

**GCE CHEMISTRY
(Summer Series) 2010**

Chief Examiner's Report

GCE CHEMISTRY

Chief Examiner's Report

Grade Boundaries

Grade	Uniform Mark
AS Maximum Mark is 300	
A	240
B	210
C	180
D	150
E	120

Grade	Uniform Mark
A2 Maximum Mark is 600	
A	480
B	420
C	360
D	300
E	240

**ASSESSMENT UNIT AS 1 BASIC CONCEPTS IN PHYSICAL AND
INORGANIC CHEMISTRY**

There were very few comments with regard to this year's examination and candidates performed very well on the paper as a whole.

- Q11** **(a)** The calculation of the number of neutrons present in the aluminium atom was extremely well done. No other answer other than 14 was seen.
- (b)** **(i)** The common error of adding electrons to an atom rather than taking them away was rarely seen compared to previous years. State symbols were also very successfully completed which provided a good start to the paper for candidates.
- (ii)** As the mark scheme shows it was essential to mention both atomic radius and electron shielding. Both were mentioned by the majority of successful candidates but there were many ways of expressing the size of the atom, apart from the radius. Candidates were more successful with part (iii) than part (iv).
- (iii)** It was essential to mention that the electrons in the case of aluminium were in the *outer* s shell. Aluminium also has electrons in the inner s orbitals and thus it was essential to distinguish the outer electrons. Candidates often gave good answers but failed to mention the essential nature of the electrons and lost the marks.
- (iv)** Although the vast majority of candidates gave the correct answer far too many, for such a relatively simple question, gave a completely incorrect electron structure.
- (v)** Candidates have been asked to sketch very similar graphs in previous examinations and it would have been expected that more success was seen. However, a very wide range of graphs were produced. As might be expected the most common error was to have two electrons forming the first line rather than three. Indeed the electrons were reversed with three electrons appearing at the end. However, the major concern was the erratic way in which the

lines were drawn. Indeed, it appeared at times that candidates were actually drawing a graph of the change in ionisation energies as the Periodic Table was traversed. Far too many candidates wished to distinguish between the electrons in the sub shells when the pattern should have been 3.8.2 rather than 2.1.6.2.2.

- Q12**
- (a)**
- (i)** The formation of an ionic solid from its elements is a question that is frequently asked in AS examinations. Over the years the performance has improved but it should be clear to candidates what is expected. Unfortunately there are still too many candidates who finally draw a covalent structure even though they have correctly deduced an ionic structure initially. There was also the added complication that a minority of candidates thought that strontium had four electrons in its outer shell which was a fundamental mistake.
- (ii)** The conductivity of strontium metal was well understood and explained. However, there was a problem in dealing with the conductivity of strontium fluoride. Having mentioned the delocalised electrons in the case of metallic strontium there was the tendency to say that strontium fluoride did not possess free electrons. Whilst this is true it was necessary to mention that strontium fluoride contained ions and that they were unable to move unless the solid salt was melted or dissolved in water. Very often the award of the second mark depended on how convincing the candidate's explanation was.
- (b)**
- (i)** The definition is given exactly in the specification and this was the answer expected for the two marks. Despite the exact definition there were many variations of it written. Sometimes it was exceedingly difficult to decide whether to award one or zero marks.
- (ii)** Virtually all candidates were able to draw a correct representation of the polarity of the S-F bond. Problems were occasionally seen when there was an attempt to use two different systems together to represent polarity.
- (iii)** There were very few problems in drawing the dot and cross diagram for sulphur hexafluoride. A very small number of candidates omitted to draw the outer electrons of the fluorine atoms.
- (iv)** It was very important to express the answer to this question in the correct language. The major failing of candidates was to state that the SF₆ molecule has 12 electrons in its outer shell. It should have been stated that *sulphur* had 12 electrons in the outer shell. Consequently many candidates lost a mark that could have easily been obtained. All candidates were aware that the octet rule refers to eight electrons except those that did not express themselves fully.
- (v)** It is still a surprise that after so many years and so many exam papers and Chief Examiner reports that there is such a tendency for candidates to draw two dimensional structures for octahedral complexes. The use of six complete lines of equal length does not convince. There are a greatly increased number of candidates who

use dotted lines and wedges. Unfortunately far too many candidates use them completely indiscriminately.

On the better side there are far fewer examples given of fluorine atoms repelling to maximum distance. However, candidates must state which electrons are responsible for the repulsion. There are electrons in the lone pairs as well as the bonded pairs.

