RECOGNISING ACHIEVEMENT

GCE

Chemistry A

Advanced GCE **A2 H434**

Advanced Subsidiary GCE **AS H034**

Examiners' Reports

June 2011

H034/H434/R/11

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

OCR will not enter into any discussion or correspondence in connection with this report.

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Advanced Subsidiary GCE Chemistry A (H034)

EXAMINERS' REPORTS

Chief Examiner's Report

General Comments

This series has seen the second summer award of the revised A level qualification for Chemistry A, H434. It is pleasing to see the continuing popularity of the course with a significant number of new centres starting the course this year.

The controlled assessment of practical skills using Tasks continues to be popular. The Tasks have worked well and have proved to be easy to administer. Tasks have been devised to take advantage of apparatus and chemicals likely to be in centres and the Mark Schemes have been a reliable measure of candidate performance (without the marking taking up too much time).

It has also been interesting to note this year that a significant number of centres have taken F325 in the January series.

Candidate Performance

Overall, candidates have responded to the challenge of the A2 papers admirably. Having seen some very demanding questions, the very best candidates have responded extremely well and have been able to demonstrate some very high quality responses. The average candidate has been able to demonstrate their knowledge and understanding and the weaker A level candidate has still been able to show what they know about chemistry at this level. It is acknowledged that candidates may have come out of the A2 examinations feeling that the papers were hard. However, this is not necessarily borne out by candidate performance and the outcomes from this series represent a real achievement for all successful candidates.

Initiatives

This year has seen the introduction of several initiatives to help both teachers and their students:

- **Resource material**
  Given that some of the analytical aspects of unit F324 are unfamiliar for some centres, it was felt that teachers might welcome a resource pack to provide a useful stimulus in helping students acquire the skills required to tackle structure elucidation problem-solving questions within Organic Chemistry. The material (published on the Chemistry A Tasks page on Interchange) aimed to provide something for all abilities, with some questions accessible to the majority of students, whilst other questions require skills that will stretch and challenge the most able students. The emphasis has been on spectral analysis, reaction mechanisms and synthesis.

- **Continuing Professional Development**
  In June 2011, a new type of CPD event was offered to teachers as a practical masterclass in association with Sheffield Hallam University. At the event, delegates were able to gain hands-on experience of modern chemical techniques and enjoy innovative classroom practicals relevant for teaching all OCR A Level Chemistry units [Chemistry A and Chemistry B (Salters)]. Feedback from the session has been very positive.

- **Active Results (new for GCE Sciences)**
  Since January 2011, GCE Chemistry A has been included in Active Results, a free results analysis service helping you review the performance of individual candidates or that of your whole centre. Active Results provides access to detailed results data, enabling more comprehensive analysis of results in order to give an accurate measure of the achievements of your centre and of individual candidates. For more information, including a demo, go to www.ocr.org.uk/activeresults

- **The OCR Community (www.social.ocr.org.uk)**
  This enables you to collaborate with colleagues and to share best practice and resources. In recognition of 2011 being the International Year of Chemistry, OCR is offering a Kindle$^{(R)}$ for the best piece of support material posted to our Community site (www.social.ocr.org.uk) to help with the teaching of OCR GCE Chemistry (specification A or Salters). For full details see http://social.ocr.org.uk/groups/science/conversations/international-year-chemistry-2011-win-kindle-ocr-0

F321: Atoms, Bonds and Groups

General Comments

The final entry of over 21000 candidates showed an increase in the region of 4000 on the previous June. The spread of marks achieved by candidates suggested that the paper was accessible to all candidates.

As in previous series, the paper examined a wide range of knowledge and skills from within the specification and in the main, the responses of candidates showed that good exam preparation had taken place. It was pleasing to see that the answers to questions involving calculations had improved. The last question, **5(c)**, required candidates to link their understanding of bonding and structure to the data given and this proved difficult for many.

The lack of chemical literacy among even moderately able candidates continues to be a concern. Incorrect formulae such as $AgCl_2$, $MgCl$ and $Na(OH)_2$ were not uncommon. Where extended answers are required, it may help some candidates to use bullet points but, above all, candidates are advised to write with legible handwriting.

Comments on Individual Questions

Question 1

(a) Most candidates scored this opening mark. Although a lot of information was required, the question was designed to allow all candidates to address familiar material and, as such, was of low demand. The main reason for candidates losing the mark was the loose use of language. For example, 'positive' or 'negative' does not convey the relative charge of protons and electrons, respectively.

(b) This definition has not featured in recent papers and slightly uncertain answers were put forward by some candidates. The most common error was to forget to equate the number of electrons lost with the number of atoms and so, for example, the suggestion that one electron is taken from a mole of atoms was not given full credit. Another common error was to confuse atoms with elements and so refer to electrons being removed from a mole of a gaseous element.

(c) Good candidates scored all three marks. It was felt that some rushed into writing a response and '6' was a frequently seen incorrect response for the number of electrons in a 2p orbital. Presumably candidates assumed they were providing the number of electrons in all three 2p orbitals. Many candidates were able to recall the maximum number of electrons in the 4th shell.

(d) Many candidates expressed ideas that showed some understanding of the concept of periodicity but only a tiny handful gave a definition that was worthy of the mark. The common error was to omit that patterns and trends are repeating features.

(e) All five responses involved candidates having to think about the chemistry involved rather than relying upon recall. The question as a whole discriminated well but weaker candidates found the question challenging. Strong candidates scored all five marks, with **1(e)(iv)** being the most difficult part. Weaker candidates tended to score only the relatively easy **1(e)(i)**. Some candidates chose responses outside the first 18 elements of the Periodic Table.

Question 2

(a) As a gentle 'lead-in', this question involving the writing of the equation for the thermal decomposition of magnesium carbonate was to the liking of nearly all candidates.

(b)(i) The writing of the equation for the reaction between magnesium carbonate and dilute hydrochloric acid was not as straightforward for candidates as the equation in **2(a)**. Many equations were left unbalanced and '$MgCl$' was not uncommon. If a correctly balanced equation was seen, then state symbols tended to be correct. If mistakes were made with state symbols these tended to be $MgCl_2$(s) or H_2O(aq).

(b)(ii) This question turned out to be more difficult than was envisaged. Candidates were unable to relate this question to the equations seen in the previous two parts of Q2. The question was phrased in order to elicit understanding of the chemistry of magnesium carbonate. The heart of the question asked for a comparison of the description of the reaction of dilute hydrochloric acid with magnesium oxide and with magnesium carbonate. In the past the responses to similar questions would have been '…*one fizzes and dissolves and the other just fizzes*…'.

(b)(iii) This question differentiated at the lower end of the ability range.

Common incorrect responses were 123.3 (due to the factor of 6 being applied to the H atoms but not the O atoms in water) and 202.3 (due to candidates giving Cl a relative atomic mass of 35). Candidates are reminded to use the supplied *Data Sheet* at all times.

