

# Examiners' Report

Summer 2013

GCE Chemistry (6CH01) Paper 01R  
The Core Principles of Chemistry

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## General

The concepts on the paper seemed accessible to the majority of candidates and there was little evidence of incomplete questions, suggesting that candidates had sufficient time to complete all tasks.

Calculations were especially impressive, with work clearly laid out to show individual steps.

## Section A

The mean mark was 16 for this section. The highest scoring questions were 5, 9 and 14 - over 90% of candidates achieved the mark. The most challenging questions were 2, 12 and 20. In the case of question 20, less than 50% of candidates achieved the mark.

## Section B

### Question 21

The majority of candidates understood the principles of electronic structure and applied them correctly to parts (a), (c), (d) and (f). However, part b (i) was a useful discriminator. Many answers simply described an orbital – using the shell or orbit model you would expect from courses prior to GCE level. Only the best candidates appreciated the concept that the orbital was a 3-dimensional space in which you would **probably** find the electron. The shapes of the orbital were well known. Although surprisingly it was often an incorrect s-orbital that failed to score. This was because some candidates believed the s orbital was actually the same dumbbell shape as a p-orbital but in a different orientation.

### Question 22

Over 75% of candidates were able to explain the key feature of the mass spectrometer accurately in (a). When they did fail to score it was often due to poorly expressed ideas that left the examiners in doubt as to whether the idea was understood. For example a number of responses in a (i) used the expression 'electrons were bombarded' or similar. In such cases the examiners knew the electrons in the sample were to be hit, but the mark was for the description of what they were hit with. Hence such answers, without further amplification, did not score.

Many candidates had clearly taken the time to learn the definition in (e). The most common errors were omission of the idea that the atoms need to be described as in the gaseous state prior to ionisation and a lack of clarity regarding the notion that the energy change is per mole rather than per atom. For instance the statement 'energy required to remove one mole of electrons from a gaseous atom' implies all the electrons are being removed from a single atoms so scored two marks out of three.

Candidates were often able to identify the substances that would conduct in (d).

However, the explanations in (ii) did provide a level of discrimination in two ways. Firstly, those who read the question with care benefited as they explained the conductivities of **both substances in both states**. Failure to discuss the conductivity of Na(l) was a common omission. Secondly, a significant minority believed that the conductivity of ionic substances is due to free electrons rather than free ions, so failed to score marks two and three.

### Question 23

Parts (a) and (b) were well answered. Only a small number of responses missed the mark in (b) (i) as they failed to balance the equation correctly. The dot and cross diagram in (c) proved more of a challenge. The most common error seemed to be the idea that **both** oxygens were attached to the sulfur by a double bond. This suggests candidates trying to derive their answer from first principles rather than following the bonding representation in the question stem.

In (d), many understood the idea of a skeletal formula, though its translation into a molecular formula in (ii) was less well done. Another common error was the equation:



Given the overall quality of the work from many candidates this seemed an odd error given that the CH<sub>2</sub> molecule does not exist.

However, the idea of reforming was only understood by a minority. Most candidates assumed the question was about cracking so gave answers in terms of formation of alkenes. Other answers were generic, simply talking about the formation of 'more useful products' without any indication as to why they were more useful. The best answers recognised that the branched or cyclic nature of the product increased the octane number to give a more efficient fuel.

Skeletal formulae were used effectively by most to work out the isomers in (e) (ii), though again a few ignored the guidance in the question or simply drew rotated variations of isomers already given in the stem.

There was much evidence in (f) to reveal that candidates had a very good understanding of the free radical substitution mechanism. The use of butane did not concern the vast majority of candidates. When errors did occur it was generally due to the appearance of hydrogen radicals in the propagation steps.

## Question 24

Although many candidates scored four marks in (a), formulae shown were often a mixture of the displayed and structural format. There seemed to be evidence that several centres have taught the reaction with aqueous bromine (with BrOH as the electrophile) as another example of electrophilic addition. Hence a small number of bromoalcohols were incorrectly suggested as the product of the reaction with liquid bromine. Candidates who use at such additional content, need to be careful that they appreciate the difference between this reaction and the one required by the specification.

In (b) over 50 % of the candidates were able to draw fully correct mechanisms. Probably the most typical misunderstanding was the idea that the halogen splits homolytically in the first step. It was pleasing to see very few examples of arrows going in the wrong direction, suggesting that either candidates have memorised the steps superbly or, more hopefully, that they appreciate precisely what a curly arrow represents.

In (c) the calculation was often shown very clearly, with each step obvious to the examiners. The most common error amongst weaker candidates was to simply express the two masses in the question as a percentage rather than to calculate the theoretical yield.

## Question 25

Once again recall of the definition in (a) was excellent. Previous reports have asked candidates to ensure they learn the definition in unit one and this cohort of students seem to have acted on that advice.

The calculations in (b) were again well presented and executed in the main. A minority failed to take into account the total volume of the solutions was  $100 \text{ cm}^3$  after mixing, but often went on to get marks via transferred errors. The most challenging part seemed to be (iii).

Errors seemed to fall in two categories; firstly those who did not include state symbols and secondly, the candidates who tried to cancel out the spectator ions without really understanding the principle of the unchanged nature of such ions.

Part (v) was a useful discriminator as although some realised the reaction was similar they were unable to express precisely why the enthalpy change would be the same. Answers often stopped frustratingly short of credit by recognition that both acids and alkalis were strong but without explaining why that would lead to the same enthalpy change.

## **Hints for revision**

Read each question stem with great care to make sure you are attempting to answer the question asked. In addition useful help can also be found there!

Practice writing unfamiliar ionic equations to develop the skill of cancelling out spectator ions.

When revising use the specification as a checklist, as well as past papers, to ensure you go over all parts of the course.

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