OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL CHEMISTRY

(9620) CH02

Report on the examination

January 2021

REPORT ON EXAMINATION: INTERNATIONAL A-LEVEL CHEMISTRY 9620 UNIT CH02 JANUARY 2021

The paper allowed all students to show their ability. There were no questions that could not be answered by some students. Students did not seem to have any problems finishing the paper in the time allowed with all questions attempted by almost all students.
The more difficult questions were those requiring explanations such as questions 2 and 3. Calculations were done well.

QUESTION 01

01.1 Many students wrote about uv light was used to break the bond but did not go on to say how the electrons were distributed after. Many students gave homolytic fission as the answer. In the second part, initial step was a common wrong name.

02.1 Most students gained both marks. Some students did not add the hydrogens and 119.5 was a common mistake. A small number of students rounded 134.5 to 135 and lost the second mark.

03.1 Students found this question difficult with only a third of the students gaining the mark. Mis-spellings of the fluoro part were common even amongst students who gave the rest of the answer correctly: floro, fluro and flouro were common wrong spellings. Students had difficulty with the numbering of the halogen atom substituents.

04.1 A small number of students gave an equation rather than attempting a mechanism. Students sometimes failed to draw a lone pair on the hydroxide ion or they omitted the negative charge. Students who were close were often careless in drawing arrows: they often started from the O atom rather than the lone pair on O or from the α-carbon atom/bromine atom rather than from the C–Br bond.
There were a small number of elimination mechanisms too.
Some students gave a S_n1 mechanism: this could score both marks even though very little of a primary halogenoalkane would react by this mechanism.

05.1 Students found this question difficult with only a third of the students gaining both marks. The role as a base was well known. A few students stated it was an oxidising agent. The condition was often given as heat. This does increase the proportion of alkene : alcohol but using alcohol (usually ethanol) as solvent is the essential condition here.

QUESTION 02

02.1 This was generally well known. Students who scored one mark were divided between the rate and concentration mark fairly evenly. A common wrong answer was that concentrations were equal rather than constant.

02.2 0.3 mol was the commonest wrong answer for **E**.

02.3 This was done very well with about three quarters of the students scoring full marks. A few students did not give an expression for K_c or gave it without using the correct convention of brackets for concentrations of a substance. A few students could not rearrange the expression for K_c to make [**E**] the subject of the equation and some students who did rearrange it and substitute the correct quantities inverted the expression in the calculation: 2.90 was the commonest wrong answer.

02.4 About two thirds of students gained this mark. The bigger distractor was that K_c would decrease with only a few students saying that K_c would increase.

02.5 About three quarters of the students gained this mark with approximately equal choice between the other two distractors for the remainder.

02.6 Only a few students failed to address this as a problem using Le Chatelier's principle: most of these gave a kinetic argument. Most students deduced the reaction was exothermic and therefore would shift to the left hand side (or that the reverse direction was endothermic). Some students failed to address the third marking point or simply stated that this was to "oppose the change" without being specific about the temperature.

QUESTION 03

03.1 This question differentiated well. Only about 10% of students scored full marks but just under half scored three marks. Most students gained the first mark. A few students only gave one E_a or omitted this part; some failed to label their E_a's clearly; some did not label the axis but some point on the curve itself. Some students restated that the E_a was lower with the catalyst without giving a reason why and lost the second mark. Most students scored the third point. The fourth point differentiated well between students with only the strongest students discussing the **frequency** of successful collisions: many students stating only that the number of successful collisions increased.

03.2 Most students gained the second mark by stating that the frequency of successful collisions decreased. Many students failed to gain the first mark by talking about particles in general rather than reactant particles. Some students stated that the catalyst was used up or that the energy decreased during the reaction.

03.3 This question proved very difficult for almost all students and few addressed the key idea. Most students stated that a small increase in temperature increased the number of particles with $E \geq E_a$ but did not address the key part of the question of the much greater increase in rate. Fewer students tackled the effect of concentration and very few identified that increasing the concentration did increase the number of particles with $E \geq E_a$

QUESTION 04

04.1 Generally well done with about three quarters of students scoring the mark. Reactions with water were common wrong answers. A few students tried to write equations with silver ions in them.

04.2 The commonest wrong answer for the bond angle was 109(.5)^o with 120^o being common. The commonest incomplete explanation was that the bonds would repel each other so the ring would spring open. Very few students described the concept of ring strain.

04.3 Many more students scored the first mark for the arrow and positive charge in the first structure. Students who got close to the second mark often drew the arrow starting at the O^+–H bond but going to the H atom or starting at the H atom and going into the bond.

04.4 Anti-freeze was the commonest correct answer. Students often mistook this compound with ethane-1,2-diol and gave plastics/polyesters as an answer.

QUESTION 05

05.1 Students sometimes lost the first mark by giving dehydration only – the type of reaction and not the mechanism. Electrophilic addition and nucleophilic addition were the common wrong answers. For the reagent, students often lost the mark for failing to state that the acid had to be concentrated. A few students lost the mark by giving the wrong formula for the acid needed: a name is sufficient unless a formula is specified in the question. Sodium hydroxide was a common incorrect reagent.

