



# **GCE EXAMINERS' REPORTS**

**CHEMISTRY  
AS/Advanced**

**JANUARY 2010**

## **Statistical Information**

This booklet contains summary details for each unit: number entered; maximum mark available; mean mark achieved; grade ranges. *N.B. These refer to 'raw marks' used in the initial assessment, rather than to the uniform marks reported when results are issued.*

### ***Annual Statistical Report***

The annual *Statistical Report* (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

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**CHEMISTRY**  
**General Certificate of Education**  
**January 2010**  
**Advanced Subsidiary/Advanced**

*Principal Examiner:* M. E. Anthony Ph.D.

**Unit Statistics**

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

<b>Unit</b>	<b>Entry</b>	<b>Max Mark</b>	<b>Mean Mark</b>
CH1	2016	80	44.4

**Grade Ranges**

A	56
B	50
C	44
D	38
E	33

*N.B. The marks given above are raw marks and not uniform marks.*

## CH1

### General Comments

The third CH1 since the introduction of the new specification, this paper attracted an entry of 2016 candidates, of whom 390 were repeating the unit. 230 sat through the medium of Welsh.

Overall the paper allowed all students to access most questions and gave a good range of marks. In addition, there were several discriminating questions that clearly set apart the much stronger candidates from the core, but never left any student struggling to achieve. This latter point was highlighted by the small number of scores below 30/80. There was no evidence of students having insufficient time to complete the paper. The mean mark was 44.4, the highest mark 77 (out of 80 maximum) and the lowest 3.

Section A was well answered, though very few candidates achieved full marks, the main stumbling blocks being Q.3(b) and Q.6(b). In Section B, Q.7 was the best answered, with Q.8 not far behind and the long-answer part (b) keeping the average mark for Q.9 quite high as well. The real discriminator was Q10, where only the best candidates scored highly, though consequential marking ensured weaker candidates could still access many of the marks.

### Atebion Cyfrwng Cymraeg

Roedd safon yr iaith ysgrifenedig Cymraeg yn gymharol i'r Saesneg yn y papur yma. Nid oedd yna unrhyw arwydd fod cyfrwng y cwestiynau yn effeithio ar safon yr atebion. Mi roedd y patrwm ateb, yn enwedig yn adran B, bron yn union yr un peth. Mi wnaeth ymgeiswyr sgorio'n uchel yng nghwestiwn 7 yn arbennig.

Mi roedd y mwyafrif o atebion anghywir yn dilyn yr un patrwm a'r canolfannau Saesneg. Y prif anhawster oedd methu cymhwyso gwybodaeth cyffredinol megis ecwilibria, enthalpi a chyfradd adwaith gyda'r achosion pendant a rhoddwyd. Ni welwyd llawer o ymgeiswyr yn gadael cwestiynau'n wag neu'n methu gorffen y papur. Nid oedd yna unrhyw arwydd fod yna fwy o ymgeiswyr cyfrwng Cymraeg wedi methu cwblhau'r arholiad i gymharu ag ymgeiswyr cyfrwng Saesneg.

### Detailed Comments

#### Section A

- Q.1 This electron configuration question was very well answered by nearly all candidates. Any errors were usually associated with an incorrect number of electrons obtained from the Periodic Table, but these were rare.
- Q.2 Most students were able to pick up the first mark for selecting the correct letter to represent aluminium, but many failed to achieve the second mark by offering a sufficient explanation for their choice. There was much confusion between electron *shells* and *sub-shells*.
- Q.3 (a) Whilst some candidates confused mole and relative atomic mass, it was pleasing that most candidates correctly completed the sentence defining the term *mole*, in contrast to the abysmal results of previous years when the same definition has been set. Obviously, giving candidates half of the answer in the question stem greatly improves their marks!

