WELSH JOINT EDUCATION COMMITTEE
CYD-BWYLLGOR ADDYSG CYMRU

General Certificate of Education **Tystysgrif Addysg Gyffredinol**

EXAMINERS' REPORTS

JANUARY 2006

AS/Advanced Chemistry

WJEC
CBAC

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.

CHEMISTRY

General Certificate of Education

January 2006

Advanced Subsidiary/Advanced

Principal Examiner: M. E. Anthoney 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.

Unit	Entry	Max Mark	Mean Mark
CH1			

Grade Ranges

A
B
C
D
E

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

Unit CH1

General Comments

1295 candidates sat this paper, a slight increase on January 2005, with 70% sitting the paper for the first time, most after about five months of their A level course. ????? sat through the medium of Welsh.

The mean mark was 32.6, midway between the means for the two corresponding papers in January 2004 and January 2005. Interestingly, the mean mark for first time candidates was identical to that for resits. The highest mark was 65 (out of 66 maximum) and the lowest 1.

Section A was well answered, with the majority of candidates scoring over half the marks.

Section B was more of a problem, with the longer responses required for Q7a and Q7c producing many badly-structured, imprecise answers and Q9 and Q10 showing large gaps in the Inorganic Chemistry knowledge of some candidates.

The paper showed up large differences between centres in the preparedness of their candidates for this paper, more so than in previous years. With some centres, none of the candidates had progressed much beyond GCSE level, while other centres had all their candidates showing familiarity with most of the syllabus topics even when mistakes and lack of understanding led to lower marks.

Section A

Q.1 There was a high proportion of correct answers with, as expected, equating the number of neutrons to relative atomic mass minus number of protons being the commonest error.

Q.2 One of the best answered questions, though some weaker candidates relied on random guesswork.

Q.3 (a) Again well known, though too many of the diagrams were scruffy. “Dot and cross” diagrams are not acceptable for electron density distributions.

(b) A surprising number of candidates failed to appreciate the increased electron density between the molecular nuclei (“sharing” of electrons) compared to atoms.

Q.4 Both parts were well answered, with few problems.

Q.5 Many candidates found this short question surprisingly difficult, with unnecessary calculations of Mr values not uncommon. There is a decline in the ability of candidates to handle formulae.

Q.6 The correct answer, C, was also the most popular answer, often arrived at by a process of eliminating the other possibilities.

Section B

Q.7 (a) Too many candidates lost marks by concentrating on only one element (usually the first-named) out of each pair. As mentioned previously, there was a lack of precision in many answers.

(b) Candidates scored well on parts (i) and (ii), though many received the benefit of doubt for badly-worded answers.

In part (iii), many candidates failed to appreciate the significance of the long half life. The calculation in (iv) was reasonably well done, but many candidates struggled with standard form for numbers, with even correct answers often quoted in long form (2600000000 years).

(c) Very few candidates structured their responses in such a way as to give two clearly distinct answers corresponding to the two terms *dipole* and *hydrogen bonding*. Indeed, the impression was given that many candidates thought the terms were synonymous. This made marking the question very time consuming.

Q.8 (a) (i) Most candidates correctly identified ^{35}Cl and ^{37}Cl.

(ii) There were many correct answers, but a surprising number of candidates calculated the relative atomic mass of chlorine instead.

(iii) Most candidates understood the possible combinations of ^{35}Cl and ^{37}Cl, but many lost marks by failing to identify Cl_2^+ as the species involved.

(b) (i) It is disappointing that a significant number of candidates failed to balance such a straightforward equation.

(ii) The use of "cumulative" oxidation states (e.g. giving H in H_2O as +2 for two H atoms rather than +1) was a common error.

(iii) To avoid guesswork, even when the correct oxidising agent was identified, no credit was given without the correct reason in terms of oxidation states.

(c) The trend in oxidising power was well known, that for volatility less well understood.

Q.9 (a) A surprising number of candidates seemed to be just guessing at the five compounds asked for, implying a widespread lack of knowledge of the nature of simple inorganic compounds. Can so many students really believe that sodium chloride produces an acidic solution?

(b) A disturbing number of candidates seemed to have no appreciation of the meaning of "full sub-shell electron configuration", answers such as 2.8. or Na^+ being all too common.

(c) This and the next part were both poorly answered. Only the best candidates appreciated the giant covalent lattice structure of silicon(IV) oxide compared to the discrete molecular structure of the chloride.

(d) The trend in chlorides from ionic bonding to discrete molecular covalent bonding going across the Periodic Table was not well known. An early, rigorous appreciation of trends within the Periodic Table can save a lot of heartache and rote learning later in the course.