05.2 This was well done. The common wrong answer was a three carbon chain $–CH_2CH_2CH_2–$ $–CH_2CH_2–$ was also given.

05.3 The physical property was well done. Higher melting point or boiling point were the common correct answers. The chemical property less well done: less reactive was a common insufficient answer. The key point is that the polymer is saturated so does not undergo addition reactions. Only a few students talked about the different reactions with bromine water.

05.4 Students found this challenging: some students did not attempt a skeletal structure; some students gave the skeletal formula of the polymer; some students gave the skeletal formula of butane, methylbutane or 2-methylpentane.

05.5 Students again found this challenging: this had the highest number of non-attempted answers. The term “plasticiser” was not well known. The effect on the polymer chains was better understood: most students who scored the mark described the effect on the intermolecular forces.

QUESTION 06

06.1 Many students lost this mark by failing to use acidified reagent. The formula for the dichromate was sometimes incorrect or incomplete: *e.g.* K_2CrO_7 or $Cr_2O_7^{2-}$. Students were more successful when they used the name rather than attempted the formula.

06.2 A significant number of students did not attempt a condenser but merely drew a connecting tube from the flask to the receiver. Other students tried to draw a condenser with varying degrees of success. The cross-section was not well understood: many students had openings to the outside air and others had no barrier between the cooling water and the vapour. Students who got close, often had barriers to the passage of the vapour (often between the flask and the still head or between the still head and the condenser), omitted a delivery tube and either had gaps in the apparatus or sealed the receiving flask completely. Few students gained both marks.

06.3 Many students gave the answer to prevent the propanal formed from evaporating. The commonest wrong answer was to prevent further oxidation of the propanal. Many students lost the mark by stating that this was to condense the propanal alone without going further – the condenser would condense the propanal so the ice bath is an extra precaution to make sure all the propanal vapour is condensed and to prevent any propanal evaporating.

06.4 Students did this question well with many gaining full marks. Students mainly lost marks for not giving their answer to 3 significant figures. or by rounding off values earlier so their final answer was not correct to 3 significant figures. Students should carry through at least one significant figure more through their calculation than is required in the final answer. Other students lost marks by not converting masses into moles or by using a mixture of moles and masses. A few students simply divided the mass of propanal by the mass or propanol and gave that as a percentage.

06.5 Many students failed to gain this mark by saying the wavenumber between 2500–3000 cm^{-1} must be checked without explaining the significance of this *e.g.* check whether there is an absorption between 2500 and 3000 cm^{-1}. Some students used the carbonyl absorption 1680–1760 cm^{-1}; some used the fingerprint region. A few students confused the O–H (alcohols) absorption rather than the O–H (acids).

06.6 The use of a reflux condenser was well understood. Students sometimes failed to give an explanation or gave an incomplete explanation such as to make sure the vapour condensed and returned to the flask.

QUESTION 07

07.1 Generally well done. Students sometimes failed to balance the equation for oxygen. In the calculation, students sometimes omitted to multiply by the factor of 6.

07.2 In the equation, students sometimes gave different products from those specified *e.g.* methane or gave two moles of propene. The commonest wrong answer for the conditions was to add zeolite. High temperature and high pressure were well known. Students often gave ranges for temperatures or pressures. This was allowed but only a single figure is needed unless a range is asked for and all of the student's range must be correct for the mark: better to give a single figure.

07.3 This question was well done and differentiated well also. Most students used bromine or bromine water as the reagent and knew this would turn colourless. The commonest wrong answer was zeolite.

07.4 This question differentiated well between students. The mechanism was the more difficult part. Most students named the major product. Some students misunderstood the question about the carbocation and stated that is was carbocation 1 (or 2). Many students failed to draw the carbocation in the mechanism part and instead drew the bromopropane structure; some students formed the carbocation in the first step. Many students either failed to draw in curly arrows or drew them incorrectly.

QUESTION 08

08.1 Many students stated functional – this was insufficient for the mark. A few students gave positional isomerism as the answer.

08.2 Students did this question well with over three quarters gaining full marks – there was also good differentiation. Most students gave Tollens' reagent and correct observations. A small number of students used Fehling's reagent or acidified potassium dichromate(VI): observations for these were recalled less well. Students who used potassium dichromate sometimes omitted the acid.

08.3 Answers of 71, 72, 73 and 74 were all common. Some students added 1 to their answer of 72 to account for an extra proton. Some students halved their answer of 72 to give 36.

08.4 This was generally done well with either 1620–1680 cm^{-1} or 3230–3550 cm^{-1} given as the commonest answers; other correct answers gave one value or a smaller range of these. Common wrong answers were 1000–1300 cm^{-1} (in the fingerprint region); 1680–1750 cm^{-1} (C=O stretch) or 2500–3000 cm^{-1} (carboxylic acid O–H).

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