(b)(iv) Most candidates were able to draw ions with correct charges and correct numbers of outermost electrons. Occasionally charges were omitted. This series saw a significant number of covalent $MgCl_2$ molecules amongst weaker candidates. There was also evidence of an increasing trend whereby candidates drew both ionic and covalent structures. Such responses received no credit.

(c) This calculation was undertaken well and most scored two marks. A significant number of candidates rounded to one significant figure when converting from mass ratio to molar ratio. Over-rounding of the molar ratio led to an incorrect whole number ratio of atoms appearing in the empirical formula.

(d) This part was answered better than similar questions from previous series. Question **2(d)(i)** demonstrated that most candidates could convert volumes and concentrations into numbers of moles and **2(d)(ii)** indicated that the stoichiometric relationship was understood. Question **2(d)(iii)** proved more difficult as there was a multi-step calculation required involving conversion from a number of moles to a mass and then expressing this mass as a percentage. This taxed weaker candidates although many found the percentage sum more difficult than the chemical conversion of moles to mass.

Question 3

(a) Most candidates could not provide the correct response for this difficult equation, which is directly from the specification. Many gave H_2 as a product and formulae such as $Na(OH)_2$ were seen in responses from weaker candidates.

(b)(i) Most failed to score this mark, despite allocating Cl an oxidation number of +5 in the next question. By far the most common response was sodium chlorate(III) — presumably as a result of the '3' at the end of $NaClO_3$.

(b)(ii) This question discriminated well. Only the weakest candidates attempted to apply redox changes to two separate elements. Many weak candidates assumed it was the Na atoms which underwent redox and received partial credit for choosing one element. The better candidates appreciated that the disproportionation involved C*l* and used correct oxidation numbers. The common omission was a lack of attributing oxidation/reduction to the correct direction of change of oxidation number.

(c)(i) This question enabled nearly all candidates to pick up marks. The benefits and disadvantages of using chlorine in water treatment are well known.

(c)(ii) Most produced the correct diagram. Candidates should check that all non-bonding electrons are shown on atoms such as chlorine.

(c)(iii) The shape was well known but candidates struggled with the spelling of 'tetrahedral'.

(d) Of the four marking points required here, most candidates knew that silver nitrate should be added and that a white precipitate would be seen. When it came to confirming this by adding dilute ammonia solution there were fewer correct answers with some candidates suggesting the use of concentrated ammonia or not specifying dilute, while others suggested the use of nitric acid. The ionic equation proved difficult for some candidates. $AgCl_2(s)$ was frequently seen.

Weaker candidates often put forward suggestions based on displacement reactions involving other halogens and cyclohexane. This received no credit in this instance as it would not have positively identified the presence of chloride ions.

Question 4

(a)(i) The explanation of what constitutes a salt was not appreciated by the majority of candidates. Where candidates did express that the H^+ ion of an acid is replaced by a metal ion, one frequent error was to write that the metal ion was a Zn^+ ion.

(a)(ii) This difficult question involved candidates realising that the phosphate ion had a 3^- charge and that the formula would therefore be $Zn_3(PO_4)_2$. $ZnPO_4$ was the common incorrect response. Weaker candidates opted for ZnP and such like. Other acceptable responses such as $ZnHPO_4$ and $Zn(H_2PO_4)_2$ were given credit.

(b) This extended response produced copious amounts of writing, most of which was often redundant as the key points were usually made in the first few sentences.

Candidates who have difficulty expressing themselves on paper are advised to use simple sentences or even bullet points to communicate multiple points. However, 5 marks (out of 5) was the most common score, which would suggest that the trend in reactivity of Group 2 elements is well known.

Question 5

This question was aimed at the understanding of the structure and bonding within substances.

(a) Nearly all candidates appreciated that the bonding within giant metallic lattices allowed mobility of electrons. Most candidates appreciated that giant ionic lattices have ions fixed in place and that these ions became mobile upon melting. Weaker candidates incorrectly assumed that electrons became mobile when giant ionic lattices melted.

(b)(i) Once again there was evidence that candidates did not read the question properly. The word 'two' for the number of molecules of NH_3 was emboldened but this did not prevent a significant number of responses showing one or three molecules. Many candidates did not include the role of lone pairs in hydrogen bonding in their diagrams.

(b)(ii) This difficult question was answered well.

Candidates were expected to realise that the overall strength of hydrogen bonding in water was greater than that in ammonia. This could have been answered by either of two explanations. The first explanation uses the idea that oxygen is more electronegative than nitrogen and would therefore form stronger hydrogen bonds. The second explanation uses the idea that an oxygen atom has two lone pairs compared to one lone pair on a nitrogen atom — consequently water forms more hydrogen bonds.

(c) The information in the stem of the question was designed to inform candidates that neither compound was ionic due to the lack of electrical conductivity. The question asked for an explanation of the differences in melting point. Therefore it was expected that the emboldened words of 'bonding' and 'structure' would guide candidates towards the correct responses based upon covalently bonded structures.

The question was designed to be demanding and it succeeded in differentiating well. Good candidates picked up all five marks. Moderate candidates tended to score the marks for the $SiCl_4$ structure and the relative weakness of its van der Waals' intermolecular forces. Weaker candidates incorrectly assumed SiO_2 to be ionic and tended to give contradictory statements about the nature of the bonding in $SiCl_4$. It was not uncommon to see $SiCl_4$ incorrectly ascribed as having an ionic lattice held together by van der Waals' forces due to permanent dipoles.

Once again, candidates are advised to use bullet points to prevent later contradictions in answers.

F322: Chains, Energy and Resources

General Comments

The cohort for this component has increased since the June 2010 series. This increase is due to more candidates sitting the paper for the first time, as well as an increased number of candidates re-taking the examination from January 2011. Candidates were awarded marks that covered almost the whole mark range and the paper differentiated well. It allowed candidates of all abilities to demonstrate positive achievement.

Some candidates produced excellent answers to the questions that needed extended writing. The answers were well organised and were focused on the bullet points in the question. Weaker candidates often found these questions very difficult but nevertheless did make attempts to answer them.

Candidates found writing equations difficult and often gave equations that were not balanced or used formulae of compounds that do not exist. Candidates must also take care when drawing displayed or structural formulae to ensure that all hydrogen atoms are shown. Centres should remind candidates of the need to make their writing legible, particularly when writing formulae.

Comments on Individual Questions

Question 1

This question focused on enthalpy changes involving glucose.

(a)(i) Many candidates were able to give the correct products for respiration but a significant proportion could not balance the equation. A common error was to show $9O_2$ rather than $6O_2$. Some candidates wrote the equation for fermentation instead of respiration.

(a)(ii) Many candidates were unable to explain why respiration was exothermic in terms of bond breaking and bond forming. A common misconception was to refer to the energy needed to form bonds rather than the energy released. A typical incorrect answer stated that more energy is needed for bond breaking than for bond forming. The best answers given by candidates involved making three separate points:

- Bond breaking absorbs energy;
- Bond forming releases energy;
- More energy is released than absorbed.