(e) (i) To obtain full marks, candidates had to show by diagram, or describe, the octahedral arrangement of Na^+ about each Cl^-, and vice versa, together with 6:6 co-ordination. A common error was to talk about Na and Cl *atoms*.

(ii) Intended as a more difficult question, a pleasing number of candidates picked up on the different stoichiometry of $MgCl_2$ compared to the other two compounds.

Q.10 (a) The calculations were quite well done, with good numbers of candidates correctly identifying $Ca(NO_3)_2.4H_2O$.

(b) (i) Some candidates were led astray by a mistaken belief that the flame test must be carried out on dry solids. Simple "red" is not sufficient to identify a flame colour unique to calcium; brick red or orange-red are more appropriate.

(ii) The formation of a white precipitate of $Ca(OH)_2$ with excess hydroxide was known by about half the candidates, but a correct equation for the reaction and the solubility of calcium hydrogencarbonate were present in far fewer scripts.

(iii) There were many good answers on the hydration of ions, but a few candidates assumed H^+ and OH^- ions were involved.

(c) There were surprisingly few correct answers for the number of moles of gas produced and only a few of the best candidates achieved a successful calculation of the volume.

(d) What should have been a straightforward question elicited a surprising spread of answers, with calcium oxide, hydroxide, chloride, fluoride and sulphate all being put forward several times as components of bones and skeletons, plus several others where the correct choice of compound was spoiled by an incorrect formula e.g. $Ca(CO_3)_2$.

CHEMISTRY

General Certificate of Education

January 2006

Advanced Subsidiary/Advanced

Examiner: D.H.Ballard, B.Sc., Ph.D., C.Chem., F.R.S.C.
Lecturer in Science Education, Nottingham Trent University

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.

Unit	Entry	Max Mark	Mean Mark
CH2			

Grade Ranges

A
B
C
D
E

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

Unit CH2

General Comments

This paper was taken mainly by candidates in Year 13, nearly all of whom were retaking this module. There were some very good scripts, which showed the value of sound revision. It was disappointing to see around 10% of the candidates who could only score 20 marks or less out of a paper total of 66 and a further sizeable percentage who could not obtain half marks.

As in some previous examinations, a number of candidates did not read the questions carefully enough and wrote what they knew about the topic rather than responding to the question.

The general standard of the papers was similar to those seen in other January CH2 examinations and every question was accessible, with no dead marks.

The examiners felt that the calculations in this paper were handled with confidence but some candidates did not take sufficient care with significant figures and others muddled up plus and minus signs in ΔH calculations.

The time allowed seemed adequate and there was no evidence of candidates having to rush answers towards the end of the paper.

Section A

Q.1 (a) The correct name for the compound was 2-bromo -2-methylbutane. There were some candidates who gave only one' two' and joined bromo and methyl together, causing problems for the examiners.

(b) Almost all candidates recognised the type of reaction as an elimination.

Q.2 Although many candidates correctly indicated E_f and ΔH on the diagram, there were those who wrote the letters without arrows, leaving the examiners with no clues as to what they meant.

Q.3 (a) The question asked for an observation. Vague statements such as 'a gas is given off' does not constitute an observation. Similarly, 'carbon dioxide is given off' is a conclusion, not an observation.

(b) Most candidates correctly gave the confirmatory test for carbon dioxide.

Q.4 Many candidates did not use the information in the table to respond to the question. The examiners were looking for a comment about the stability of the two oxides as indicated by the ΔH_f^{θ} values provided. This was seldom done; the more usual response was about one of the oxides being more exothermic than the other.

Q.5 Most candidates recognised that propanoic acid was the most soluble in water from the list given.

Q.6 The use of a catalyst was a popular incorrect choice, but the question emphasised **this** reaction for which a catalyst was an inappropriate response.

Section B

Q.7 (a) (i) The question asked for methane and chlorine as reactants and chloromethane as the product. A number of mechanistic equations were given which did not include these reactants and products.

(ii) A number of candidates still cannot give a clear definition of the meaning of the term free radical.

(iii) The initiation stage of the free radical substitution reaction was well known.

(iv) Most candidates gave a satisfactory explanation for the further reaction to give dichloromethane.

(v) This was the weakest part of the question. Relatively few candidates could explain how butane could be a product from the reaction of ethane with chlorine. Some candidates referred to ethane free radicals rather than ethyl free radicals.

(b) Hexane and its formula were identified by most candidates.

