AQA

AS LEVEL
CHEMISTRY

7404/2 Organic and Physical Chemistry
Report on the Examination

7404/2
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General

This examination of the AS specification highlighted some key points about students' performance that may prove useful.

Students need to:

- be very familiar with all the practical procedures contained in the specification and, very importantly, understand why they carry out the procedures that they do in practical work, rather than just know what to do;
- be encouraged to set out working with a clear explanation of each step in a calculation rather than just writing down a set of different numerical expressions.

Section A

Question 1 Analysis of organic compounds

01.1 This question looked for a chemical test to distinguish between an aldehyde and a secondary alcohol. Many students scored well but the use of acidified potassium dichromate(VI), which would gave the same result with both compounds, was a common incorrect answer.

01.2 This question looked for a chemical test to distinguish between a cycloalkane and a cycloalkene. Students did this well, with nearly three-quarters scoring full marks.

01.3 This question required students to use reasoning to work through a mathematical problem step by step based on data from high resolution mass spectrometry. Students did this well, with nearly two-thirds scoring all three marks.

Question 2 Fuels

02.1 Students struggled to define the term 'fraction'.

02.2 The catalyst used in catalytic cracking was well known.

02.3 The drawing of the skeletal formula of a stated organic compound was done well.

02.4 Students determined the molecular formula of a compound from its name / skeletal formula and then wrote a balanced equation for its complete combustion. Many students struggled to determine the correct molecular formula but could write a balanced equation for the complete combustion using their formula.

02.5 Students struggled to explain why carbon dioxide absorbs infrared radiation, with few describing the idea that radiation is absorbed at the frequency of the bond vibration.

02.6 Students knew well the problem caused by NO pollution and how NO is removed from the exhaust gases of petrol-fuelled cars.

02.7 Students struggled to define the term 'carbon-neutral'. Many referred to carbon rather than carbon dioxide and few referred to the atmosphere in their answer.

Question 3 Nucleophilic substitution of halogenoalkanes

03.1 This mechanism was drawn well by students.

03.2 Students struggled to explain how the graph showed the relative rate of reaction of two halogenoalkanes. Fewer than one fifth of students scored both marks.

Question 4 Electrophilic addition of alkenes

04.1 This skeletal mechanism was done relatively well by students, despite involving an unusual structure.

04.2 Many students could explain why products are formed in different amounts, but some did not appreciate that this depends on the stability of the carbocation intermediates rather than the stability of the products. Some thought that the products were carbocations. Many students did not refer to the inductive effect of alkyl groups to explain the relative stability of the carbocations.

04.3 Students were asked to draw the structure of the major product of a reaction of an alkene containing two C=C bonds with hydrogen bromide. The more complex nature of dealing with two C=C bonds made this challenging to many.

Question 5 Energetics

05.1 Students did very well on this question where they had to determine the enthalpy of combustion of a fuel from calorimetry data.

05.2 Many students did appreciate that the true enthalpy of combustion value would be more exothermic than the measured value from a calorimetry experiment. However, many students struggled to express their answer clearly and often wrote confusing statements. When referring to the relative magnitude of exothermic reactions, stating that a reaction is more or less exothermic than another is clearer than suggesting whether a value is bigger or smaller which can be ambiguous, especially when the enthalpy change is negative.

05.3 This bond enthalpy question was relatively complex, but many students did work through it successfully. Common mistakes were to omit bonds or to miscount the number of C-C bonds in the alcohol.

05.4 Students found this question challenging. The key was to use the units to determine the route to the final answer.

Question 6 Intermolecular forces

06.1 Students who referred to electronegativity usually scored the mark on this question.

06.2 Few students could use the idea of symmetry to explain why the compound was not polar.

06.3 Students struggled with this question. Few used the information about polarity in questions 06.1 and 06.2 to inform their answer.

06.4 Students struggled to describe the hydrogen bonding between molecules of propan-1-ol. Some students used a diagram and this often helped to achieve higher marks.

Question 7 Organic preparation

07.1 Many students were confused about the purpose of a condenser in a distillation experiment and how it worked. This was revealed by misconceptions in their explanation of why the water should enter the condenser at the bottom.

07.2 Students found this elimination mechanism challenging; just under a quarter of students achieved full marks here.

07.3 Students made good progress with determining the percentage yield in this organic preparation. However, many incorrectly believed that the yield is the mass of the product over the mass of the reactant.

Question 8 Maxwell-Boltzmann distribution

Most students scored well on this question and could draw two appropriate distributions. Students found it harder to explain why reactions were faster at higher temperature with reference to their distributions and how the distributions indicated the number of particles with energy greater than the activation energy.

Section B

Question 9 Polymers

This was answered correctly by a majority (73%) of students.

Question 10 Chlorination of methane

This was answered correctly by the vast majority (84%) of students.

Question 11 Overall equation in free radical substitution

Students struggled with this question, with many believing that hydrogen is a product.

Question 12 Usefulness of ozone

This was answered correctly by a great majority (79%) of students.

Question 13 Reaction of a halogenoalkane with hydroxide ions

This was answered correctly by a great majority (78%) of students.

Question 14 Infrared spectroscopy

Many students incorrectly thought that the alcohol O-H group was a carboxylic acid O-H group.

Question 15 Shapes of molecules

There was much to consider in this question and a range of answers was given by students. Just over 40% of students gave the correct answer.

Question 16 Equilibria and K_c

This was answered correctly by a majority (55%) of students.

Question 17 Combustion of alkanes

Students found this question difficult, possibly due to having to determine the molar reacting ratio first.

Question 18 Naming E-Z stereoisomers

Students struggled with this question, with many believing it was the Z, not the E, stereoisomer. This was possibly due to a misunderstanding of how the Cahn-Ingold prelog priority rules apply when there is an ethyl group on each C of the C=C bond.

Question 19 Relative reaction rates

This was answered correctly by a majority (51%) of students.

Question 20 Comparing relative molecular mass using skeletal formulas

This was answered correctly by a majority (59%) of students.

Question 21 Empirical formula

Students found this question difficult, possibly due to it requiring two steps to determine the molecular formula from the name and then the empirical formula.

Question 22 Oxidation of alcohols

This was answered correctly by a majority (53%) of students.

Question 23 Atom economy

This was answered correctly by a clear majority (65%) of students.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.