(b)(i) The definition for enthalpy change of combustion was well known.

(b)(ii) A significant proportion of candidates could not explain why it was not possible to determine the enthalpy change of formation of glucose by a direct method. Good answers referred to the reaction having a high activation energy or that many different products would be formed. A common misconception was that the calculation could not be done without the enthalpy change of combustion for oxygen. Other candidates referred to the heat loss that would occur during the reaction. A significant proportion of candidates did not attempt this question.

(b)(iii) A fairly large proportion of candidates obtained the correct answer. Common misconceptions were to reverse the cycle and not to use the correct molar ratios.

Question 2

This question focused on the physical and chemical properties of alcohols.

(a) In **(i)**, most candidates could give the general formula for an alcohol and, in **(ii)**, the molecular formula for the alcohol with 13 carbon atoms per molecule. The Mark Scheme allowed the use of $C_nH_{2n+2}O$ in **(i)** and $C_nH_{2n+1}OH$ in **(ii)**.

(b) A significant proportion of the candidates could not precisely define the term *functional group* and did not appreciate that the term group referred to a group of atoms within a molecule. A common misconception was to link the functional groups with the properties of the molecule rather than with its reactions.

(c)(i) Many candidates appreciated that the alcohols had hydrogen bonding but less stated that the alkanes only had van der Waals' forces. A significant proportion of the candidates did not compare the strengths of these two intermolecular forces, it was not sufficient to state that van der Waals' forces were weak — they had to be weaker than hydrogen bonding.

(c)(ii) Candidates often appreciated that there were fewer or weaker van der Waals forces in methylpropan-1-ol but often did not fully explain why. For example, some candidates referred to methylpropan-1-ol being branched but did not state that butan-1-ol was not branched.

(d)(i) Candidates tended to score either both marks or no marks. A significant proportion of candidates gave balanced equations for methane rather than methanol, while other candidates forgot about the oxygen atom in methanol when balancing the equations.

(d)(ii) An extremely large proportion of the candidates appreciated that incomplete combustion was caused by a lack of oxygen.

(d)(iii) The complete list of uses of methanol from the specification was not well known and a significant proportion of the candidates did not attempt the question. Often candidates gave the uses already given in the stem of the question rather than focussing on a chemical feedstock.

(e) As in previous years, candidates found writing equations for the oxidation of alcohols demanding. Candidates often forgot that water was made in addition to the butanoic acid and either gave hydrogen or no second product. The Mark Scheme required that the correct carboxylic acid be identified so that $CH_3CH_2CH_2COOH$ was needed instead of C_3H_7COOH.

(f)(i) Candidates were more likely to get the structure correct than the name of the alcohol. The most common incorrect structure drawn was $(CH_3)_2CHCH_2OH$.

(f)(ii) Candidates found **(ii)** more difficult than **(i)** and a significant proportion did not attempt to answer the question.

Question 3

This question focused on nitrogen monoxide and covered a range of topics including enthalpy changes, rate of reaction, equilibria and catalysis. Candidates found this question hard.

(a) In **(i)**, the definition for *endothermic* was well known. Candidates found **(ii)** much more demanding than **(i)** and only a small proportion got the correct answer.

(b)(i) Candidates were often able to draw the energy profile diagram but used double headed arrows for the enthalpy change rather than an upwards arrow. Many candidates drew in a correct activation energy and only a small proportion of candidates muddled the enthalpy change with the activation energy. Common misconceptions were to start the activation energy from the enthalpy of the product or to label the maximum of the curve as the activation energy.

(b)(ii) There were some excellent definitions for *activation energy* referring to the minimum energy needed for a successful collision or to start a reaction, however a significant proportion of candidates did not refer to the minimum energy and gave a more vague answer such as the energy needed for a reaction to happen.

(c)(i) Candidates often referred to the rate of the forward reaction being equal to the rate of the backward reaction but made no attempt to explain how this situation was reached. Candidates had to refer to the forward reaction slowing down and the reverse reaction speeding up until the rates were equal.

(c)(ii) Candidates found it easier to explain the effect of pressure on the rate of this reaction than the position of equilibrium. Candidates often appreciated that the particles were closer together and as a result there were more collisions per second. A small proportion of candidates had the misconception that the molecules would move faster as the pressure increases. Only a small proportion of the candidates used the idea of the position of equilibrium and many candidates often quoted the information given in the stem.

(c)(iii) Some candidates often referred to the rate of reaction either being too fast or too slow. Another misconception was that the temperature and/or pressure were too high. Good answers appreciated that it was not a closed system.

(d) Although a majority of candidates referred to the presence of an unpaired electron, common misconceptions included a radical as being very reactive, having a lone electron or a free electron.

(e)(i) Despite the wording of the stem of the question that mentioned the reaction between nitrogen monoxide and oxygen, a significant proportion of the candidates gave equations involving an oxygen atom or an ozone molecule.

(e)(ii) The best answers gave three correct equations with supporting written statements. Incorrect misconceptions involved the formation of NO_3 rather than NO_2 or that nitrogen atoms were involved in the process of ozone depletion; other candidates gave the wrong overall equation for depletion of ozone giving $O_3 \rightarrow O_2 + O$ rather than $O + O_3 \rightarrow 2O_2$.

(e)(iii) The use of IR spectroscopy in identifying air pollutants was not well known and often only one mark was awarded for some reference to identifying the bond present in the molecule. A common misconception was to refer to molecular ions or fragment ions, confusing mass spectrometry with infrared spectroscopy.

A significant proportion of candidates did not attempt either parts **(e)(ii)** or **(e)(iii)**.

Question 4

This question focused on atom economy and percentage yield and was the most accessible on the question paper.

(a) Many candidates were imprecise in their completion of the atom economy expression. Candidates needed to refer to the (relative) molecular mass of the desired product and of the total of the molecular masses of all of the products. Alternatively, molar mass or relative formula mass could have been used instead of molecular mass.

(b) Almost all candidates could recognise cracking in **(b)(i)** and isomerisation in **(b) (ii)**. In **(b) (iii)**, a large proportion of candidates identified **Process 2** as not having a 100% atom economy but did not always state that it was the water that was the unwanted product. Only an extremely small proportion of candidates chose **Process 5** because it made two products.

(c)(i) Candidates often appreciated that carbon dioxide is a greenhouse gas that causes global warming but were less likely to mention the increase in atom economy.

(c)(ii) Candidates had to make a decision, either percentage yield or atom economy. No marks were available for this decision but for the level of the explanation given. A fully correct explanation was given two marks and a partially correct explanation was given one mark. Candidates that did not make a decision but commented on both terms could not be awarded two marks. Candidates were equally divided between atom economy and percentage yield. A common misconception was that increasing the percentage yield would reduce the amount of waste product.

Question 5

This involved a range of questions about different aspects of organic chemistry.