(c) (i) The question asked for the mechanism of propene with hydrogen bromide. Around 20% of the candidates drew a curly arrow from the hydrogen atom of hydrogen bromide to the double bond and a sizeable number also drew curly arrows from atom to atom. The examiners fell that the drawing of correct and precise mechanisms is a cause for concern. Evidence suggests that many candidates are learning them without a clear understanding of what is occurring.

(ii) A number of candidates could not state that the relatively greater stability of the secondary 2-propyl carbocation was a reason why 2-bromopropane was the main reaction product. It was common to see statements such as ‘2-bromopropane is more stable than 1-bromopropane.

(d) The question asked candidates to describe a test, with observations, to detect the presence of a bromine atom in 2-bromoppropane. A number of good answers were seen but very often the reagent order was wrong , which meant it could not work as planned. Again, the examiners thought that a lack of real understanding was to blame with a number of candidates learning the material ‘parrot fashion’.

Q.8. (a) (i) The term ‘homogeneous ‘ was well understood.

(ii) A few candidates are still not using square brackets to represent concentration in K_c expressions.

(iii) Some candidates failed to recognise that the value of the equilibrium constant is only altered by a change in temperature, not by a change in pressure. Around one third of the candidates believed that the value of the equilibrium constant would change as the pressure changed.

(iv) The application of le Chatelier’s principle was used correctly by a number of candidates. A few neglected to state that the reverse reaction was endothermic.

(b) (i) Many candidates merely said that the number of collisions increased. It is the increase in the **rate** of successful collisions which is important**.**

(ii) A lack of practical experience in the method of sampling in kinetics reactions lead to candidates losing marks. Vague answers involving indicators gained no credit.

(iii) The question asked candidates to give their answers to three significant figures. A number of candidates did not do this and were penalised. Although the question lead candidates through each stage of the percentage calculation, many candidates could not obtain a satisfactory answer. Some extremely weak (and strong) vinegar is apparently being sold !

(c) This was a two mark question and it was unusual to see candidates gaining both marks.

Very often an inadequate description scored only one mark.

Q.9 (a) (i) The environmental problems associated with carbon dioxide and sulphur dioxide were well recognised by most candidates.

(ii) Enthalpy calculation seem to be troublesome for a sizeable minority of candidates but most candidates were able to gain at least one of the two marks available.

(b) (i) Nearly all candidates were able to describe a test for ethene with bromine being the preferred choice.

(ii) Addition or hydration was the usual correct response to the type of reaction occurring when ethene reacted with water / steam. A few wrongly stated hydrolysis. The question did not ask whether this process was electrophilic, nucleophilic or free radical and such additional responses were ignored by the examiners. The structural formula of ethanol was usually correct but a few inexplicably gave the formula of ethane.

(c) (i)&(ii) It was disappointing to see that some candidates still do not know the meaning of the terms empirical and molecular formulae.

(iii) A large majority of candidates did not notice that the question said that Compound **T** was a branched alkene, and gave but-1-ene or but-2-ene as their response instead of 2-methylpropene. The latter does not show cis- trans isomerism but part (iv) of this question was marked consequentially on the candidate's answer to (iii). There was confusion, too, in describing the lack of free rotation about a double bond.

Q.10 (a) Many candidates had difficulty with this bond energy calculation. The principal reason was that they did not realise that there were four Cl-O bonds present. As a result it was unusual to see full marks for this part.

(b) Only the more able candidates were able to spot a 3:2 ratio in the equation and give the correct answer of 2.4 mol dm^{-3} min^{-1} as a result.

(c) (i) This question concerned ethene and crude oil. There were many excellent answers to this question, but all too many obtained ethene directly from crude oil by fractional distillation without the need for cracking larger alkane molecules. The equation for the polymerisation of ethene sometimes lacked clarity in the use of 'n' and there were some speculative values for the temperature and pressure of the polymerisation step. The specification lists the figures for the pressure and temperature used in polymerisation and candidates should restrict their answers to these values.

(ii) The question asked for an advantage and a disadvantage of the use of poly(ethene) in society. Many candidates simply gave uses and these did not gain credit.

Glyn Jones has submitted the following comments about the performance of the candidates who took the examination through the medium of Welsh. A translation is provided beneath.

Marciwyd 27 o sgriptiau.

Gyda sampl fychan mae'n hawdd cael yr argraff anghywir. Serch hynny, gwelwyd rhai sgriptiau eithaf da ond fe roedd sawl ymgeisydd yn anaddas ar gyfer Lefel A, a chofio eu bod, o bosib, yn ail sefyll yr arholiad.

Roedd safon yr iaith a ddefnyddiwyd gan yr ymgeiswyr cyfrwng Cymraeg yn foddhaol iawn. Ni welwyd llawer o eiriau gwallus. Cafwyd esboniadau eglur a disgrifiadau cywir gydag ansewdd y cyfathrebu ysgrifenedig yn foddhaol.