- (b) However, as in previous years, mole calculations remain a mystery to many candidates; many did not correctly work out the answer to part (b), with 0.1 and 0.3 being the most common incorrect attempts.
- Q.4 Even though most candidates were capable of correctly identifying the energy change in part (a) as corresponding to the first line in the Balmer Series, many were incapable of drawing the arrow in (b) to illustrate the ionisation of a hydrogen atom. As expected, a common incorrect answer was to draw the arrow in the wrong direction, as a decrease in energy level. More surprising was the significant number of candidates who extended the arrow way beyond infinity,  $n = \infty$ .
- Q.5 Candidates were generally aware of the shape of a p-orbital, and a large majority gained the mark. Lost marks tended to arise either from sloppy drawing or candidates who attempted to draw all three p-orbitals without identifying clearly the x, y and z axis, with the answer resembling the petals of a flower as a result.
- Q.6 (a) The term *dynamic equilibrium* was very well known, though a few candidates dropped marks by offering a definition of Le Chatelier's principle instead or by neglecting to include mention of 'rate' in their answer.
- (b) In contrast to part (a), this part was very poorly answered. Many candidates either repeated their answer from part (a) or failed to adequately describe the constancy of properties or concentrations at equilibrium, often confusing the terms 'same' and 'constant'.

## Section B

- Q.7 (a) (i) Many correct answers, but dropped marks usually came from careless nomenclature such as 'elements with the same number of protons, but different numbers of neutrons'.
- (ii) Very well answered, although some did drop marks for not stating which isotope(s) had 114/116 neutrons.
- (iii) Although the majority of candidates gained a mark for working out the graphical ratio of 19:31, many were incapable of converting this ratio to the correct % values. A significant number instinctively used the ratios to calculate the relative atomic mass, often correctly, but received no credit as it was not asked for in the question.
- (b) (i) A large number of candidates' answers provided a clear understanding of the idea of  $\beta^-$  particle as an electron, but many lost marks by failing to address the 'emission' part of  $\beta^-$  emission. A few confused  $\beta^-$  emission and ionisation of the atom.
- (ii) Well answered by most candidates, with the most common incorrect answers arising from use of the atomic number rather than mass number.
- (c) (i) Whilst the majority of candidates attained the mark, some marks were lost as a consequence of poor or ambiguous wording, e.g. 'the time it takes for half of the atom to decay' or 'the time for the mass to fall to half its original value'.

- (ii) Most candidates were able to read the half-life off the graph, although there were quite a few surprising wrong answers, ranging from 6.5 days to 191 hours!
  - (iii) This part was marked consequentially upon the half-life value obtained by the candidate. Whilst most utilised their half-life value from (ii) correctly, a few had issues with calculating the number of half-lives incorrectly, e.g.  $10\text{g}/1.25\text{g} = 8$  half lives.
  - (iv) Disappointingly, the majority of candidates either failed to read off the values correctly from the graph and/or used them incorrectly to work out the change in mass in the first 20 days. The most common incorrect expression was  $8.3\text{g}/20\text{days}$ . Most candidates gained the second (consequential) mark for dividing the mass by 20.
- (d) It was pleasing to see a large number of correct, logically set out, answers earning 3 marks. In (i), the most common error was dividing the relative atomic masses by the %. Part (ii) was marked consequentially upon the formula obtained in (i), but hardly any answers were seen where a (consequentially) correct equation followed an incorrect formula.
- Q.8 (a) (i) Whilst most candidates attained the first mark, poor explanations meant that many did not manage to get the second mark. However, a lot of students nevertheless achieved the QWC mark because they offered an (insufficient) attempt at describing, in terms of moles and ratios, the reason for Reaction 1 being the most efficient.
- (ii) Well answered. There were signs that the majority of candidates are finally making a real effort to learn definitions.
- (iii) The first mark was more commonly achieved than the second, as many neglected, when explaining why high pressure moves the equilibrium to the right, to specify that the right hand side of the equation had the least number moles of *gas* and treated gases and solids alike.
- (b) (i) Both marks were achieved by many as they had clearly (and indeed very encouragingly) read the information and interpreted it correctly. Indeed, one of the commonest errors was for candidates to interpret the graph correctly but then mix up the definitions of exothermic and endothermic.
- (ii) There were many impractical (and consequently mostly incorrect) attempts for part (I), this unfortunately in turn having a negative and consequential effect on part (II), e.g. 'add it to sodium hydroxide' and 'sodium hydroxide is difficult to get hold of'. Nevertheless, by correctly interpreting the graph, a good number of candidates recognised the need for  $\text{NaHCO}_3$  to be heated.
- (c) (i)-(iii) A good number of candidates managed to correctly work their way to all four marks and many others attained three consequential marks after surprisingly miscalculating the relative molecular mass for carbon dioxide (answers somehow ranging from 6 to 192). A small rump of weak candidates clearly had no idea from start to finish and ended up with zero.

