reciprocal of time from the graph and did not then convert.

Many candidates recognised that there was a positive correlation between the rate and the concentration in (c)(ii) but this was insufficient to score the mark. The idea of directly proportional was scored by only about 20% of candidates.

As mentioned earlier, the multiple choice in (d) was found difficult, while that in (e) was also challenging by about 35% of candidates scored this mark.

Question 7

Q7 was the extended response question. This provided an excellent spread of marks and proved very accessible to most candidates. The most common score was 5, closely followed by 2 and 0, all with between 15 and 20% of the marks. 1 mark, scored by 11% of candidates, was the least common score. Indicative point 3 was the most often not seen.

Question 8

This question was based on the practical activity for determining enthalpy change of combustion, which is a very commonly encountered practical.

The equation for the enthalpy of combustion of methanol in (a)(i) was not as well answered as expected, with nearly 40% not scoring either of the marks, and only just over 10% scoring both marks.

The calculation in (a)(ii) was slightly unusual and proved a significant challenge. Relatively few candidates were able to score well, with many rather unsure of how to proceed. This made the final two questions difficult.

The calculation of percentage error was challenging, although some error in the previous section could be accounted for. This still proved one of the harder questions on the paper. The stock answer to the final question about precision of apparatus is nearly always that higher precision is better, but in this question the other errors in the activity are so high as to make this extra precision unnecessary. Some candidates saw this and were able to score one, or both, of the final marks.

Summary

- Read questions with care, making sure they answer the questions being asked not a similar, familiar question.
- Be very clear on answers to questions about equilibrium, so it is obvious how the equilibrium position changes with changes in conditions.
- Practice drawing structures of organic molecules in such a way as to show the connection of atoms together. If in doubt full displayed structures are the best method for this.
- Practice answering questions set in practical contexts. These are present in every paper.

