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General Certificate of Education

Chemistry 1421

CHEM2 Chemistry in Action

Report on the Examination

2010 examination - June series

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General Comments

CHEM2 is demanding and the HSW contexts add to that demand. Candidates were better prepared this year compared with June 2009.

It was pleasing to see that full marks were seen on every question with overall scores up to 99%. There was evidence that candidates had adequate time to complete the paper but little time to spare. The lower achieving candidates had more opportunity this year to show what they could do and the most able candidates had adequate challenge.

Centres should continue to encourage candidates to know the specification content and should also aim to explore applications of the principles in this Unit.

Section A

Question 1

Intended to be a relatively straightforward introduction to the paper, parts of this question proved challenging to many candidates. In part (a)(iii), only 30% of the candidates were able to explain that the diagram showed that the sum of the bond enthalpies of the reactants was less than that of the products. In part (b)(ii) confusion arose between the effect of pressure on the rate of a reaction involving gases and how pressure changes might affect the position of an equilibrium.

Question 2

The meaning of the term *hydrolysis* was not well known and whilst the use of silver nitrate to show the presence of iodide ions was known, the reason for not including 1-fluorobutane rarely gained full marks. More than half of the candidates were able to explain the student deduction in part (b). In part (c) the simple response that a nucleophile is an “electron pair donor” eluded many, but the mechanism was generally well done with 85% gaining some credit. Candidates had little difficulty drawing the tertiary carbocation in part (d) but only the best candidates wrote about carbocation stability.

Question 3

This question was high scoring. In the explanation of the effect of an increase in temperature on the equilibrium, candidates often lost the final mark, because they failed to state that the equilibrium moves to lower the temperature by absorbing the heat. Too often the answer referred simply to opposing the change.

Question 4

In part (a), candidates rarely knew the meaning of the term *molecular ion*. In part (b), most could show why the answer for the precise M_r of N_2O was 44.00105, but the fact that <u>both</u> propane and carbon dioxide could be confused with N_2O using M_r values to one decimal place, was not always explained. In part (b)(iii), the idea that the precise M_r for the ^{12}C isotope is defined as exactly 12.00000 was poorly understood. The calculation proved straightforward for many candidates with 65% gaining full marks. The common mistake was an answer of +684 kJ mol^{-1}. Only half of the candidates knew about a standard pressure of 100 kPa in part (c)(ii).

Question 5

In question 5, it was the section on redox in part (b) that was least well answered. It was pleasing to see some very good mechanisms in part (c)(ii) and this part of the question discriminated extremely well producing the full range of marks. In part (c)(iv) too many candidates knew the correct acid but failed to draw a **displayed** formula.

Question 6

The usual mistakes were made in naming but parts (a)(i) and (ii) were high scoring. In part (a)(iii) many candidates were unable to draw a correct displayed formula and the type of isomerism was frequently incorrect. Many candidates had little difficulty in part (a)(iv) with drawing the (E) isomer. Part (b)(i) was well answered with 84% gaining some credit, even though a correctly assigned spectrum needed a reason, which included both the particular bonding and the infrared range. The type of structural isomerism was less well answered and only a quarter of the candidates recognised that it must be cyclohexane.

Question 7

Free-radical substitution mechanisms continue to discriminate extremely well and the whole range of marks was seen. There was a demand for candidates to show clearly the ethyl radical, but this was penalised only once. The reaction of chlorine with cold water was given correctly by 54% of candidates and whilst many could give an actual application, they were less familiar with the relatively small quantities of chlorine used and the benefits outweighing the risk. The name for sodium chlorate(I) was not well known.

The simplest ionic equation was written correctly in part (c)(i) by 56% of candidates but the explanation of why bromine has a higher boiling point than chlorine tended to score only one mark with too many candidates failing to refer clearly to the forces between molecules.

Section B

It was helpful for candidates to have the parts of Section B divided onto different pages, even though this meant that in Question 9 they needed to turn back to the introductory story for each part.

Question 8

Most candidates seem to know something about fermentation and part (a) discriminated extremely well.

In part (b), only the best candidates were able both to state that such a fuel is carbon-neutral and also to demonstrate that the six moles of CO_2 taken in during photosynthesis are later released in the fermentation process followed by the combustion of ethanol. Failure to recognise that two moles of ethanol were burning resulted in only four moles of CO_2 and left candidates confused. A few candidates seemed to think that a balanced equation with six carbon atoms on each side is carbon-neutral.

The calculation in part (c) proved demanding as candidates failed to count up accurately how many of each bond were broken and how many were formed. They were able quite often to get only one of these correct. The idea that mean bond enthalpies are average values obtained from many different compounds was not well known.

In part (d) the equation used to calculate the heat change was well known but conversion to enthalpy change proved difficult for all but the best. The idea of incomplete combustion was often missed.

Question 9

Overall this was one of the most discriminating questions on the paper and even the weakest candidates were able to score some marks. In part (a) many candidates were able to appreciate that the equilibrium would shift to the right to replace the lost CO_2 even if they did not express the idea as fully as they might have. In part (b) most candidates could extract information from the story and appreciate that there is a significant difference between waste gases being released into the atmosphere and collecting the SO_2 and making sulfuric acid from it. The expense associated with electrolysis in part (c) was well known but candidates often missed the fact that the zinc is pure and it is this that justifies the expense. A few candidates confused yield with purity. Quite a few candidates failed to use Zn^{2+} ions in their half-equation in part (d), but most knew that the reaction occurred at the negative electrode. Part (e) proved relatively demanding despite two possible equations that were not redox. Part (f) was well answered and credit was awarded for formation of either the oxide or the hydroxide.