- (d) (i)-(iii) There were many good answers that achieved the maximum three marks, though only the best used equations to show the reaction(s) of carbon dioxide in water. A disappointing number of candidates lost one or more marks by silly errors and loose wording. One of the commonest mistakes was to claim carbon dioxide as an acid because it could donate  $H^+$  ions, despite the absence of any hydrogen in the formula  $CO_2$ . Other examples included 'the air is acid because it contains protons', or 'water is acid because it dissociates to  $H^+$  and  $OH^-$ '.
- Q.9 (a) (i) The bond enthalpy calculation was generally well done, though as usual a significant number of candidates ended up with an incorrect sign.
- (ii) The calculation of  $\Delta H_f^\ominus$  was poorly done, with only the best candidates appreciating the significance of  $2HCl$  in the equation for part (i). Some totally ignored part (i) and tried to set up a new calculation from scratch.
- (iii) Well answered overall, with the small number of errors occurring in the standard temperature rather than the pressure.
- (iv) Very well done, with an ambiguous 'chlorine bond' the only significant mistake.
- (v) Only a minority of candidates actually attained all three marks by logically following on from their answer to part (iv). Most low marks stemmed from incorrectly trying to sum two or three different energy values (of particular colours) to match the total energy of Cl-Cl & H-H bonds.
- (vi) Most of the candidates who answered part (v) correctly went on to answer this part as well.
- (b) The majority of answers picked up at least four marks out of eight (including 2 for QWC). However, many did not get the mark for a correctly-labelled energy profile diagram. Significant numbers either omitted some labels such as the reactants and products, or drew the profile for an endothermic reaction or even a Maxwell distribution curve instead. Others failed to cover all the bullet points listed, instead concentrating at length, and repetitively, on one or two of the points.
- Q.10 (a) A lot of two mark answers and most candidates clearly understand the definitions of acids & bases and their roles in proton transfer. However, those candidates who tried to base their answers on conjugate acid-base pairs frequently went astray and failed to identify the *reactants*.
- (b) (i) As expected, this question proved a challenge, though consequential marking ensured nearly all candidates (apart from those who failed to attempt the question at all) gained at least one mark.
- Only the very best candidates appreciated the need to change 53.4kJ into 53,400J (or vice versa), but many did get two marks for then consequentially working through to 2.75 moles as their answer.

- (ii) The majority of candidates managed to follow through their answer to (i), most getting the mark consequentially for '110 mol dm<sup>-3</sup>' (obtained from 2.75 moles). Only a few, however, seemed to appreciate the unlikely occurrence of such a high concentration.
- (c) (i) Even though most candidates had very little trouble picking up the mark for correctly averaging the titres to 31.23 cm<sup>3</sup>, few were able to work out the concentration correctly. Most incorrect answers were based on figures from part (b) whilst totally ignoring the 25.00 cm<sup>3</sup> and 0.1000 mol dm<sup>-3</sup> given in the stem to part (c).
- (ii) Most students recognized the titration method as being more precise, and consequently went on to pick up at least one extra mark for explaining why.
- (d) (i) Poorly answered. Whilst many candidates seemed to appreciate that elements had a standard enthalpy change of formation of 0 kJ mol<sup>-1</sup>, most were incapable of explaining why, e.g. 'the elements are 0 because they are diatomic elements naturally'. It is important to realise that only elements in their stable / normal form have  $\Delta H_f^\ominus$  zero. For example, ozone, O<sub>3</sub>, is an element but has  $\Delta H_f^\ominus$  143 kJ mol<sup>-1</sup> since energy is needed to make it from the more stable O<sub>2</sub>.
- (ii) Many four mark answers for the  $\Delta H_f^\ominus$  calculations, and many more candidates achieved at least two marks consequentially for a single calculating error in each question, e.g. incorrect signs '+1266.4 kJ mol<sup>-1</sup>' and '+802.3 kJ mol<sup>-1</sup>'. Consequential marking was not allowed where two or more errors were present in the same calculation.
- (iii) Although most candidates recognized one advantage of using ammonia was the absence of carbon dioxide amongst the products, only a few were able to offer a specific disadvantage compared to methane. Common incorrect answers included 'ammonia doesn't cause pollution' (for the first mark) and 'ammonia is not renewable' (for the second mark). Vague answers such as 'costs more' gained no credit.