(a) A very large proportion of candidates appreciated that compound **A** contained carbon and hydrogen but a small fraction of these candidates forgot to state that these were the only two elements in compound **A**.

(b) A large proportion of the candidates identified compound **F** as the saturated hydrocarbon.

(c) A large proportion of the candidates gave $C_5H_{10}O$ as the molecular formula but a small fraction made errors with the number of hydrogen atoms present. A common misconception was to show the structural formula rather than the molecular formula.

(d) A large proportion of the candidates chose compounds **D** and **E** as the structural isomers. A much smaller proportion chose the other pair of structural isomers, compounds **F** and **G**.

(e)(i) Many candidates could not name or explain the shape around carbon atom number **1** giving answers such as trigonal planar, bent or square planar, as well as the correct answer of tetrahedral. Only a very small proportion of the candidates focused on the number of outer electron pairs although credit was given for stating that there were four bonds around the central atom. Some candidates gave bond angles and/or drew diagrams but these were not given credit without supporting words.

(e)(ii) Only the most able candidates could state that the shape was trigonal planar and a significant proportion of the candidates did not attempt the question.

(f)(i) Many candidates identified compound **G** as showing *E*/*Z* isomerism.

(f)(ii) Candidates were often able to state that a carbon–carbon double bond does not rotate but could not explain with sufficient clarity that each carbon atom of the double bond has two different groups attached. A common misconception was that the double bond stops the molecule from rotating rather than the bond.

(g) Good answers were well organised, with no errors, but possibly with a few omissions such as the name of the mechanism. Almost all candidates drew the mechanism for the reaction with the hydroxide ion involving S_N2. A small proportion of candidates used the S_N1 mechanism which, if correct, was given full credit. An extremely small proportion of the candidates used water as the nucleophile which made the mechanism rather more complicated. The most common misconceptions in the mechanism were to show the heterolytic fission of KOH, or to have KOH as the nucleophile. Some candidates forgot to include the negative change on the hydroxide ion. Some candidates need to take more care when drawing curly arrows to ensure that they do start from the lone pair or the negative charge on the hydroxide ion and go to the electron deficient carbon atom (rather than the C–Halogen bond). An extremely small proportion of candidates gave an addition mechanism.

A significant proportion of the candidates forgot to name the mechanism although only a very small proportion of the candidates forgot to include the type of bond fission.
Many candidates used bromine or chlorine when referring to compounds **B** or **C**, for example stating that bromine reacted faster than chlorine. Many candidates realised that bond enthalpy was a key factor but did not always specify that it was the C–Br or C–Cl bond.

(h) A significant proportion of the candidates were able to get all three structures correct. Most of these candidates gave their answers in the form of skeletal formulae. A small proportion of the candidates drew non-cyclic structural formulae rather than cyclic ones.

Question 6

This question focused on addition polymers and associated environmental issues.

(a)(i) Candidates found drawing the structure of the monomer easier than naming it. A common misconception was to state that the monomer was ethylethene; other candidates just named the monomer butene which was not sufficient.

(a)(ii) Good answers clearly explained that the hydroxyl groups in the polymer could form hydrogen bonds with water. Weaker candidates often mentioned hydrogen bond formation but it was not clear how these were formed.

(b) More candidates could recall the toxic nature of carbon monoxide than the acidic nature of hydrogen chloride. A common misconception was that hydrogen chloride would contribute towards ozone depletion. For the second part of the question, candidates had to link the name of the gas with a way of reducing its environmental impact or give alternative ways of disposing of polymers. Many candidates could not give a way of reducing the amount of hydrogen chloride and did not mention reaction with a base. Candidates were most likely to give carbon capture and storage linked with carbon dioxide for a marking point. The use of a catalytic converter was not given credit because the question was about the incineration of polymers rather than the reaction inside an internal combustion engine. Candidates who gave alternative ways of disposing plastics often mentioned recycling but without linking it to sorting out the different polymers.

(c) Candidates sometimes just repeated the stem or gave examples of the environmental impact of the disposal of polymers rather than focusing on the actual question. Good answers appreciated that the pollution could travel from country to country and that all countries contribute towards the pollution. Alternatively, candidates referred to specific international protocols.

Question 7

This question assessed the quality of written communication. In particular, candidates had to link the explanations with the evidence provided. Good answers were well organised and all the evidence was used to identify propanoic acid, ethanol and ethyl propanoate. Often these answers started with the statement that compounds **X** and **Y** must be a carboxylic acid and an alcohol because of the formation of the ester. Candidates should be advised to ensure that if both the name and structure are used to identify a substance then both must be correct if the mark is to be awarded.

Candidates were often able to link the infrared absorptions to the correct bonds and hence the functional groups.

Candidates had much more difficulty with the empirical formula for **X** and often did not state the correct whole number mole ratio and hence the empirical formula. A significant proportion of candidates rounded up $C_{1.5}H_3O$ to get C_2H_3O rather than doubling to get $C_3H_6O_2$. Many candidates did not clearly use the molecular ion m/z of 74.0 to explain why the empirical formula was the molecular formula.

Candidates did not always use the information in the mass spectrum of **Y**. In particular many candidates did not link the molecular ion peak at m/z 46 with the molecular mass of **X**. However, a small proportion of candidates did use some of the fragment ions such as m/z 31 to obtain extra evidence for ethanol. A common misconception was that the peak at m/z 31 was evidence for methanol rather than ethanol.

F323: Practical Skills in Chemistry 1

General Comments

This is the third year that this unit has been in operation and it is clear that teachers and lecturers are more familiar both with the demands of the scheme of assessment and the associated paperwork required for moderation. The scheme of assessment remains popular amongst centres as evidenced by a sharp increase in centres entering candidates for the first time, resulting in an increase of more than 10% in candidate entries.

Comparatively few centres needed their marks adjusting, although when adjustments were required these were mainly in a downwards direction.

It can only be emphasised that the accurate marking of coursework is essential in order to provide a single justifiable rank order for candidates within each centre so that the moderation process can proceed smoothly.

In the vast majority of samples moderated, marking was clear, accurate and representative or the work presented. Moderators, the vast majority of whom are teachers, appreciate how much time and effort is spent in centres preparing samples for moderation and it was clear that much of the work this year had been internally standardised very thoroughly.

Candidates appeared better prepared for their assessment this year and displayed high levels of proficiency in quantitative work. On the whole, calculations were well presented and accurate. However, there are still a number of issues linked to over-rounding at an early stage and the use of decimal places and significant figures.

Administration (the comments included in this section apply equally to F323 and F326)

This is the third year that the Moderators have been concerned about the number of clerical errors found in samples.

Clerical errors resulted from:

- Incorrect totalling of marks within the Tasks
- Incorrect transfer of marks from the pages within a Task to the front cover
- Failure to mark a whole page or pages of a Task
- Incorrect addition of the three Task marks (Qualitative + Quantitative + Evaluative) making up the total for the unit
- Incorrect transcribing from centre records to the MS1 forms.