A minority of candidates obtained the full four marks for this question.

- (vi) The question revealed that polar bonds were present and consequently there was no mark for mentioning polar bonds. Weaker answers spoke of charges cancelling out but this is not strictly true. Better answers followed the mark scheme and relied upon the concept of dipoles.
- (c) (i) Most candidates obtained the correct name of dative or coordinate bond.
- (ii) The marking conference decided that it was necessary to state that the lone pair came from the nitrogen atom. Consequently many candidates lost a mark even though they mentioned the donation of a pair of electrons, it was from the ammonia molecule by implication because nitrogen was not mentioned.
- Q13** (a) (i) Oxidation is the loss of electrons and this was stated by the vast majority of candidates.
- (ii) More problems were experienced with the definition of reduction in terms of change in oxidation state. At times too many answers were given in addition to the correct one.
- (b) The oxidation numbers were correctly given with few errors.
- (c) (i) Candidates, on the whole performed well on this question and the following one. Just a few thought the iodine ion carried a positive charge and attempted to carry this error through to part (ii) which was not allowable.
- (ii) All candidates at least obtained one mark (apart from the use of I^+) for an unbalanced equation and the majority gained two marks for correct balancing.
- (d) The mark scheme performed well in allowing candidates to obtain more marks than generally obtained in questions of this type. It was rare for candidates to obtain no marks. Knowledge of iodine chemistry was good. There were few contradictions eg by saying that iodine had ionic bonding. Comments made were generally accurate.
- Q14** (a) (i) The equation was not well done despite the fact that this was a well defined part of the specification. One of the most common answers was to produce HOCl despite the presence of an alkaline solution ie
- $$Cl_2 + NaOH \rightarrow NaCl + HOCl$$
- Despite the incorrectness of this answer it was awarded one mark. Very few fully correct answers were seen.

- (ii) Candidates knew the definition of disproportionation but occasionally let themselves down by slightly misquoting their answer and stating species rather than element or introducing unnecessary terms.
- (b) (i) The equation for the reaction of hydrogen with chlorine was very well known. Little use was made of atoms rather than molecules.
- (ii) Either candidates knew the answer and obtained the marks or they floundered by referring to the strength of interaction between the molecules which was the answer to the next question. Hydrogen bonding need not have been mentioned instead the relative polarisation of the bonds could have been the central issue. However, many candidates were familiar with hydrogen bonding. Obviously they could have been repeating the examination.
- (iii) Similar comments apply to part (ii) as mentioned in part (i). It was essential to comment on the bonds but many candidates considered intermolecular bonds instead. The question proved more difficult than expected especially as it came straightforwardly from the specification.
- (c) (i) Candidates were very familiar, as usual, with the test for chloride ions. A white precipitate was given by virtually all candidates.
- (ii) The ions were correctly written almost without exception. The state symbols were not as successful.
- (iii) It would have been sufficient to say that the precipitate had dissolved but it was expressed in a variety of ways involving “disappearance”.
- Q15** (a) The definition of anhydrous was generously marked. Candidates mentioned that it was the removal of water but tended to write extraneous comments referring to white powders and giving information which was irrelevant to the definition.
- The calculation was tackled well. The only minor problem tended to be the misinterpretation of the formula mass of sodium carbonate despite the fact that the formula was given in the introduction to the question.
- (b) (i) The definition of a standard solution was well known. Occasionally it was stated that the volume was known as well.
- (ii) The equation was well known although a significant minority, as always, wanted to try and balance an equation using the formula NaCO_3 rather than Na_2CO_3 .
- (iii) Phenolphthalein was the popular alternative to methyl orange as the selected indicator.
- (c) This section provided a long detailed calculation to work out the formula of the hydrated sodium carbonate which was tackled well by all candidates. With the possibility of carrying errors through the marks obtained were high.