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*Principal Examiner:* E. W. Charles B.Sc.

**Unit Statistics**

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<b>Unit</b>	<b>Entry</b>	<b>Max Mark</b>	<b>Mean Mark</b>
CH2	696	80	44.9

**Grade Ranges**

A	56
B	50
C	44
D	38
E	33

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## CH2

### General Comments

For almost all the candidates, this was their second attempt at the CH2 unit. It was felt that the paper was straightforward and gave an opportunity for weaker candidates to show positive achievement. There were many excellent scripts which showed the value of sound revision and many more candidates gained 80% or more than scored 20% or less.

The highest mark was 74 and the lowest 11. As expected, Section A was answered well. In Section B the most successfully answered question as a whole was Q.7 with Q.10 being the least successfully answered. The easiest parts on the entire paper proved to be Q.1, Q.10(a)(ii) and Q.7(b)(i), while the hardest parts were Q.8(e)(ii), Q.10(b)(iii) and Q.8(a)(iii) in that order.

It was pleasing to note that a significant number of candidates performed well in the few calculation questions but while most managed to write a chemical equation Q.11(a)(i), forming an ionic equation Q.8(a)(iv) still proved too much for the majority. It was also good to see that almost all were very knowledgeable in the use of infrared spectra.

As in previous examinations the examiners noted that many candidates did not read the questions carefully enough and did not give specific answers to the actual question. Once again for many candidates, answers that required detailed responses often lacked depth of content and were sometimes contradictory. This was particularly true in Q.7(a) boiling points of hydrocarbons and Q.11(c) electrical conductivity in metals and ionic compounds.

The Organic Chemistry questions were answered better than the Inorganic/Physical Chemistry questions, suggesting that candidates have benefited from extra work on the CH4 module since their first attempts at CH2.

### Atebion Cyfrwng Cymraeg

Safodd 11% o'r ymgeiswyr y papur trwy gyfrwng y Gymraeg. Gydag ond ychydig o sgriptiau cyfrwng Cymraeg anodd ydi cael darlun cyflawn. Ar y cyfan roedd safon yr atebion yn wanach na'r rhai drwy gyfrwng y Saesneg ond gwelwyd safon iaith da iawn, gyda'r mwyafrif yn ennill nifer o'r marciau am ansawdd eu cyfathrebu ysgrifenedig.

Defnyddiwyd yr enwau cemegol cywir am y cyfansoddion a'r adweithiau gan y mwyafrif. Ble welwyd problemau oedd yng nghwestiynau 10 (b), (c) a 11 (c) lle cymysgwyd termau fel 'atom' a 'moleciwl' neu 'electron' ac 'ion' a defnyddiwyd 'fe' a 'hi' yn lle iaith sbesiffig, er roedd y problemau yma'n gyffredin l'r myfyrwyr cyfrwng Saesneg hefyd. Yn gyffredinol nid oedd iaith y cwestiynau wedi achosi unrhyw anhawster i'r ymgeiswyr.

Diffyg gwybodaeth a dealltwriaeth oedd yn debygol o fod y rheswm dros golli marciau ac nid yr iaith a ddefnyddiwyd ar y papurau.

## Section A

The candidates generally scored quite well in this section, with the average mark being around 7 out of 10.

- Q.1 Proved to be the easiest part of the whole paper. Almost all the candidates correctly identified Van der Waals as the weakest bonding.
- Q.2 Well answered. Most stated that HF showed hydrogen bonding. As expected a significant minority chose  $\text{CH}_3\text{OCH}_3$ .
- Q.3 This question involved the shapes of molecules and was again well answered. The main error was to give the shape of  $\text{PCl}_3$  as trigonal planar.
- Q.4 Only just over half the candidates got the full two marks for this standard question on ionic bonding. Many candidates showed covalent bonding. There were also many ambiguous answers.

There should be two clear steps – one showing the atoms donating / receiving electrons and the other showing the charges on the ions formed.