It must be emphasised that it is the centre's responsibility to ensure that the marks submitted accurately reflect the work of their candidates.

Centres are advised in future to carefully check the adding up of marks within scripts and then use the OCR 'marks spreadsheet' (available from Interchange from the Supporting Materials section of the GCE Chemistry A page) to add the marks for the best Task in each category.

Centres should also note that when sending work to the Moderator, a copy of the teacher/technician trial results (where required), the Centre Authentication Form (CCS160) and details of any correspondence with OCR should be included.

For the candidates selected for moderation, the centre should only send the highest scoring Task from each of the categories (Qualitative, Quantitative and Evaluative). Sending more Tasks for any candidate delays the Moderation process and will result in centres being asked to re-submit their samples according to the regulations set out in the specification and Practical Skills Handbook.

Teachers in centres are advised to consult with the Practical Skills Handbook for Chemistry A, available on the OCR website and on Interchange.

Comments on AS Tasks

As in previous years, the Tasks proved effective in assessing the ability of the candidates sampled by the Moderators. The marks submitted by the vast majority of centres showed both an accurate interpretation of the Mark Schemes and a good degree of discrimination between candidates. Three Tasks, one of each type, were offered for the first time this year and it appeared that these were submitted by less centres due to their familiarity with the previously offered Tasks. Most centres appear to give candidates the opportunity to repeat one or all of the skills on at least one occasion although some centres just offer one Task of each type for assessment.

Qualitative Tasks

Candidates struggled once again with the Qualitative Tasks with many finding it difficult to accurately verbalise their observations.

Candidates should be made aware through class teaching of the difference between a precipitate and a solution and be steered away from quoting exotic or mixtures of colours in their answers.

Candidates should also be encouraged to follow instructions carefully and note down all of the required changes. Candidates frequently did not add reagents drop-wise, sometimes failing to note down initial changes or alternatively only noted down one of the observations when more than one observation was required.

Centres should trial all of the Tasks carefully and check that the centre results agree with the Mark Schemes before allowing candidates to attempt a Task.

Tasks have been trialled extensively and it is unlikely that the results provided cannot be obtained. In exceptional circumstances, if teachers are unable to obtain any of the marking points themselves having checked the solutions have been made up correctly, their observations should be submitted by e-mail to GCEscienceTasks@ocr.org.uk at OCR with a brief summary of the issue.

It is particularly important that measures are taken to prevent stock solutions being contaminated by candidates which could have an effect on other candidates in the centre.

There were a number of issues with the marking of this skill area which requires comment and centres should take note of these for future submissions:

- Centres must ensure that marks are awarded in line with the marking points and marks should not be awarding for just part of a required answer. This was particularly the case when an answer such as '*the solution effervesces, becomes warm and the metal dissolves*' is required. Centres cannot award credit if one of these observations is omitted.
- Incorrect chemistry in statements made by the candidates, which contradicts answers in the Mark Scheme, should not be credited.

- Alternative or unbalanced chemical equations should not be credited unless there is provision for this in the Mark Scheme.

Quantitative Tasks

There were a number of issues which require comment and centres should take note of these for future submissions:

- The Moderators require centre results including masses, titration data and temperatures to be included with the work submitted in order to assess the accuracy of the candidates sampled. Where there is more than one group of candidates it is essential that centres indicate which candidates have been assessed against which values.

- Centres should note that the mass measured by a candidate in a Quantitative experiment will have an impact on the recorded titre or temperature change. The candidate is unlikely to use the same mass and obtain the same titre as the teacher's value. The look-up tables (available in the zip folder with the Task on Interchange) provide a method to assess the candidate's accuracy.

- In order to make questions clearer for candidates, when an answer is required to a specified number of decimal places, significant figures or even a whole number, this is stated in the question. Centres cannot credit answers which do not conform to this requirement.

- Titration, mass and temperature readings must be quoted to the degree of precision given in the question and should be consistent.

- Calculations should be checked to ensure that the candidate has completed the Task correctly. On Interchange, a look-up table is provided in the zip file for each Task to help teachers quickly check calculations.

On the whole the work of candidates was completed to a very high standard and it was clear that many candidates demonstrated proficiency in both the performance of titrations and in the treatment of the results obtained from their practical work.

Evaluative Tasks

This skill area proved to be the most difficult for candidates and discriminated well.

Candidates are becoming more proficient in the calculation of errors resulting from provided data. Teachers should note that advice on dealing with errors can be found in the Practical Skills Handbook for Chemistry A, available on the OCR website and on Interchange, which deals with the assessment of measurements and their associated errors.

There were a few areas in the marking of Tasks which were of concern to the Moderators. These included:

- In a number of cases, Mark Schemes were interpreted quite leniently, particularly when questions asked for answers to be given to a number of significant figures. Some centres credited answers from two to ten significant figures when the Mark Scheme specified answers to be given to three significant figures only for instance.
- In answers where candidates could be awarded either one or two marks for their work, teachers often failed to read the Additional Guidance and awarded the wrong mark.

F324: Rings, Polymers and Analysis

General Comments

This is now the fourth F324 session and evidence suggests that candidates are now well prepared and comfortable with this examination paper.

Candidates responded well to the demands of this summer's paper and it was pleasing to see some very good answers to even the most challenging questions. All questions had parts that were accessible to everyone; the average candidate scored reasonably well on all questions and the better candidates had the opportunity to show their flair for chemistry on the more demanding questions. There was an excellent range of marks, ranging from zero to very nearly full marks.

Most candidates made good use of their time, completing the paper and having time to go back and add to or correct their answers.

As always on a mainly organic paper, many candidates drew excellent unambiguous structures. However, there were still far too many cases where it was difficult to tell where a bond or curly arrow started and finished. Some candidates still struggle to represent connectivity correctly, assessed in question **3(d)(i)**. Pleasingly, the ambiguous use of sticks in structures, which might have represented bonds with the H atom missing or methyl groups, has almost entirely disappeared.

Comments on Individual Questions

Question 1

(a) As in January, the first question was a fairly straightforward mechanism, straight from the specification. It was obvious that many candidates were expecting this or a similar question and a significant proportion of responses earned full marks. The most difficult marks were the generation of the electrophile and the regeneration of the catalyst. The mechanism itself proved relatively easy, the common mistakes being a missing H^+ ion as a product or HCl in its place and the second curly arrow coming from the H atom attached to the ring rather than from the bond.

(b) The equation was of low demand as the question gave the formulae for both reactants and the organic product. However, there were many responses with the formulae copied incorrectly or balanced incorrectly, when only a '2' was needed. The second product, H_2O, also proved difficult, with H_2 and O_2 often being seen. In the second part, the number of carbon environments proved challenging, with less than half the candidates realising that there were six.

(c) Many candidates responded with either substitution on different carbon atoms or multiple substitution. Better candidates suggested both. Disappointingly, there were many stereoisomer suggestions.

(d) This was familiar territory and there were many very good answers. Most candidates earned full or nearly full marks.