ASSESSMENT UNIT AS 2 FURTHER PHYSICAL AND INORGANIC CHEMISTRY AND INTRODUCTION TO ORGANIC CHEMISTRY

- Q11** The vast majority of candidates scored full marks. Some only scored 2 marks since they stopped at the empirical formula.
- Q12**
- (a)
 - (i) Electrophilic addition was well known by the majority of candidates.
 - (ii) Generally well done. The best answers showed the dipole on the HBr molecule, the correct orientation of its approach to the C=C bond, the correct structure of the intermediate and the full negative charge on the bromide ion. "Curly arrows" were not essential.
 - (b)
 - (i) Esterification was well known. Condensation was also accepted.
 - (ii) A significant minority of candidates did not identify ethanoyl chloride. There was evidence of poor spelling of the word "Ethanoyl".
 - (iii) The spectra were generally correctly linked to the compound by the majority of candidates.
- Q13**
- (a)
 - (i) Extremely well done by virtually all candidates.
 - (ii) Again, well known by almost all candidates. Spelling of the word "catalytic" was sometimes poor.
 - (b) Most candidates were able to apply the 2:1 ratio successfully and the majority scored the full 2 marks.
 - (c)
 - (i) Again "addition polymerisation" was well known and the majority of candidates scored full marks. Some candidates left out the "addition" and scored only one mark. Use of the incorrect term "additional" was also noted in some scripts.
 - (ii) Silly mistakes cost the mark in a lot of cases eg leaving the C=C in the final structure.
 - (d)
 - (i) The answers to this question exposed a very poor understanding of geometric isomerism across the ability range. Despite the wording of the question, many candidates didn't draw a **branched** alkene. Hex-3-ene was a popular choice. Many drew unbranched alkenes which would certainly not exhibit geometric isomerism eg hex-1-ene. Appropriate naming of the structure also caused problems. This is obviously an area for improvement, particularly for candidates progressing to A2 units.
 - (ii) Again, very poor responses here. The marks could be gained by carrying an error through. Only the most able candidates scored full marks in part (d).
- Q14**
- (a)
 - (i) Well known by many, although a number of candidates did not include the phrase "enthalpy **change**".

- (ii) Too many candidates were losing easy marks on definitions which they should be able to reproduce. Some candidates seemed to be suggesting that combustions are endothermic by using the phrase “energy **required**”. Other students wrote of the substance being “burned in **1 mole of oxygen**”. There were many other silly mistakes.
- (iii) Reasonably well answered by most candidates. Silly mistakes cost many candidates easy marks. Combustions are exothermic processes and the negative sign was missing in many answers. The value for water was often not doubled. The sign of the methane value was incorrectly manipulated. Units were often left out of the answer. Many candidates need to get into the habit of including units with calculated quantities.
- (b) (i) Generally well done. It is necessary in this type of question to indicate the relative position of the reactants and products i.e. labels are required. A relatively small number of candidates had the products at a higher level than the reactants.
- (ii) This definition was not well known with very disappointing responses. Very few candidates scored full marks for this question. Many candidates scored zero. Omitting “1 mole” of the bond or the “averaging” over many compounds were common responses. The latter point was very poorly answered. This is a simple definition which candidates need to learn.
- (iii) Overall disappointing responses here. Many candidates ignored the estimated value of -698 and simply let the energy required to break bonds = the energy released on bond formation. This is fine for a reaction with an enthalpy change of zero but is clearly not appropriate in this question. The relatively simple mathematics of rearranging an equation defeated many students. Some managed, following 2 errors, to gain 1 mark for their numerical answer, but then threw it away by omitting to give the required units!
- Q15** (a) Too many candidates lost one of the marks by focusing only on the rates and ignoring the fact the amount of any given reactant or product remains constant; or by focusing only on the amounts and ignoring the rates.
- (b) Generally well understood and explained. Candidates need to be reminded that a “state and explain” type question which is worth two marks requires a statement and an explanation. A small number of strong candidates threw away an easy mark due to giving one without the other.
- (c) Generally well understood and explained. Most candidates identifying that the forward reaction was exothermic/reverse reaction was endothermic.
- (d) There being no effect on NO_2 was well understood and the majority scored this mark but few achieved the second mark. The key point missed by many, but not all, was that the rate of forward and reverse reactions are increased **equally** in the presence of a catalyst.