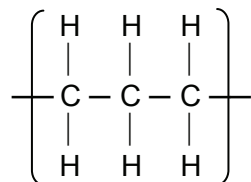
- Q.5 Very well answered. Almost all candidates identified the need to halve the value for solubility obtained from the graph.
- Q.6 Poorly answered. The main error was to use  $\text{CH}_3$  to represent the side chain rather than showing it in skeletal form. More worryingly a significant number gave the displayed formula instead of the skeletal formula.

## Section B

- Q.7 This was a question about hydrocarbons and was the most successfully answered question in this section.
- (a) Almost everyone gained some credit for this part – mainly due to the QWC mark – although less than a quarter gained full marks. Most candidates lost marks because their answer stated or implied that the forces broken during boiling were intramolecular. A typical answer was ‘hydrocarbons containing few carbon atoms have less bonds to break therefore have a lower boiling point’.
- (b) (i) The vast majority knew that pentane was an alkane.
- (ii) The meaning of structural isomer was well known but a significant number lost a mark by stating ‘chemical formula’ or ‘formula’ instead of ‘molecular formula’.
- In part II candidates had to draw and name structural isomers of pentane and surprisingly more than one-third failed to gain more than half marks. The main errors were to give pentane as an isomer of pentane (losing 2 marks) and incorrectly naming 2,2-dimethylpropane as 2-dimethylpropane.
- (c) Very well answered. Over three-quarters were able to explain the term cracking.

- Q.8 (a) (i) About half the candidates knew that CFC referred to chlorofluorocarbon but far fewer could spell it!
- (ii) The vast majority knew a use of CFCs.
- (iii) Although most were clearly aware of the meaning of the term radical, a number of candidates failed to give the specific answer required. Common errors were stating that a radical 'has an unbonded electron', 'has only one outer electron' or 'is an unpaired electron'.
- Part II was poorly answered. Some referred to electronegativity instead of bond strengths and others did not compare the strengths of the C – F and C – Cl bonds. Candidates need to realise that in an answer involving comparison, reference must be made to both aspects.
- (iv) Part 1 was fairly well answered. Too many failed to state that the acid was neutralising the remaining sodium hydroxide. Instead they gave vague answers such as 'removing impurities' which gained no credit.
- The reagent and observation were both well known.
- In part IV disappointingly less than a third gave a correct answer to a simple equation. Most candidates showed a lack of understanding of the concept of ionic equations.
- (b) In this part candidates had to draw the mechanism for the hydrolysis of bromoethane and although the majority gained some credit fewer than 1 in 6 gained full marks. The most common errors were:
- lack of a dipole on the C – Br bond
  - showing the charge on the hydroxide ion as  $O^{\delta-} - H^{\delta+}$
  - curly arrow not going to the  $C^{\delta+}$
  - lack of negative charge on the transition state.
- (c) (i) Elimination is not well known with many candidates failing to identify the product as ethene. The most common answer was ethanol.
- (ii) Even fewer candidates managed to give the necessary conditions for the elimination reaction and this proved to be the hardest part of the paper.
- Q.9 (a) About three-quarters of candidates gained at least 3 marks out of 4 for this part. A few candidates who correctly obtained the empirical formula as  $C_2H_4O$  incorrectly gave the molecular formula as  $C_4H_8O$ . Others lost marks due to a failure to include oxygen or only giving an empirical formula.
- (b) (i) Very well answered. The vast majority used the data sheet correctly.
- (ii) Again well answered, although a significant minority lost a mark by stating that the product was a carboxylic acid without identifying it or by failing to realise the oxidation was complete and suggesting propanal.
- (c) The majority could name a suitable reagent for preparing propene from propan-1-ol.

- (d) The vast majority could identify the need for bromine water and most of these gave the correct colour change, although the tendency of some to state 'decolourise' without indicating the initial colour remains.
- (e) Disappointingly fewer than 2 in 5 candidates could draw the repeating unit in poly(propene). The most common answer was:



- (f) Most could answer this although a significant minority failed to realise that the requirement for a substituted monomer ruled out poly(ethene) as an answer.

Q.10 This was the least successfully answered question in this section.