Question 2

This question had several challenging parts and candidates did not score as well as on the first question.

(a) Whilst most candidates could explain why amines were bases, the formulae of the salts proved to be one of the most challenging questions on the paper. Many candidates did not attempt the question or gave responses which bore no resemblance to the correct answer. Part **(i)** was surprisingly the most difficult. The nearest close miss of $C_2H_5NH_3^+HSO_4^-$ was not credited as the question stated 'excess' amine. Against expectations, there were more correct formulae for the salt of the organic acid.

(b)(i) This part was well answered, with only the position of the '+' charge on the diazonium ion causing any problems, despite the regular appearance of this ion in this paper.

(b)(ii) Too many answers gave the conditions for the formation of the diazonium ion rather than its reaction. A few thought that the product was used as an antiseptic, confusing the product with a phenol.

(b)(iii) There were also many excellent answers and credit was given whether or not an ion/salt had been formed from the phenol group.

(c) Again, there were many excellent attempts at this difficult equation. The commonest error was use of $0.5H_2$ instead of H^+ as the third product.

Question 3

This was a fairly challenging question on condensation polymers.

(a) The definition of *condensation polymerisation* was generally well understood, although many ambiguous answers could have been describing condensation reactions.

(b) Candidates found the structures of both polymers to be very challenging, especially the second one, where they needed to realise that the structure given contained a double carbon–carbon bond. There were many impossible structures containing carbon atoms with more or less than four bonds. However, the better candidates gave good answers.

(c) This again depended on identifying the presence of a carbon–carbon double bond. Once this was known, then the addition of water to give two isomers presented less of a problem. There were a significant number of chain rearrangements however.

(d)(i)(ii) Parts **(i)** and **(ii)** were relatively straightforward and there were many very good answers. Connectivity was tested in **(i)** and it was disappointing to see a small number of C–HO bonds.

(d)(iii) Most realised that the solubility depended on hydrogen bonding. The harder part was linking the number of hydrogen bonds possible for each molecule to the number of groups capable of forming hydrogen bonds.

(d)(iv) Answers were often far too vague. General comments such as 'harmful' will not gain credit. Many candidates responded in terms of optical isomers in pharmaceuticals.

Question 4

This was a short five mark question. Generally answers were very good, with many gaining full marks. Most gave $NaBH_4$ as a reducing agent and acidified dichromate as an oxidising agent. The orange to green colour change in the latter was well known. Tollens' reagent and a silver mirror were acceptable alternatives for the oxidation reagent and associated observation. The equations were less well known in the straightforward oxidation equation, water was often incorrectly given as a second product.

Question 5

This question assessed modern analytical techniques.

(a) Here an explanation of how compounds could be identified using GC–MS was required. The answer looked for separation (by GC) and identification from fragment patterns or the comparison of the mass spectrum with a database (by MS).

(b) There were many good answers proving the formula to be $C_4H_6O_4$, although too many simply added the relative atomic masses together without using the 54.2% of oxygen given in the question. Most could identify the carboxyl (or carboxylic acid) group from the infrared spectrum. A few identified only part of the group from one peak, for example, –OH or C=O.

(c) The proton NMR spectrum provided a challenging question. Three marks could be obtained by linking features of the spectrum to the structure of the molecule. The final, and by far the most difficult mark, was for putting all this information together to deduce the structure. Only the most able candidates scored full marks on this question.

The three one-mark questions were comparatively well answered. Nearly all knew the use of TMS, and most could describe the role of D_2O. The reason for the use of a deuterated solvent was less well known, but the majority realised that the protons in an undeuterated solvent would cause another peak. Vague answers, such as the solvent 'interfering' with the spectrum should be avoided.

Question 6

The final question this series represented a fairly gentle end to the paper with the possible exception of part **(b)**.

(a) The large majority of candidates could ring the two chiral carbons. Most could also identify at least three of the functional groups; a ketone group was a very common incorrect answer, with the amide/peptide group the group omitted.

(b) The identification of the hydrolysis products was the most challenging part of the last question. Most identified methanol and many identified one or both of the amino acids. Only a very small minority realised that the amine groups would be protonated under the acidic conditions.

(c) The last part of the last question was meant to be a gentle end to the paper. However, there were a large number of vague answers, such as the ubiquitous 'harmful'.

F325: Equilibria, Energetics and Elements

General Comments

This was a challenging paper which assessed candidates' ability across the spectrum of the specification. In the main, the Examiners were impressed by the level of responses, with good quality answers being provided for what were often quite challenging questions. In particular, the ability of candidates to handle chemical calculations showed an improvement on previous years, this being helped by their setting out of answers in a clear and logical way.

Comments on Individual Questions

Question 1

(a) For a significant number of candidates, this question did not provide the comfortable start that it should have done. Although almost all knew that *lattice enthalpy* is linked to the formation of an ionic compound, some omitted to note that one mole of compound is formed, while others did not mention that the ions must be gaseous.

(b)(i) In general this was well answered but weaker candidates tended to stop short of a sufficient answer and stated only that energy is given out when ions are hydrated, an answer that does little more than re-state the question. A correct response required a statement that bonds were being formed.

(b)(ii) As with **(b)(i)**, responses here were of a good standard and many candidates were awarded both marks. It is worth noting that a number of candidates gave as their two answers, Mg^{2+}(aq) + Cl^{-}(aq) and $MgCl_2$(aq). Unfortunately these are equivalent, a concept difficult for some candidates to grasp.

(b)(iii) This calculation proved to be relatively challenging. By far the most common error was to forget that two chloride ions were being hydrated and so arrive at an incorrect answer of –2284 kJ mol^{-1}. This response was seen almost as often as the correct answer.

(c) This part could have been better answered. It was clear from many of the scripts that candidates had confused the enthalpy change of hydration with that of solution. As a result, candidates often compared the strength of the ionic bonds in $MgCl_2$ and $CaCl_2$ either by correctly noting the relative sizes of the metal ions or sometimes by comparing the size of the Mg^{2+} ion with that of the Cl^{-} ion. Similarly for the second mark they discussed bonds broken in the salt as the cause of the different enthalpy values. It is noteworthy also that a number of candidates were not awarded this second mark because they did not give sufficient detail in their answer, simply stating that Mg^{2+} would have a greater force of attraction but never mentioning water.

Question 2

(a) This was extremely well answered and the majority of candidates gave very clear answers that earned them all three available marks.

(b) The equation for **Stage 3** in which water reacts with nitrogen dioxide was the easier of the two marks and was awarded often. The first equation for **Stage 1**, although more challenging, still saw many correct answers. Errors nearly always arose because of difficulties with balancing, as the species involved were given in the question.

(c)(i) Only the very weakest candidates failed to give a correct answer here.