- (e) (i) The conditions used in the Haber Process were well known. There was evidence of confusion with units.
- (e) (ii) Too many candidates thought the compromise was about cost. Many mentioned yield but not rate or vice-versa.
- Q16** (a) Many candidates scored full marks. A few had some problems with the classification of structures and with naming the fourth structure (2-bromobutane) due to the way they had drawn it.
- (b) (i) Disappointingly, very few candidates scored the full four marks for the chemistry and many dropped a mark for the quality of written communication. The purification was not well known. Many candidates described the process of recrystallisation. Too few referred to sodium carbonate or sodium hydrogen carbonate **solution** and/or **anhydrous** CaCl₂ etc. Too many candidates did not start sentences with capital letters and there was little or no punctuation.
- (ii) Generally well done, with easy to follow, logical calculations submitted in most cases.
- (c) Again well known, though some candidates forgot to mention that silver nitrate needed to be “aqueous”.
- Q17** (a) (i) Both axes were generally well labelled. Enthalpy appeared on the y-axis quite frequently.
- (ii) Very poorly answered. A qualitative understanding of the distribution is required. Many candidates mentioned 0 K when the question clearly indicates that distribution curve refers to a temperature of 450 K.
- (iii) Well answered by most candidates. Candidates should take care to ensure that the curves only cross once.
- (iv) Quite well answered by the majority of candidates. In a lot of cases good detailed responses were obtained with correct references to activation energy but then the candidates forgot to finish by saying the rate of reaction was reduced ie they explained but did not **state** the effect on the rate of reaction.
- (b) Generally very well known by most candidates but it was obvious, in some cases, that some candidates knew of a number of catalysts and just listed them in a fairly random/hopeful order!
- (c) (i) Generally very well answered.
- (ii) Again, generally well done, although some candidates did not pick up on the 2:1 ratio or omitted the necessary units in their final answer.

ASSESSMENT UNIT AS 3 INTERNAL ASSESSMENT: PRACTICAL EXAMINATION

The teacher marking in this unit was, in many cases, of a high standard. Again centres tended to fall into three categories, those who stuck rigidly to the mark scheme, those who had a more flexible approach and used some professional judgement and those who were unduly generous to their candidates. The standardisation process and moderation of all scripts means that candidates are not advantaged or disadvantaged in any way as a result of this variation. Centres are advised to stick rigidly to the mark scheme and if adjustments to the mark scheme are needed these will be done at the Standardising Meeting and taken into account during the moderation of the scripts.

Q1 TITRATION (PAPERS 1 AND 2)

This question was similar to those from previous papers and candidates generally performed well.

- (a) This discriminated between many candidates. The candidates were required to describe the diluting of the concentrated alkali. Some pipetted 25cm³ of the concentrated alkali into a beaker and then added 475cm³ of distilled water from a measuring cylinder. The rinsing was rarely described for both uses of the pipette and the use of a safety filler frequently omitted. Some candidates omitted the diluting of the alkali and simply described pipetting the solution into conical flasks. A few candidates described how to carry out the titration.
- (b) The table was generally well drawn and labelled. The most common mistake was to calculate the average titre outside the table and then omit the units. A few candidates used the rough reading when calculating the average titre. A large number of candidates produced very accurate results consistent with the supervisor's value. A small number of candidates produced results up to and even more than 1cm³ different from that of the supervisor.
- (c) The colour change had to be from yellow to orange/red/pink. A number of centres accepted orange as the starting colour but this was not allowed as this could have resulted in the colour change of orange to orange being credited.
- (d) The equation was generally well known but a number of candidates are still incorrectly giving Na(OH)₂/ K(OH)₂/NaCl₂/KCl₂.
- (e) The calculations were similar to previous years and generally well done. Part (vii), the calculation of the percentage of hydroxide in the oven/drain cleaner was the only part which caused any difficulties.

Q2 OBSERVATION AND DEDUCTION (PAPERS 1 AND 2)

Candidates were obviously well prepared for these exercises and the standard in these questions was high.

- (a) Despite the fact that compounds using magnesium were used for the first time this did not hinder the candidates. Some candidates still describe the appearance of a white precipitate as a 'cloudy solution'; the examining team were prepared to accept 'cloudy white solution'. At this level candidates are expected to describe precipitates as white or coloured and to use the term precipitate.

The use of 'negative tests' for elimination purposes will continue and candidates should be aware that this is an essential part of the identification process.

Some candidates identified chlorine ions instead of chloride ions.

- (b) This was again well answered and the use of 'negative tests' was again part of the exercise. Some candidates gave the OH^- ion instead of the $-\text{OH}$ group.

Q3 PLANNING (PAPERS 1 AND 2)

- (a) (i) Many candidates described weighing the whole apparatus with and without the oxide, although not the usual method this was accepted.
- (ii) Many candidates described cooling the apparatus as a safety precaution and the mark scheme was amended to accept this answer.
- (iii) The concept of weighing to a constant mass is well understood and was explained by the majority of candidates.
- (iv) There were some interesting suggestions for allowing the apparatus to cool. Many candidates were able to relate this to the re-oxidation of the hot metal.
- (b) The calculation of the empirical formula was well done. A few candidates used 32 instead of 16 as the atomic mass of oxygen, this error was carried through to the end of the question.
- (c) The equations were well answered. The calculation was well done by the most candidates. The only area of difficulty was in the final part of the calculation.