- (a) (i) Disappointingly less than half gave the correct answer. Most knew that electronegativity was related to the attraction of an atom for electrons, but many did not realise that these electrons must be in a covalent bond.
- (ii) Nearly everyone could use the information to state the trend in electronegativity across a period.
- (iii) A range of answers were seen with many gaining one mark but only about a quarter gaining both marks. Most answers were based on the number of electrons in the outer shell or how many electrons an atom needed to obtain a full shell rather than referring to nuclear charge.
- (b) (i) Most candidates gained at least one mark. The vast majority were able to note the increase in melting temperature up to carbon followed by a decrease. However, many did not give the detail needed to obtain the second mark.
- (ii) The vast majority were able to predict a value for the melting temperature of aluminium but a significant minority lost the mark by omitting the unit.
- (iii) Very poorly answered. Most seemed unaware that sodium and magnesium are metals and so contain metallic bonding. Answers such as 'magnesium has a higher atomic mass therefore it will contain more van der Waals forces which will require more energy to break' were seen.
- (iv) Poorly answered. References to the number of electrons in the atom, the size of the atom or even bond strength were common. Answers such as 'melting temperatures increase down group 7 as the atoms increase in size they have more electrons which increases the strength of forces between the electrons and the nucleus making them more stable' were seen.

It should be emphasised that Group 7 elements exist as molecules not atoms and that during melting it is the forces between the molecules that get broken.

- (c) Again poorly answered. The question refers to both bonding and structure. A significant number did not refer to covalent bonding and even where this was made clear it was not always stated that these bonds were strong and that they were broken on melting. Far too often reference was made to breaking the van der Waals forces between the layers. Many did not mention or describe a giant covalent structure and so lost the structure mark.

- Q.11 (a) (i) This question was about the reaction of calcium and water. Most gained a mark for indicating that bubbles were formed but other observations were not as clearly recalled. Many thought that calcium floated on the surface and some thought that a flame was produced indicating a confusion between the behaviour of Group 1 and Group 2.

Just over a half gave the correct equation in part II. The main error was giving calcium oxide as a product.

In part III many candidates gained one mark for stating that strontium was more reactive as reactivity increases down the group. To obtain the second mark an explanation was required in terms of ease of electron loss or ionisation energy.

- (ii) In parts I and II, most candidates correctly used  $n = cv$  to calculate the number of moles of acid. And many gave the correct mass of calcium used. The main error was a lack of use of the stoichiometry of the reaction to halve the number of moles present.

Part III was fairly well answered only. Many thought that flame tests could only be done on solid samples. Although this was not penalised, a mark was lost for stating 'red' instead of 'brick red' as the colour of the flame. However most of the incorrect answers were based on precipitation reactions.

- (b) Poorly answered. Some candidates thought that sodium would not react with dilute hydrochloric acid which showed a worrying lack of chemical knowledge and understanding. Less than half could come up with alternative reagents. A surprising number suggested displacement reactions as routes to produce pure solutions of sodium chloride ignoring the other products made in these reactions.

- (c) This part involving how calcium and calcium chloride conduct electricity was answered fairly well. Over half scored at least 4 marks out of 6, mainly due to gaining both QWC marks.

Most candidates could identify the mobile delocalised electrons as the mechanism of conduction in calcium. However, many failed to state the conditions necessary for conduction simply stating 'calcium metal will conduct' and so lost a mark. Others stated that calcium only conducts when solid, ignoring the fact that the metal will also conduct when molten.

Most candidates knew that calcium chloride had to be molten or in solution to conduct electricity. However, most thought that this was necessary to free up electrons to move. The movement of ions as a route to conduction was not well known. Consequently a significant minority stated 'they conduct electricity when molten due to the electrons being free to carry electricity.'

**CHEMISTRY**  
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**January 2010**  
**Advanced Subsidiary/Advanced**

*Principal Examiner:* D.H.Ballard, B.Sc., Ph.D., C.Chem., F.R.S.C.

**Unit Statistics**

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CH4	1303	80	46.3

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## CH4

### General Comments

This was the first CH4 paper for the new specification and all candidates were taking this module examination for the first time. There was a very wide range of marks obtained by the candidates, from a relative few who scored less than 20 to a number of stronger candidates who obtained 60 or more out of 80.

