1995 HIGHER SCHOOL CERTIFICATE EXAMINATION

CHEMISTRY

Candidature

In 1995 10433 students presented for the examination in 2 Unit Chemistry. This represents a significant decline from the numbers for 1994 (11978) and follows the disturbing trend observed since 1992 (14394).

General Comments

It was very clear from the responses to parts of the paper that:

1. The Grey Syllabus (published in October, 1993) was still being used. This syllabus was superseded by the *blue glossy* version published in 1994 for implementation in that year, and which was the version used by the Examination Committee in setting the examination.

2. The *mandatory experiences* are not being attempted in a number of centres. This was made very clear by students who answered questions based on the specific practical work with expressions such as:

   > *"We didn't do the experiment. We didn't do any experiments in Carbon Chemistry or Chemical Energy".*

   This is very disturbing. Since mandatory experiences are now included in the Syllabus, questions on those experiences can be asked in the examination.

3. Students need to give concise, relevant explanations instead of rambling answers. Spelling is important, especially in naming organic compounds.

4. For numerical answers, students are advised to show working and to round-off answers *at the end of the calculation* instead of *during the parts of* a calculation.

SECTION I : CORE

Part A

The multiple-choice questions were, on the whole, reasonably well answered. The following table gives, for each question, the percentage of candidates who chose each response. Brief comments on some of the questions are given below.

Question	% Response A	% Response B	% Response C	% Response D	% Omitted	% Multiple Answer
1	**78.68***	2.84	2.06	16.41	.02	.00
2	7.20	33.46	8.78	**50.49***	.06	.01
3	6.32	14.74	8.82	**69.98***	.14	.00
4	**91.34***	3.46	2.95	2.18	.05	.02
5	6.78	**55.97***	20.39	16.75	.10	.01
6	.49	.85	2.27	**96.36***	.02	.01
7	**54.10***	9.36	4.46	31.95	.12	.01
8	8.17	4.02	**80.11***	7.68	.02	.00
9	5.32	12.17	**74.35***	8.08	.08	.00
10	20.85	**20.53***	49.22	9.27	.11	.02
11	2.11	5.20	3.20	**89.42***	.07	.00
12	27.94	5.31	**56.24***	10.41	.08	.01
13	9.18	15.76	**69.65***	5.34	.07	.00
14	10.53	**53.63***	10.16	25.34	.32	.02
15	32.50	**37.64***	17.13	12.55	.16	.02

*** Correct response**

Question 2

The use of low pH is often confusing for students. This confusion was shown here, since a high percentage of candidates chose the incorrect option (B).

Question 5

This was not well answered, with many students having problems in interpreting structural diagrams of crystals. A number of candidates did not realise that iodine is diatomic and molecular.

Question 7

The surprisingly large number of candidates choosing response (D) probably reflects confusion between *atoms* and *ions* or that they did not read the word *atom*.

Question 10

It was disappointing that so few candidates chose the correct response. It is obvious that the chemical properties of weak and strong acids are poorly understood by most students.

Question 14

This question tested students' understanding of equilibrium. It was disturbing that 45% of the candidates did not fully understand this concept.

Question 15

This was a searching question which required a lot of mathematical manipulation. Those who chose (A) made one mistake and forgot that sulfuric acid contains two protons.

PART B

Question 16

(a) This question was based on a MANDATORY EXPERIENCE, the oxidation of alkanols.

(b) It was pleasing to see that a high proportion of students answered this question well. It was disturbing, however, that some were unable to give the observed results for the test.

Question 17

(a) and (b) Both parts were generally well answered. Most students indicated an understanding of the principles of equilibrium.

(c) This part was less well answered. Many candidates were unable to *describe* a colour change, such as getting darker.

Question 18

(a) This part was generally well answered, the most common mistake being failure to balance H_20.

(b) The more able students found no problem. Some candidates did not know how to start the question, and many did not realise that one species was in excess.

Question 19

(a) The majority of students understood the concept of the amphiprotic nature of the bicarbonate ion. Marks were lost when ionic equations were not used.

(b) A common error was the mistaken belief that H_30^+ and 0H are a conjugate pair.

Question 20

(a) Answers to this part were poor. The most common mistakes resulted from the use of incorrect formulae.

(b) Candidates had very few problems in handling this calculation.

Question 21

(a) This part proved difficult because of student confusion with scientific notation or their mistaking pH for pKa (which is not in the Syllabus). The concept of Ka and decreasing acid strength was not well understood by most candidates.

(b) In answering this part a number of students confused *ions* with *electrons*.

Question 22

All parts of this question were generally well answered. Some students did not relate their answers to colour change.

Question 23

(a) This part was poorly answered since few responses were concise. Many students discussed only one property, contradicted themselves, or showed a poor understanding of the bonding difference between NaCl and CCl_4.

(b) This was generally well understood, although scientific diagrams were poorly drawn.

Question 24

All parts were generally well answered. Common errors in part (a) included points that were incorrectly plotted, especially C_{10}, and in drawing a line of best fit.

(c) Here students often did not indicate the physical state for each species.