Q4 (PAPERS 1 AND 2)

- (a) The definition of refluxing frequently referred to evaporation instead of boiling. The examining team define refluxing as '**continuous boiling and evaporation of a mixture without loss of material**'.
- (b) (i) Many candidates named sodium hydrogen carbonate/carbonate but not the use of the solution or the separating funnel.
- (ii) A wide range of anhydrous solids was suggested and the examining team limited the options to anhydrous sodium sulphate/magnesium sulphate/calcium chloride. Few candidates removed the solid by filtering or decanting.
- (iii) Many candidates correctly described distilling the liquid but few gave a suitable temperature range.

Q5 (PAPERS 1 AND 2)

- (a) The flame test was well known as was the colour expected from the sample. Most errors related to not using concentrated hydrochloric acid and/or not using a blue Bunsen flame for the test.
- (b) In **Paper 1** candidates were usually able to describe adding the hydrochloric acid and carbon dioxide turning lime water milky/cloudy but failed to explain how the carbon dioxide was put into the lime water ie by bubbling the gas through the lime water.

In **Paper 2** the identification test for the halide ions was well known.

- (c) In **Paper 1** candidates lost marks for failing to describe dissolving the solids in solution. Precipitation tests cannot be carried out without using solutions and this has been noted on previous reports.

In **Paper 2** candidates lost marks by failing to note that silver chloride is soluble in both dilute and concentrated ammonia solution. Few candidates noted that a colourless solution was formed despite being asked for observations – the formation of a colourless solution is a valid observation and has appeared in the observation and deduction exercise. The correct reference to silver iodide being insoluble in both dilute and concentrated ammonia solution was more common.

ASSESSMENT UNIT A2 1 PERIODIC TRENDS AND FURTHER ORGANIC, PHYSICAL AND INORGANIC CHEMISTRY

Candidate responses to this paper were generally good, with most questions being accessible. Calculations were well answered as were those involving the application of knowledge. Many of the issues raised in the last chief examiner's report had been taken on board with candidates reaping the rewards. No difficulties were reported on the level of language used and the time allocation was appropriate.

- Q11**
- (a) (i) Generally known straightforward equation.
- (ii) Most used the explanation based on the specification wording, ie strong acid/weak base and scored well. Others used proton donation by the ammonium ion in a variety of ways which was accepted.
- (iii) This proved to be quite challenging. Most gave the shared electrons correctly but many included only seven electrons on one of the oxygen atoms. The inclusion of an "additional" electron through the negative charge is often problematic.
- (b) (i) The formula for nitrogen(I) oxide was the main error with NO_2 a popular choice.
- (ii) Well known and clearly expressed answers from most candidates.
- (c) (i) A huge range of answers was predictably enough encountered. The answers accepted included mention of specific composition, volume, storage and lack of smell.
- (ii) Well answered with key errors involving the use of only one nitrogen or incorrect RFM.
- (d) (i) A magnificent variety of descriptions for a very simple process was noted. The vast majority secured the mark.
- (ii) The use of mgcm^{-3} did cause confusion and powers of ten were frequently incorrect as a result.
- (iii) Oxidation numbers, at times, were given simply as the charges on the iron ions and not presented in the correct format ie +2 or +3. It was pleasing to note that most candidates referred to the oxidation state of nitrogen rather than the incorrect nitrate(III) ion.

- Q12**
- (a) A very pleasing response was noted, with most gaining full marks.
 - (b) Many credible attempts were encountered. The salt acting as the source of the high propanoate ion concentration was missed by most however. The two key equations were needed with the appropriate arrow(s).
 - (c)
 - (i) As with previous years, the most frequent error was omission of water as a product.
 - (ii) Despite the report issued for the January examination, some candidates still described the role as a dehydrating agent which again was not accepted.
 - (iii) The scheme was clear cut for this question. One mark was allocated for noting that only the propanoic acid contains hydrogen bonds. The second mark needed some statement on the relative strength of hydrogen bonds compared to other intermolecular forces.
 - (iv) Well answered with mention of the key advantages – namely yield, rate and purity.
 - (d) The reaction with ammonia often had $-\text{NH}_2$ in the answer. The reaction with sodium carbonate was well done whilst reduction with lithium was frequently shown as an aldehyde.
- Q13**
- (a)
 - (i) Generally well known.
 - (ii) Poorly answered even though credit was given for the formula when a name was actually sought. As a general point candidates really need to provide what is requested in the stem in such questions.
 - (iii) Poorly done with surprisingly few correct responses. Al_2Cl_6 was often given.
 - (iv) The classification of oxides caused few problems.
 - (b)
 - (i) The equation was stated correctly by the majority.
 - (ii) The diagrams often required some measure of interpretation but usually gained full marks.
- Q14**
- (a) The equation caused significant difficulties despite all reactants and products being given.
 - (b)
 - (i) Well known, with some interesting spellings. Calorimeter appeared on a number of occasions.
 - (ii) Generally well answered.
 - (iii) The concentration – time graph frequently did not start on the axis; as in previous years this was penalised.
 - (iv) Most deduced the rate would be quadrupled, although some simply wrote that it would increase.
 - (v) The graph was known as expected although some lost credit by not including adequate labels. A number of endothermic pathways were encountered despite the information provided.