(c)(ii) Candidates found this calculation challenging but the best candidates were able to obtain the correct answer and to be awarded all five marks. The Examiners looked for a correct method and credit could be given for each step in solving this unstructured problem, even if the figures used were incorrect. The final marks proved to be the easiest and all but the weakest candidates were able to substitute their values for the concentrations of the three species (whether correct or incorrect) into a correct equation from part **(i)** and were able to derive the correct units. Working out the correct concentrations for each of the gases at equilibrium proved to be much more challenging and scripts displayed a very wide range of ways in which candidates had proceeded from the given starting concentrations.

Question 3

In the main, this question was well answered. Candidates were guided by the points in the question and set about their answers in a very ordered and methodical way. Most candidates used the graph both to evaluate two half-lives and to draw a tangent to the curve at $t = 0$. It was pleasing to see that the majority of candidates realised that as the data were plotted from experimental results there would be a degree of variability in the half-lives. With the order safely established, many candidates then went on to achieve near full marks. A few common errors were forgetting the units for both the initial rate and the rate constant and giving the formula of bromine as Br rather than Br_2 when stating the rate equation.

Question 4

(a)(i) This was a very straightforward question that relied on recall of a fact that many may have known since GCSE. It was nearly always answered correctly.

(a)(ii) Again this was well answered although a number of weaker candidates simply linked the strength to the concentration of protons. When it came to providing an equation the most common error was to use an arrow rather than showing the reaction as an equilibrium.

(a)(iii) Not surprisingly, answers here nearly always fell into two groups, those who placed acetic acid as the weakest acid and those who ranked pyruvic acid as the weakest with the others following in pK_a order. Very occasionally other random orders of the four acids were seen but this was very rare.

(a)(iv) Candidates found this quite challenging and even those who were able to use their rank ordering from part **(iii)** to decide which species would be the proton donor and which the acceptor, they often fell down by omitting a hydrogen from the formula or omitting the charge on one of the product ions.

(b)(i) Candidates always find equations such as this difficult. A common error that arose in the composition of the reactants was giving the formula of calcium hydroxide as CaOH but it was in the formula of the product calcium pyruvate that candidates were most likely to introduce errors. Here the formula either did not show the correct ratio of the two ions or often included the charge on the pyruvate ion without a cancelling charge being shown for the calcium ion.

(b)(ii) Strong candidates recognised this as a simple acid–base reaction and gave the required response while a number of other candidates diligently worked through the equation from part **(i)** to arrive at the correct answer. Weaker answers still contained calcium and pyruvate ions.

(c) This was well answered and it was clear that the majority of candidates had taken the time to prepare well for this sort of calculation. It was also pleasing to see that many read the question carefully and gave their final answer to the correct number of decimal places.

(d)(i) This structure was shown correctly by almost all candidates.

(d)(ii) Good candidates tended to gain one mark here for giving an equation that showed the loss of the first proton from oxalic acid, although it was noteworthy how many suggested this as a reaction linked to larger of the two pK_a values. For the second dissociation the most common error was to show the loss of both protons from oxalic acid. A handful of candidates gave equations for K_a rather than chemical equations in answering this part.

(e) The first step towards the correct answer for this part relied on the choice of acid with which to form the buffer. Some candidates clearly did not link the desired pH with the pKa data from the table. Most common among the suggested acids was acetic. This seemed to have been chosen because it was the weakest with candidates knowing that a buffer requires a weak acid. The Mark Scheme allowed candidates who had chosen an incorrect buffer mixture to be awarded all marks for the subsequent calculations. However, the equation which had been learned so carefully for **(c)** was the undoing of a significant number of candidates who proceeded to simplify the expression for K_a into one involving $[H^+(aq)]^2$. Some candidates derived the correct ratio by using the Henderson–Hasselbalch equation.

Question 5

(a) This was well answered and many candidates picked up both marks. The most common error arose for process **E** which needed candidates both to assess the impact of a liquid and a gas upon the entropy and then to note that the moles of gas are fewer in the products.

(b) Surprisingly this was not as well answered as might have been expected. Although the signs were given correctly, for many candidates it was the explanations that let them down. Some candidates attempted to make their answers too complicated and started discussing the processes in terms of free energy. It is also noteworthy that a number of candidates reasoned that the enthalpy change accompanying melting must be zero as no bonds in water were broken.

(c)(i) In the main this was well answered and the majority of candidates were able to manipulate the given data to arrive at the correct answer.

(c)(ii) Again this was well answered although a number of candidates did give two answers that both relied on hydrogen's use as a fuel.

(d) There were many very strong answers here although it should be noted that a handful of able candidates forgot to address the second bullet point and so did not link their value to whether the reaction would be spontaneous or not. A few candidates fell into difficulties when changing units from kJ mol^{-1} to J mol^{-1} but such cases were comparatively rare.

Question 6

(a) There were many strong responses to this question. Almost all candidates were able to give a correct definition of a ligand, to describe its interaction with a transition metal and to explain a complex ion. In terms of drawing a distinction between a d-block element and a transition metal, many candidates collected the mark for a correct definition of a transition metal but very few gained the mark for describing a d-block element. Although they knew that it involved filling the d sub-shell, they did not make the required link to the energy of the sub-shell. Candidates who attempted the electron configurations nearly always did so successfully. One problem for a number of candidates was that despite being directed to use the information in the question, they proceeded to select other transition metals and so did not gain either of these marks.

(b)(i) This question was very well answered and most candidates were awarded both marks, although a few omitted to give a value for the bond angle. Weaker candidates suggested the bond angle either as 60º (by considering the drawing as a flat hexagon) or 109.5º.

(b)(ii) Fairly well answered.

(b)(iii) Again this was well answered although a significant number of candidates gave answers involving only partial substitution of the $[Ni(H_2O)_6]^{2+}$ by ammonia.

(b)(iv) This was also well answered and most candidates picked up at least one of the available two marks by giving an equation producing the ion they had proposed in part **(iii)**. When marks were not awarded, candidates tended to make careless errors such as omitting the charge on one of the complexes.

(c)(i) Although there were many correct responses to this question it was perhaps a little surprising how many candidates were not able to work out a correct molecular formula for the ligand. The most common error was to count the number of hydrogen atoms as ten rather than eight.

(c)(ii) This was well answered and almost all candidates gave the correct answer of 4. When an incorrect response was seen, this was invariably 2.

(c)(iii) Again this was well answered, the only common error being to draw the complex with only two bipyridyl ligands in a square planar arrangement.

(c)(iv) At first glance this appears a very demanding question but closer reading of the information in the question reveals that the candidate is receiving considerable help with not only the formula of the repeat unit but also a description of how the ligand bridges between the two metal centres. The main problem now becomes one of elucidating the structure of the 4,4'-bipyridyl ligand. Hints on how to do this were contained at the start of part **(c)**.

Question 7

(a) Candidates clearly felt back on safe ground with this question and most picked up both marks here.

(b) Again most candidates found this straightforward.

(c)(i) Most candidates clearly knew how to approach the problem of constructing an overall equation from two half-equations but many fell down either when it came to balancing the equation or in transcribing the unfamiliar species NiO(OH) where they omitted the oxygen. A significant number of candidates left hydroxide ions on both sides of the equation.