Question 25

(a) Answers to this question were poor. Many students did not realise that glycerol is 1,2,3-propantriol, as is stated in the Syllabus.

(b) Those who failed to name the functional group lost marks.

(c) This part was not answered well. Many students could not indicate how structure is related to boiling point.

PART C

Question 26

(a) (i) Many candidates found it difficult to answer this question fully, often referring only to graphite and not to methane.

(ii) Students generally answered this part better than the previous part (i).

(b) This was the best answered section of the question and many candidates showed a good understanding of polarity. Marks were lost by those who did not explain the difference between the solubilities of methane and methanol in water.

(c) Candidates found it difficult to score marks here. Common errors included:
- unbalanced equations,
- not knowing the correct formula for the carbonate ion,
- not giving a chemical equation.

Question 27

From the quality of answers it was obvious that there had been little practical experience in this area.

(a) Most knew the definition of a standard solution but were unable to express it clearly.

(b) The majority of candidates were unaware that sodium hydroxide reacts with carbon dioxide in air.

(c) Scientific diagrams of a 25.00 mL pipette were poor.

(d) Although mathematical errors were common, most candidates were able to calculate molarity,

Question 28

On the whole this question was well answered, with the majority of students showing that they were familiar with the general concept of reflux.

(a) The most common mistake was the failure to show **all** bonds.

(b) Most students were able to name the reagent. Care needs to be taken, especially when writing methan**o**l and/or methan**a**l.

(c) (i) The majority of students understood the reason for refluxing the mixture.

(ii) Scientific diagrams were very poor. Many students still confuse the apparatus used for *reflux* with that used for *distillation*.

Question 29

(a) This part was poorly answered. Many students failed to:

- use the stoichiometry of the reaction when calculating equilibrium concentrations, or
- failed to subtract calculated concentrations from initial concentrations.

(b) and (c) Both these parts were generally well done.

(d) This was poorly handled by the majority of the candidates. K **does** have units if the reactants and products have units. As is stated in the Syllabus, page 25, point 3(i) - *Equilibrium constant is expressed as a function of the molar concentrations of the reactants and products at equilibrium*. Following from this, K **must** have units.

It is apparent that, in preparing for the Core Topic **Equilibrium**, candidates need to note not only changes from the previous Syllabus but also the depth of treatment required for this topic.

Question 30

This question was bimodal with the most common marks awarded being 4, 5, 0. Students were penalised for:

incorrect spelling, especially when naming the specific products in (b);

not recognising the fact that the reagent used in part (c) must be acidified.

Question 31

Many students were unable to explain the term *coordinate covalent bond*. This appeared to indicate that the latest Syllabus on which the HSC examination was based was not always used.

(a) and (b) Both parts were generally handled well. In part (b), however, it would have helped students if they had included a chemical equation as part of their answer.

(c) Although candidates included an equation with their answers, changes were often forgotten. Many wrongly included [H_20] as part of their equilibrium reaction. It is important that students show **all** working so that maximum marks can be awarded.

(d) Answers to this part were very poor.

SECTION II : ELECTIVES

The approximate percentages of candidates attempting each elective was:

Question 32	:	55%
Question 33	:	36%
Question 34	:	7%
Question 35	:	2%

A question concerning a mandatory experience was asked in each elective. Many students, however, gave responses such as:

"We didn't do this experiment".
"Haven't done the experiments".
"Didn't do many experiments at all".

The above responses were given by many who were marked out of **19** instead of **25** because they could not answer the question related to the mandatory practical experience.

Question 32 : Chemical Energy

(a) (i) and (ii) Both these parts were well answered. Common errors in calculating included:

- incorrect units
- excessive rounding off
- transcription errors.

(b) (i) Several misconceptions were evident in this part, including:

- production of CO_2 is <u>not</u> harmful to the atmosphere
- ethanol always completely combusts.

(ii) This part was answered well.

(c) Those familiar with the MANDATORY EXPERIENCE generally answered the question well. Some, however, answered the question by stating:

> *"We didn't do the experiment. We didn't do any in Carbon Chemistry or Chemical Energy"*

(i) A number of students could not identify a common fuel used in the laboratory.

(ii) Common errors included:

- use of a bunsen burner instead of a spirit burner
- using a gaseous fuel in a spirit burner
- not including a thermometer.

(iii) This part was well answered.

(iv) Very few students successfully gave TWO sources of error.

(d) (i) This was very poorly done, although the equation is stated in the Core.

(ii) The equation $\Delta H = m \times Cg \times \Delta T$ seemed to be well known, but its application was poor. The main problem concerned the correct use of *mass*. Students must realise that the mass is related to the specific heat capacity.

(iii) Most students who answered point (ii) correctly had little difficulty with this part.

(e) (i) and (ii) Both parts were generally well answered, although some students did not realise that hydrogen is diatomic.

(f) The concept of bonds broken being endothermic and bonds formed being exothermic was not well understood by many candidates.

(g) (i) This part was generally well answered, although many candidates did not realise that the energy change involved ONE MOLE of the substance.