Mae fy sylwaddau ar y cwestiynau yn Saesneg I gyd yn berthnasol I'r Cymry.

27 scripts were marked.

With it being such a small sample it is easy to get the wrong impression. Nevertheless, there were some good scripts and many for whom the examination was too difficult.

The standard of the language used was satisfactory.

There were few incorrect terms/ words used. The explanations and descriptions met the requirements of the Quality of Written communication.

My comments on the individual questions are common to both the English and Welsh medium candidates.

CHEMISTRY

General Certificate of Education

January 2006

Advanced Subsidiary/Advanced

Chief Examiner: D.H.Ballard, B.Sc., Ph.D., C.Chem., F.R.S.C.
Lecturer in Science Education, Nottingham Trent University

Unit Statistics

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Unit	Entry	Max Mark	Mean Mark
CH4			

Grade Ranges

A
B
C
D
E

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Unit CH4

General Comments

There was a very good spread of marks, with a number of outstanding scripts, but equally a number of scripts were very poor with about 7% of the candidates getting 15 marks or less out of a total of 75.

The examiners felt that the overall standard of organic chemistry was similar to previous examinations.

Areas which seemed strong were practical information as an aid to structure elucidation, chirality in molecules, test for phenol, calculations and structures of amino acids and peptides.

Areas which still need attention are reaction mechanisms, description of chemical tests, examples of types of reaction and intermolecular bonding. There was also a lack of precision in drawing fully graphic formulae with the bonding atoms in the correct order. For many candidates stating if a reactant is 'aqueous' or is 'in solution' does not seem important and 'reflux' is a condition for all reactions.

Finally, the questions involving comparisons being made in order to differentiate between one compound and another should be given some attention. A number of strong candidates were writing about one polymer without mentioning the other type (Q.5(c)) or describing the reaction between one compound and a reagent, but 'forgetting' to describe how the same reagent would react with the second compound (Q.2(a)) and these omissions resulted in the loss of important marks.

There were no dead marks and there was no evidence of insufficient time to complete the paper.

Papur Arholiad Cymraeg

Atebwyd tua 8% o'r holl sgriptiau trwy'r gyfrwng Cymraeg. Nid oedd problemau o safbwynt safon y Gymraeg - roedd yn amlwg fod yr ymgeiswyr yn hen gyfarwydd â'r derminoleg yn y cwestiynau ac yn gwbl hyderus wrth ddefnyddio'r iaith yn yr atebion.

Cafwyd yr un drysni Cemegol ag a gafwyd gan yr ymgeiswyr cyfrwng Saesneg gydag ychydig fwy o'r ymgeiswyr cyfrwng Cymraeg, efallai yn gadael bylchau yn yr atebion i'r cwestiynau dadansoddol, e.e. Cwest 2(a); Cwest 2(b); Cwest 3(b). Dylid cadw golwg ar y math hwn o gwestiwn i'r dyfodol. Dylid hefyd cadw golwg barcud, wrth adolygu ar y prosesau cemegol fel y gwelwyd yng Nghwestiwn 5(a). Nid oedd safon yr atebion i'r rhan hwn yn ddigon trwyadl.

Section A

Q.1 (a) (i) A good start, with many candidates obtaining both marks. The most common mistakes were 'methyl' or 'benzene' being regarded as functional groups.

(ii) Proved to be the easiest mark on the paper. Only a few candidates failed to gain the mark.

(iii) This was very poorly answered, although part (II) was better answered than part (I). Some credit was given in part (I) if the structure contained three ONa groups and in part (II) if the + charge was omitted. However far too many candidates invented improbable products.

(b) (i) Only about half the candidates could successfully classify the reaction.

(ii) Generally well answered, with about one third gaining full marks. Some candidates failed to gain full marks due to incorrect calculation of the Mr of the compounds, while others ignored the rubrics and either did not give their answers to the correct number of significant figures or gave a percentage yield.

Q.2 This was the least successfully answered question in section A.

(a) This part asked candidates to distinguish between different pairs of compounds. Few achieved full marks because most candidates did not give the states of the chemicals involved, merely their names.

(i) The observation mark was usually gained but many candidates forgot to acidify before adding $AgNO_3$ solution and a significant number even omitted heating with NaOH(aq).

(ii) Easily the best answered of the three. The main error was to omit neutral or solution from iron(III) chloride. Only a few candidates thought that a purple precipitate was formed with phenol.