- (vi) This proved to be tricky enough as many candidates appeared to confuse k (rates) with K (equilibrium) and went on to say that there would be no change.
- (c) (i) Well answered with good use being made of previous mark schemes.
- (ii) Few difficulties noted.
- (d) (i) Errors were frequently made in determining the moles at equilibrium. These were carried through so that many scored [1] for the maths and picked up another mark for clearly stating “no units”. It is important that candidates indicate that no units are required in such a situation.
- (ii) Many struggled to provide a convincing statement; with some saying that the use of eqimolar amounts was the reason. Simply stating that the volumes cancel, was all that was required.
- (iii) Most realised this was the inverse of part (i).
- (iv) Very well answered, with most gaining full marks. A few lost credit through use of the wrong ratio.
- (e) Well answered by the majority of candidates. The most common problem noted was that of ratios; a small minority used the wrong reagent/product for their calculation.
- Q15** (a) Well answered.
- (b) (i) Well answered.
- (ii) Some confusion was noted with Y as some candidates stated the 1st and 2nd electron affinities of chlorine.
- (iii) The calculation was generally well done with the main errors involving a factor of two with 242 and 696.
- (c) (i) The equations caused some problems, especially with POCl_3 as a product.
- (ii) Answers frequently noted issues of speed and/or safety concerns. Care needed to be taken to state clearly that the other products using thionyl chloride are gaseous hence purification is easier.
- (d) (i) A familiar question which caused few problems other than candidates experiencing difficulties expressing themselves clearly.
- (ii) As for part (i).
- (iii) Key difficulties were encountered in establishing the number of moles at equilibrium and calculating partial pressures.
- (e) Although questions have been set on this particular reaction before, it still causes difficulties with the 1:4 ratio. A number of candidates lost credit as they appeared to be uncomfortable with the negative sign, hence they omitted it.

- Q16** (a) Poorly answered indicating that many did not understand the term “dehydrogenation”. Water was a frequent product.
- (b) (i) Well answered as expected.
- (ii) Many diagrams were confusing and difficult to award. A clear 3D arrangement showing obvious mirror images is needed (and appreciated).
- (iii) Many were able to work out the structure from the name.

**ASSESSMENT UNIT A2 2 ANALYTICAL, TRANSITION METALS,
ELECTROCHEMISTRY AND FURTHER ORGANIC
CHEMISTRY**

The performance of candidates in this examination was good.

- Q11** (a) This question provided an excellent start for candidates in the examination. There were six marks available and virtually all candidates obtained the maximum number of marks. The mention of other indicators rather than eriochrome black was extremely rare. The specification now mentions exactly what indicator should be used.
- (b) (i) Despite the fact that the equation involving the reaction of iron(II) ions with acidified manganate(VII) ions is one of the most memorable equations in A2 chemistry for titrations, the success rate was not as high as it should have been. This question distinguished highly between candidates.
- (ii) The colour change was well known but it was spoiled by those who wished to state pink/purple when pink was sufficient.
- (iii) Errors made in writing the equation were carried forward to the calculation. Marks were obtained by most candidates. The question proved to be quite discriminating.
- Q12** (a) (i) The conditions necessary for the formation of HD polythene were well known. The most difficult question was the name of the catalyst. Either the name or the formula was acceptable.
- (ii) The theory used to explain the differences in properties of LD and HD polythene are usually well known and they were on this occasion.
- (b) (i) It was a surprise to see so many mistakes made with the structure of the polyethylene terephthalate polymer. Some structures were of completely different polymers formed from completely different monomers. On the other hand many candidates reproduced exactly the required structure.
- (ii) The use of polyethylene terephthalate produced some interesting answers. A question in a previous paper have been based on the conversion of the polymer into jackets. Only two major uses were accepted ie clothing (fibres) and plastic (drinks) bottles. Some minor uses seen on the internet were listed but not seen. A wide variety of non-acceptable uses were seen.