(ii) Many students were unable to answer this question correctly. Most lost marks because of poor expression.

(iii) This part was answered well.

Question 33 : Oxidation and Reduction

(a) (i) The majority of students were able to name two metals correctly. Marks were lost if active metals were chosen that reacted with water or non-metals.

(ii) This part was generally answered well. Students lost marks if they did not clearly indicate the flow of cations and anions through the salt bridge.

(iii) This part was generally well answered.

(b) (i) Answers here were poor. Students should identify Ba^{2+} as the formula, not just write the half equation.

(ii) This part was, on the whole, well answered.

(iii) Attempts to answer this were poor. Most students failed to state clearly whether they were referring to solid atoms (in the metal) or gold ions (in the compound).

(c) (i) The majority of candidates showed a clear understanding of electron transfer from the Mg/Zn to the pipe. Terms such as *more reactive than, sacrificial anode* were used appropriately. There was some confusion over the term *oxidants* with about 10% of candidates indicating that Mg/Zn were better oxidants than iron.

Those who used potentials in their explanation were often unsure about whether the Mg/Zn had higher or lower potential as indicated by the table.

(ii) The various categories of protection were well understood. A number of candidates inadequately explained exactly how rust is prevented by the specific methods indicated. Some impractical methods were included, e.g. *greasing, oiling, coating with gold, using something else instead.*

Most recognised that oxygen and moisture play an active role in the rusting process.

(d) (i) A majority recognised that a reduction half equation was required for the cathode reaction. The most common errors included incorrect valency of the copper ion.

(ii) A minority of students wrote the correct oxidation half equation. A substantial number were distracted by the half-equation involving the sulfate ion in the table (immediately adjacent to the correct copper half-equation).

(iii) Addition of half-cell potentials was handled well and, where a negative answer was obtained, conversion to a positive answer followed. Those whose calculations resulted in a positive answer, however, almost always failed to realise that this indicated a spontaneous reaction which was inconsistent with the expected result for an electrolytic cell.

About 20% of candidates obtained the correct answer of 0.88v but very few indicated that the voltage needed to exceed this value before the cell would operate.

(iv) A majority understood that a colour change would occur, that copper sulfate was blue and that the colour would fade. Many used the word *clear*, which was not really appropriate, and a small number talked about the solution *turning brown*. A substantial amount (about 15%) failed to indicate that change involves "from ... to ...".

(v) This was very well answered. A few thought that platinum was a catalyst.

(e) (i) The common answers were S^{2-} , H_2S and S with some evidence of confusion over the wording of the question. *Chromate ion* was a common error.

(ii) The concept of oxidation yielding electrons and reduction through using them was well understood. An appropriate oxidation half-reaction was common here if part (i) were correct.

(iii) Only about 20% of candidates were able to balance the quite complex reduction half equation correctly. A common error was to use oxidation numbers to generate ions. So Cr^{6+} became Cr^{3+} .

(iv) Most candidates made a sound attempt to add together the half equations by eliminating electrons. A small number failed to gather like terms and careless transcription was common.

Question 34 : Biological Chemistry

(a) (i) This was well answered.

(ii) Many students did not realise that the two compounds I and II are isomers of each other.

(b) Answers here were good.

(c) (i) The majority of candidates did not give an equation but did give a correct structure. About 30% failed to show that water is a by-product.

(ii) Although 70% named the disulfate bond, their explanations were poor.

(iii) About 60% identified a change in shape or active site. Others did not explain how denaturing affected the structure.

(d) Responses here indicated that most candidates had first-hand experience with the practical work and many obtained good marks for their responses.

(e) (i) This was well answered.

(ii) A number of candidates confused the two stages of photosynthesis. Many had a poor understanding of the *carbon fixation process* (or *dark reaction*) as applied to photosynthesis.

(iii) Many candidates did not explain the process of photosynthesis in **chemical terms** but in biological terms. This lost them marks.

(f) (i) On the whole this was well answered.

(ii) Many students did not have a clear understanding of the **chemistry** of the Kreb's Cycle.

(iii) Answers to this part were good.

(g) (i) and (ii) Both parts were generally well answered.

(iii) Answers here were poor. Very few candidates were able to calculate the mass successfully by using maltose (C_{12} H_{22} O_{11}).

Question 35 : Chemistry and the Environment

(a) Answers to this part were reasonably good. Many students, however, did not include drying the residue of the dissolved solids before weighing.

(b) (i) Very few students used information given for sea water in explaining their choices for X and Y.

(ii) A small number of candidates appeared to have carried out practical testing for halide ions. About half of the candidature were able to describe a test for a metal ion.

(c) Answers to this part were good.

(d) This part was not well answered. Students must answer such questions in chemical terms **NOT** biological terms.

(e) Many students did not write a correctly balanced equation and, therefore, could not calculate the mass of CaO.

(f) (i) Explanations here were unsatisfactory. Many candidates answered this question only superficially.

(ii)
(iii)
All parts were well answered.
and
(iv)

(v) This was another poorly answered part. Most students did not know how uranium is extracted from *yellow cake.*

(g) Here all parts were generally well answered.