In general the papers showed clear evidence of candidates being well prepared. This paper, unlike CH4 papers in the previous specification, contained a comprehension section that was similar to those seen in the previous CH6a papers. This seemed to make the paper perhaps a little long. In a few scripts there was some suggestion that candidates had to hurry to finish the paper but in the majority of scripts this did not seem to occur.

The responses to the few calculations in this paper were generally sound. However, a continuing weaker area is in those questions where longer answers are required. Some scripts were seen where the candidates obviously knew the material but could not express themselves in a clear and concise way.

Surprisingly, the responses to Section B were often better than those in Section A.

In general the examiners thought that the paper had worked well and that the results compared favourably with those in the previous specification.

### Atebion Cyfrwng Cymraeg

Roedd y canran o ymgeiswyr cyfrwng Cymraeg yn debyg i'r canran arferol a mae hyn yn galonogol. Yn llai calonogol oedd y ffaith fod ambell ganolfan wedi cofrestru ymgeiswyr fel ymgeiswyr cyfrwng Cymraeg ond rhai unigolion wedi cwblhau sgrïptiau yn Saesneg. Gwelwyd ychydig mwy o enghreifftiau o ddefnydd termau Saesneg ar ganol atebion Cymraeg na sy'n arferol, ond rhaid canmol y llu o bobl ifanc a atebodd y cwestiynau mewn modd gwbl glir a dealladwy ac a gymrodd balchder yn eu defnydd o'r Gymraeg i esbonio'r cysyniadau. Fe atgoffir canolfannau o'r pwysigrwydd o dynnu sylw darpar ymgeiswyr at y ffaith bod marciau i'w hennill am Ansawdd y Cyfathrebu Ysgrifenedig mewn cwestiynau penodol a ddynodir gan (ACY).

### Section A

- Q.1 (a)
- (i) The examiners were looking for an answer that implied stereoisomers occurred because of different arrangements of the atoms / bonds in space. All too often the candidates merely described E-Z or optical isomerism without considering the more general 'definition' of a stereoisomer.
  - (ii) The use of skeletal formulae is a new area (apart from benzene) and seemed unfamiliar to many students. A number of candidates wrote CH<sub>3</sub> when this was implied in the formula. This is an area that needs attention and, surprisingly, was quite discriminating. A number of candidates thought that the skeletal formula was the same as the displayed formula.
  - (iii) The reagent(s) and conditions to make **ethyl** angelate were required. Too many candidates wrote that alcohol was to be used without specifying which alcohol. Most candidates, though, correctly gave sulphuric acid.

- (b) (i) Almost all candidates could describe what was meant by the term 'chiral centre', although a few spoilt their answer by stating 'molecules' instead of atoms or group bonded to the chiral carbon atom. Almost all candidates identified a chiral carbon atom in the formula.
- (ii) Enantiomers rotate the plane of polarised light. The examiners had reservations about some alternative words seen – deflect, reflect and refract.
- (iii) The term 'racemic mixture' was understood by many candidates and its effect on the plane of polarised light was also clearly stated. Some candidates failed to mention that a racemic mixture contained equal 'amounts' of each enantiomer.
- (c) (i) The meaning of the term chromophore was an easy mark for many candidates. The origin of the orange colour for DEAD was well understood and there were far fewer candidates who considered that the colour was due to emission.
- (ii) The reasons given for splitting of the peaks in the NMR spectrum of an ethyl group were often confused and it was sometimes difficult for the examiners to decide which group was being written about. This was a question where too many candidates lost marks through imprecision in their response.
- Q.2 (a) (i) Most candidates stated, correctly, that sodium hydroxide was reagent **A**.
- (ii) Too many did not know the name of KCN and potassium nitrile was commonly seen. A number of candidates used hydrogen cyanide for this stage but the examiners did not feel that this compound was acceptable.
- (iii) Most candidates gave elimination or dehydration, both of which were acceptable. Some spoilt their answer by also mentioning condensation. Candidates are reminded that just the word 'elimination' is acceptable. If they preface this word with electrophilic or nucleophilic, then the answer is considered to be wrong.
- (iv) The displayed formula of amine **D** was too often given wrongly with hydrogen atoms missing and / or the wrong number of carbon atoms in the side chain.
- (b) This NMR question was quite well attempted but only the strongest candidates could give a really precise answer about there being only two discrete environments for the hydrogen protons in compound **T**.
- (c) (i) Ethanoylation continues to baffle many candidates and, despite easing the mark scheme, the award of both marks was not that common. This is an area that may merit attention for future examinations.
- (ii) Although many candidates were able to write the formula for the zwitterion form of aminoethanoic acid, a significant number of these were penalised for not placing the positive charge on the nitrogen atom.