- Q13**
- (a) In order to obtain full marks for the definition of a polydentate ligand there had to be a completely full explanation involving lone pairs of electrons and the bond formed with a central metal atom/ion. Such a restriction made the question very discriminating and only a minority of candidates obtained the two marks. Yet most candidates gave good answers and obtained at least one mark.
- (b)
- (i) It was exceedingly rare for candidates to obtain the incorrect co-ordination number for the nickel (II) ion.
- (ii) The answer tetrahedral was given as frequently as the correct answer square planar.
- (iii) Great success was had in this question on types of bonds. Most candidates obtained the three marks and no candidate obtained less than one mark.
- (c) Entropy has recently entered the specification and although this was a fairly simple question the answers were not very good. Just saying that the entropy had increased would have earned one mark. However, the problem seen with many answers was the inclination to say that certain molecules had increased their entropy. This was incorrect. The overall entropy change needed to be commented on.
- Q14**
- (a) The systematic name for TNT has been asked before and a wide variety of answers were accepted. A similar position was adopted in this examination. Consequently nearly all of the answers were correctly given.
- (b) This was a complicated equation to balance since it involved calculating the correct molecular structure of TNT. However, candidates were usually successful in their attempts.
- (c)
- (i) The acids were correctly given as concentrated sulphuric acid and nitric acid. Marks were lost if candidates omitted to state that the acids were concentrated.
- (ii) There are two equations for the formation of the nitrating species. Either of them was accepted for two marks. They were usually correctly presented.
- (iii) The nitronium ion was well known.
- (d)
- (i) The answer electrophilic substitution was widely known.
- (ii) The mechanism for the mononitration of toluene was essentially correct and fewer errors were seen in the mechanism than in former examinations. There was little use of partial charges. The most frequent problem seen was the insertion of a positive charge in the aromaticity circle of the benzene ring.
- (e)
- (i) The reagents were given frequently as tin and hydrochloric acid but there was also the tendency to quote sodium hydroxide. If this was part of the reagents then it was incorrect but if it was a step after the reagents then it was acceptable. Indeed part (ii) was the question which required the answer sodium hydroxide.

- (ii) The answer to this part of the question was not very well done. Even acids were quoted.
- (f) (i) It would have been expected that this equation was well known, but nitric acid was often written instead of nitrous acid.
- (ii) A low temperature was the most common answer together with either 5 °C or 10 °C.
- (iii) This was a difficult equation to write and only a minority of candidates obtained the correct answer. The major problem was the variety of species in the balanced equation.
- (g) (i) Although a variety of answers was given coupling was the most common.
- (ii) The structure of the dye was well drawn. The positions of the substituent groups on the benzene rings were accurately drawn.
- (iii) The question with regard to the production of colour in dyes has been asked many times before and the answers have continued to improve. The mark scheme has basically stayed the same. Often the major problem is the explanation of how the colour is removed from white light; frequently it is said that light is emitted when it is actually absorbed.
- Q15** (a) The definition of the electronic structure of a transition metal ion had to be accurately stated. Most candidates quoted from the specification and used the term partially filled and obtained the mark available.
- (b) (i) The equation for the reaction of sulphur dioxide with oxygen was as expected extremely well known.
- (ii) The concept of a heterogeneous catalysis was well known and very few confused the reactants with the products.
- (iii) The explanation of chemisorption is a fundamental question in GCE chemistry examinations. There is more expected at A2 level than at AS. Mark schemes do evolve over time and it was more difficult to obtain marks than before. There could be seven or eight facts mentioned but they were grouped together in the mark scheme which limited the chances of obtaining maximum marks. All candidates obtained some marks.
- (c) (i) The colours blue and green were given virtually without exception.
- (ii) A great majority obtained three marks. A small minority confused chromium metal and chromium ions in the equation.
- (d) (i) Only hydrogen peroxide was acceptable as the oxidising agent. This was the most common answer.
- (ii) The colours for chromium (III) and chromium (VI) ions were not as well known as the vanadium ions. This was of particular relevance in part (iii) where an incorrect colour could be carried forward.