(iii) The first mark was often lost because HNO_3 was given instead of HNO_2 or the temperature omitted. The second mark was often lost by giving 'nitrogen gas produced' as an observation for ethylamine and 'diazonium ion' as an observation for phenylamine.

(b) (i) Although about 1 in 5 of the candidates scored full marks and an encouraging number gained creditable marks, far too many were too willing to quote directly from the data sheet with no apparent effort to use the details and to draw conclusions as to the structure of the hydrocarbon.

(ii) About half the candidates obtained the mark, many consequentially from (b)(i).

Q.3 (a) (i) Most candidates scored full marks.

(ii) Only fairly well answered. Although about 1 in 4 candidates gained full or almost full marks, many had no idea as to the mechanism required. It is obvious that most candidates do not realise that a curly arrow represents the movement of a pair of electrons and many had the curly arrows starting from the wrong place or going the wrong way. Others made the primary carbocation in the intermediate step

(iii) The worst answered part in the whole paper with most quoting Markovnikov's rule verbatim.

(iv) Many candidates managed to pick up 1 mark by mentioning the delocalised electrons in benzene. However many failed to relate this to π bonding and only the better candidates successfully explained why benzene favours substitution over addition.

(v) Well answered.

(vi) Again well answered.

(b) (i) Only about 1 in 6 gained full marks. Many candidates omitted chlorine itself and so lost a ½ mark.

(ii) Well answered with over 1 in 4 candidates gaining both marks. The main error with the test reagent was to give 'hydrogencarbonate' as if hydrogencarbonate were an entity in itself. The main error with the observation was to state 'carbon dioxide produced' with no reference to bubbles or limewater test.

(c) Fairly well answered. Many candidates lost the mark because of a general reference to CFCs.

Section B

Q.4 This question was answered significantly better than Q.5.

(a) (i) Generally well answered with around 1 in 3 candidates obtaining 7 or 8 marks and only 1 in 5 scoring 2 or fewer marks. Some lost marks by failing to give any structures despite getting the reasoning correct. The most common error was to give A as pent-1-ene. A common error in compound D was to attach a hydrogen atom to the carbon in the C=O. Weaker candidates tended to add the functional groups sequentially, especially in compounds B and C.

(ii) Well answered with the vast majority gaining some mark. The main error was to omit the condition for $NaBH_4$.

(b) Very well answered. Over two-thirds of the candidates gained full marks.

(c) Both parts were only fairly well answered . Many answers showed a lack of detailed knowledge of reagents and conditions. In part (i) only a handful knew that strong heat or heating with the parent acid was required. In part (ii) alcohol was used instead of ethanol and concentrated was often omitted from the sulphuric acid.

(d) Generally well answered but many candidates lost the mark by either not making a comparison or by omitting the wave number for the O-H bond.

(e) Only about 1 in 7 of the candidates gained full marks while around 30% of the candidates scored nothing or almost nothing. There were some quite lengthy pieces of descriptive writing but the answers were often muddled with candidates referring to hydrogen atoms being lost and propanoate molecules being formed. One suspects that many candidates spent an inordinate amount of time on this section but did not gain the full three marks.

Q.5 (a) To score highly on this question required a great attention to detail. Unfortunately knowledge of reaction types was poor in many cases and again reagents and conditions had not been learned. Far too many candidates gave scrappy, partial answers and so lost valuable marks.

Part (i) was the least well answered with many wrongly giving condensation as an example and about half the candidates failing to gain any marks. In part (ii) the main error was the failure to write a balanced equation. Part (iii) was the best answered with about 1 in 5 gaining all three marks, the main error was omitting the conditions.

(b) (i) Very well answered. Some candidates did not write the full structure and were duly penalised.

(ii) Again very well answered. Many wrote the full structure for the dipeptide but were not penalised.

(iii) Very poorly answered. Only about 1 in 10 candidates scored 3 or 4 marks, while about 4 in 10 failed to gain any credit. A significant number gained the mark for the trend, but terms such as ‘hydrogen bonding’ were used almost at random and regardless of the compounds in question. Very few realised that aminoethanoic acid existed as zwitterions or showed ionic bonding.

(c) (i) Fairly well answered. The vast majority gained at least one mark. The main errors were to include an OH on the benzene ring or to give the repeating unit instead of the monomer. A few wrongly named the polymerisation as additional.

(ii) Disappointingly answered. Fewer than 4 in 10 candidates could correctly give one monomer in the production of nylon 6,6. A significant number either gave the repeating unit or gave the wrong number of carbons in the monomer.

(iii) Fairly well answered, but far too many lost marks by making random statements about each type of polymerisation without comparing them.

Chemistry Examiners Report (Jan.06)/JD

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