- (d) The secondary structure of a protein was well understood, although sometimes hydrogen bonding was omitted.

Q.3 These questions were focused on the article 'Carboxylic acids and their esters – versatile materials in industry and in the home'.

- (a) (i) An important procedure, when diluting a solution, is to thoroughly mix the liquids – this was not commonly stated.
- (ii) This calculation was generally done well. The commonest omission was to forget the dilution factor.
- (b) This was a newer style question where candidates were asked to compare two processes and to discuss the relative advantages and disadvantages of each. Many candidates found problems in setting out their responses in a logical and concise way, with the result that many answers were not really clear. It would have been easy to give candidates two columns for their answers but there is a need for longer prose style answers that have been given minimal help by the examiners. Nevertheless, many candidates achieved at least two of the four available marks.
- (c) A formula for the tri-ester was required. Some candidates only used one molecule of lauric acid instead of three. A common error was to write  $\text{CH}_2$  for the middle carbon of glycerol. Some candidates drew every atom and bond despite the question stating that this was unnecessary.
- (d) The examiners were disappointed by the response to this question about thin layer chromatography. Many candidates used the given 'ruler' in the passage wrongly and concluded that none of the spots was given by ethyl palmitate. Sadly, some easy marks were lost here.
- (e) The polymer chain for PET was often correct but too many repeating units contained the wrong number of oxygen atoms.

## Section B

- Q.4 (a) This new mechanism for the chlorination of benzene using electrophilic substitution was well answered and was, probably, an anticipated question! The examiners do feel, however, that more care should be given when drawing the Wheland intermediate, so that the dotted line covers five of the ring carbon atoms and faces the correct way.
- (b) Questions about the inability of aromatic chloro-compounds to react with the hydroxide ion have been asked on a number of occasions but some candidates continue to find it difficult to express their ideas in a clear way. Too many candidates wrote about the  $\pi$  system of chlorine's electrons rather than its p orbital lone pair interacting with the  $\pi$  benzene ring system.
- (c) (i) Many candidates had trouble naming this alkylbenzene.
- (ii) Most candidates gained at least one of the two marks, only a few bothered to work out the atom economy and comment on this.
- (iii) Candidates continue to use infrared data correctly and appropriately.

- (iv) Many candidates gained both marks here and gave a sound reason why ethanol was a suitable solvent.
  - (v) The use of the 2,4-DNP derivative in identification was well understood by nearly all candidates, many of whom gained all three marks.
  - (vi) Candidates used the mass spectral data in a competent way. One weakness was not to give the formula of pentan-3-one when referring to the molecular ion.
- Q.5
- (a)
    - (i) This was generally well done. The better candidates used two moles of ammonia and gave e.g. ammonium chloride as the co-product rather than hydrogen chloride.
    - (ii) Although many candidates realised that hydrogen bonding was required in this question, it would have been much easier to use a diagram in their answer. Few candidates used this approach.
    - (iii) The basic nature of butylamine was well recognised by nearly all candidates. Some weakened their answer by stating that the  $\text{NH}_2$  group had a lone pair, rather than the nitrogen atom.
  - (b)
    - (i) It was pleasing to see that many candidates gained full credit for this calculation. However, there seemed to be rather an easy interchange of grams to kilograms without mention of the 1000 factor. Sometimes this meant a double error giving the correct answer!
    - (ii) This newer style of question is much more open ended than those requiring factual answers, and as a result, there could be many acceptable and valid answers. The examiners felt that an essential reason for the statement in I was the need for reliable and consistent results and this was also stated by most candidates. In II the need to try and reduce the reaction time was felt to be an important feature.
  - (c)
    - (i) Nearly all candidates appreciated that the mixture would turn from orange to green. Oxidation of ethanol or reduction of the dichromate was required for the second mark – this was often awarded.
    - (ii) This was an easy final question and many candidates gained full credit for the identification of the organic products. Some spoilt their answer by stating that a ketone was also formed.



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