- (iii) This question proved to be quite demanding with many candidates not appreciating the role of hydroxide ions in the equilibrium. Far too many candidates wished to produce the hydroxides of the metals ions present.
- Q16** (a) (i) A significant number of candidates did not write the accepted form of the molecular formula; instead writing out all the atoms with brackets around them. Occasionally even a number ie the molecular mass was written. However, the great majority of candidates obtained the correct answer.
- (ii) The calculation of the concentration of capsaicin was well performed. Marks were easily obtained.
- (b) Answers to the paper chromatography question were extremely well done. Maximum marks were elusive, however, because although candidates used two different solvents and any spots were identified by spraying with ninhydrin, no method was given of proving the identity of the capsaicin. Consequently the most frequent mark obtained was three.
- Q17** (a) (i) The primary, secondary and tertiary structures of proteins were well known but did not always gain the marks on offer because of the lack of terms to describe the increased folding of the structures. It was essential to give the intramolecular forces as listed in the mark scheme.
- (ii) The explanation why some proteins can act as enzymes was well explained.
- (iii) Biologically based questions often have more success than others. Such was the case with the efficiency of enzymes being lowered by the increase in temperature. The word denaturation was used by most candidates.
- (b) (i) Nearly all candidates stated that aspartic acid could be converted to asparagine by reacting with ammonia. Unfortunately this was only the first step in which the ammonium salt would be formed. Hardly any candidate went on to state that the ammonium salt should have been heated to convert the salt to an amide.
- (ii) This part question was badly answered because the amide grouping was written as taking part in the formation of the dipeptide instead of the amino group.
- (iii) The problem of part (i) was repeated in part (ii) where there was protonation of the amide group rather than the amino group.
- (iv) There was a wide variety of success with the flow schemes presented in this question. The most difficult of the four questions was the reaction of HCl with the amino acid. The – COOH group was incorrectly converted into - COCl.

ASSESSMENT UNIT A2 3 INTERNAL ASSESSMENT: PRACTICAL EXAMINATION

The teacher marking of this unit was in general of a high standard. Centres tended to fall into one of three categories. Some centres were very rigid in their application of the mark scheme. Some were more flexible and used some common sense in its application. Others were unduly generous to their candidates. The standardisation process and remarking of all scripts means that candidates were not advantaged or disadvantaged in any way as a result of the above. There was a much more realistic spread of marks than in the coursework of the previous specification.

Q1 TITRATION (PAPERS 1 AND 2)

Grade A candidates typically scored between 20 and 25 whereas Grade E candidates typically scored between 10 and 20.

- (a) Candidates had to decide for themselves how to carry out the titration. Candidates performed very well in this question. When marks were lost it was often for not rinsing the burette or pipette or for not adding the sodium thiosulphate dropwise when approaching the end-point.
- (b) Most candidates scored well in this part of the question. A small number of candidates used the rough titration value when calculating the average. A few lost marks for not including units in the table or for the average titre. Some candidates quoted the initial burette reading as 0 instead of 0.0.
- (c) Most candidates performed well here. The 2:1 ratio of thiosulphate to iodine was well known.
- (d) This part proved difficult for many, and this part of the question was where candidates lost marks, many getting all other parts correct.
- (e) Candidates scored well here although in many cases it was on the basis of carrying an error through from part (d).

Q2 OBSERVATION/DEDUCTION (PAPERS 1 AND 2)

Grade A candidates typically scored between 20 and 25 whereas Grade E candidates typically scored between 10 and 20.

- (a) Candidates should be encouraged to record all observations not just those which they feel will score marks. For example, in test 5 many candidates ignored the formation of the precipitate and only described the colour of the final solution. Knowledge of the formulae for complex ions was disappointing in many cases.
- (b) Again, candidates should be encouraged to record all observations not just those which they feel will score marks. The fact that two layers formed was ignored by most candidates. The structural formula of E proved to be very difficult and candidates did not use the NMR data to establish the structure of the ester.

Q3 PLANNING (PAPERS 1 AND 2)

As in previous practical examinations, the question which followed the titration and observation/deduction exercise proved to be much more discriminating. Grade A candidates typically scored in the low to mid teens whereas many Grade E candidates typically struggled to score above 5.

The style of question was similar to the planning exercise in Unit 6 of the old specification. The equations and percentage yield calculations were well done by many candidates. However many aspects of practical technique were either not well known or were not used appropriately. For example, many candidates suggested using recrystallisation to purify the ester. "State and explain" was ignored by too many candidates with many giving no justification for their suggestions. Candidates should note that when purifying an ester they should make it clear that the ester is shaken with sodium carbonate solution and when carrying out distillation it is important to state the temperature or temperature range at which the distillate will be collected.