(c)(ii) As expected, the oxidation part proved the easier of the two with most candidates able to assign the oxidation numbers of cadmium as the metal and as the hydroxide. The reduction proved more challenging in terms of assigning the correct oxidation number for nickel in NiO(OH), but there were still many candidates who gained full marks.

(d)(i) Candidates found this more challenging than it should have been. Of the correct answers, most took the route of giving the reverse of both half-equations rather than quoting the reverse reaction to the one they had written in part **(c)(i)**.

(d)(ii) This was by some margin the most challenging question on the paper although the required responses were the half-equations from an alkaline hydrogen fuel cell.

Question 8

It was often the case that candidates seemed to take some considerable working to arrive at a proposed equation which was often inaccurate. They might have done better to have pressed on with the easier steps of the calculation. Of the four ionic equations, the first of which only required the two half-equations to be combined, was most often marked correct. One of the equations for **Step 2**, that between an acid and a carbonate, was given correctly the next often, although a significant number of candidates assigned only a single negative charge to the carbonate ion. Having assigned one equation to this step, very few candidates indeed thought that they also needed to cover the formation of the precipitate. **Step 4** involves a challenging equation as it is, of course, possible to derive an equation that fits the number of types of atom but only falls down in terms of balancing charge, as a result of not noting the oxidation number of the copper in copper(I) iodide that was quoted in the question.

The incorrect equation, $Cu^{2+}(aq) + 4I^{-}(aq) \rightarrow CuI_2 + I_2$, was a recurring error from those candidates who made a good overall attempt at the question. Some candidates had clearly memorised the correct equation from studying the course and this seemed to be the most common route towards a correct response. In general candidates fared much better with the calculations. Almost all were able to work out the amount of thiosulfate from the titration results and then convert this into the correct amount of iodine. Converting this to an amount of copper naturally depended on the equation that had been suggested for **Step 4**. With this done, the only serious obstacles left were to scale up by 10 and to remember to quote the answer to only one decimal place.

F326: Practical Skills in Chemistry 2

General Comments

The majority of the work received had been assessed reliably and most teachers seemed to be comfortable with using the Mark Schemes provided. The majority of centres provided marks that were unchanged as a result of the moderation process.

Nevertheless there was concern over a number of cases where, although the overall accuracy of the marking was good, an individual candidate within the centre had been very generously treated. This meant that work had to be referred back to the centre. Rigorous adherence to the Mark Scheme is essential. If there are cases where there is an element of doubt, it is helpful if some annotation is provided on the script as a guide to the Moderator. Centres are reminded, however, that the Additional Guidance column of the Mark Scheme provides most variations on what is acceptable.

There were still a significant number of errors made in the addition of the marks obtained by candidates. It was felt that this often arose because centres used a mixture of ticks and circling of marks. It would help centres if a consistent method was used and it is generally felt that one tick per mark is the most reliable method to follow. However, care needs to be taken where more than one response is required for a mark to be awarded.

Administration

See the comments included in the Administration section of the F323 report.

Comments on A2 Tasks

Centres have a choice of how many Tasks they feel it is appropriate for their candidates to complete. Generally there was a mixture of different Tasks in the work received although it was not unusual for only one Task in each category to be used for assessment. It was found overall that the different Tasks were equally popular.

Qualitative Tasks

It was the Qualitative Tasks where Moderators expressed the most concern about the accuracy of the marking. Within the Tasks there are a number of occasions where two observations are required for one mark and too often the mark was awarded where only one of these was correct. If the Mark Scheme requires '*yellow precipitate*' followed by '*a blue solution*' then both colours must be given and it is insufficient to write '*precipitate dissolves to give a blue solution*'. It is worth noting too that, although '*solid'* is allowed as an alternative to '*precipitate'*, by A2 candidates should really be using the accepted terminology. Candidates should also be encouraged to make a decisive judgement about the colour they are describing and, if necessary, use words such as light or dark to qualify its shade. Some discretion is allowed but too many colours such as '*yellowy–orange with a tinge of red*' may result in the mark not being awarded. Equally important, it must be made clear whether the colour described refers to a precipitate or a solution.

In general, a statement contradicting another statement, means that a mark cannot be awarded and centres are sometimes too generous in applying this principle. For example, the description of a solution as being cloudy is a contradiction which should result in no mark being given.

All the Tasks have been extensively trialled and the observations provided in the Mark Schemes have been independently confirmed. On the rare occasions centres have reported difficulty in reproducing the expected results (during teacher trialling of Tasks in advance of the candidates), alternatives may be allowed but only if the centre contacts OCR at GCEscienceTasks@ocr.org.uk to obtain permission. It is clearly advisable for this to be done before the candidates carry out the Task as it is rarely possible to resolve issues if these are reported once the Task has been completed. Safety issues remain the responsibility of the centre who are at liberty to advise candidates of any precautions they feel are necessary to ensure the safe conduct of an experiment.

Quantitative Tasks

The Moderators were grateful to centres with multiple sets of candidates who made it entirely clear which set of supervisor's results applied to which candidates.

Generally the Quantitative Tasks were accurately marked and the Moderators only reported a few issues. One was the failure of some centres to check that points on a graph had been plotted correctly. It was observed, however, that this was sometimes made very difficult by the strange choice of scales selected by candidates. Plotting graphs is not a skill that candidates seem particularly comfortable with and it perhaps needs more practise within centres. Although it is sometimes important that it is made clear that a graph passes through '0,0' there are many occasions where it is unnecessary to include the origin on the axes. A mark may not necessarily be awarded for choosing the line of best-fit through the points plotted but it was noted that the choice made by candidates was often ill-judged.

Significant figures remain a difficulty for candidates. Nevertheless it was found that, even where it was explicitly mentioned in the Mark Scheme, this requirement had sometimes been ignored. In these circumstances it was inevitable that the Moderators could not support the mark given. Reasonable license is often allowed and this is clearly stated in the Mark Schemes but it must not be extended further.

When steps in a calculation are given a mark, it can be assumed that if a candidate gives the correct final answer, these steps have been covered and the full mark can be awarded. The only exception lies where an explanation is specifically requested in the question and in these cases the Mark Scheme will always specify how the marks are to be awarded. Occasionally a candidate provided a perfectly valid explanation not covered by the Mark Scheme and this should clearly be accepted. In these circumstances, if the centre is uncertain how to assign the marks, OCR should be consulted via GCEScienceTasks@ocr.org.uk.

Evaluative Tasks

As with the other Tasks, it is expected that candidates will be familiar with the background theory that is relevant to the Evaluative Task. However, the Tasks are designed to include some parts that will challenge even the best candidates. It is expected that a mark of 15 will be relatively rare. It is, of course, not always possible to list all the variations in wording that may be worthy of credit but great care is needed to check that a given answer is acceptable within the guidelines given in the Mark Scheme.

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