C A R I B B E A N E X A M I N A T I O N S C O U N C I L
HEADQUARTERS

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION

MAY/JUNE 2010

CHEMISTRY
GENERAL PROFICIENCY

GENERAL COMMENTS

This year marked the first sitting of the CSEC Chemistry examination with the new format for Paper 02. Paper 02 now has six compulsory questions instead of five (Question 1 – Question 5) and one optional question (Question 6 or Question 7). Questions 1 - 3 were structured items and 4 - 6 were extended essays. Question 6 was based on Section C of the syllabus – Chemistry Involved in Cooking. There was no change to Paper 01.

Several candidates did very well on the examination scoring full marks on several of the questions. However, while it is clear that a relatively small number of candidates have done fairly well on this examination, it is also clear that too many continue to perform way below the required standard. In many instances, questions that require straight recall of definitions proved to be difficult for students as responses were vague or inaccurate. Much of the inaccuracy arose from the confusion of terms which sound alike or have things in common. This suggests that enough care is not given to differentiating and clarifying concepts as candidates prepare for these examinations. Some topics such as writing and balancing equations, organic chemistry, and solving mole-related problems continue to pose significant challenges for several candidates.

DETAILED COMMENTS

Paper 01 – Multiple Choice

This paper tested Sections A and B of the syllabus in the profile, Knowledge and Comprehension. Performance on this paper continues to be steady and satisfactory. The marks ranged from 0 - 60.

The mean score was 57.5 per cent and the standard deviation was 11.14.

The candidates experienced the most challenge with the item based on the following objective:

- A. 6.26 – the approximate value of the Faraday constant.

The best performances were on:

- A 1.2 – the differences between the three states of matter in terms of energy and management of particles.
- A 2.8 – the classification of elements in the periodic table based on atomic numbers, atomic structure and oxidation state.

Paper 02 – Structured Essay

<u>Question 1</u>

Syllabus References: A: 3.4,7.2, 7.3, 7.4, 8.2; B2: 7.1, 7.2, 7.3

Part (a)

In this part of the question, candidates were required to (i) identify the labels on an energy profile diagram which showed a catalyzed and an uncatalyzed pathway of an exothermic reaction, (ii) plot a graph of the volume of oxygen (at RTP) against time using the given data for the decomposition of hydrogen peroxide, (iii) write a balanced equation to show the catalytic decomposition of hydrogen peroxide, (iv) compare the candidate's graph with one that was already plotted, and account for the differences between the two (v) read the volume of oxygen at a given time, and calculate the number of moles of oxygen in the volume, making use of the molar volume at RTP.

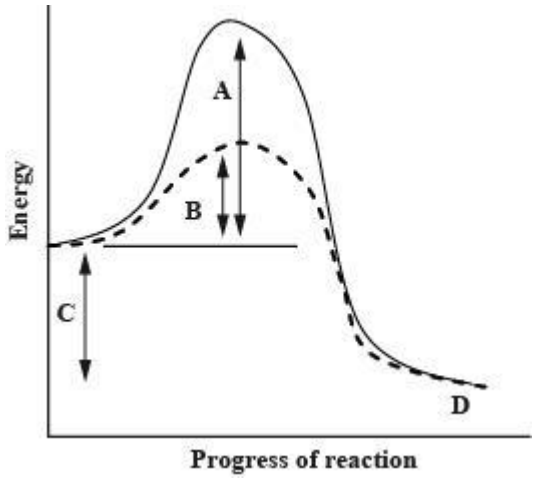
Candidates' Performance

Many candidates identified the 'product' on the figure of the reaction profile, but did not distinguish between the activation energy of the catalyzed and uncatalyzed pathways, and did not identify the difference between the energy of the reactant and the product as the 'enthalpy change' of the reaction. Some candidates wrote 'enthalpy' instead of 'enthalpy change'. Many candidates gave the correct equation for the catalytic decomposition of hydrogen peroxide going to water and oxygen gas, but some incorrectly had the manganese dioxide taking part in the reaction and undergoing a chemical change. Most candidates scored the maximum 3 XS marks for correctly plotting the six points on the graph. The majority of the candidates correctly indicated that Jonathan's experiment produced more oxygen, and at a faster rate, than Karen's experiment. However, most did not link the higher rate of production of oxygen gas to the higher concentration of hydrogen peroxide used in Jonathan's experiment. The vast majority of candidates correctly read the volume of oxygen at 45 seconds in Karen's experiment as 8 cm^3.

Part (a) (i)

Expected Responses

The correct labels for the energy profile diagram are listed below the diagram.



A: Uncatalyzed activation energy
B: Catalyzed activation energy
C: Enthalpy change
D: Products

Part (a) (ii)

Expected Responses

The balanced equation for the catalytic decomposition of hydrogen peroxide, using manganese dioxide, MnO_2, as catalyst is:

$$2\ H_2O_2(l) \xrightarrow{MnO_2} 2\ H_2O(l) + O_2(g)$$

A catalyst, in this case manganese dioxide, remains chemically unchanged at the end of a reaction. The formula of the catalyst should be written over the arrow to recognize its presence during the reaction.

Part (a) (iii)

Candidates' Performance

Common errors in plotting points on the graph included:

- Plotting the points in ink
- Using a pencil with a blunt point
- Not encircling or intersecting points clearly

Part (iv)

Candidates' Performance

This part of the question proved to be the most challenging for the candidates. A large number of candidates were not able to interpret the difference between the slopes of the TWO plots, and did not relate the increased slope in Jonathan's plot to the increase in concentration of hydrogen peroxide.

Common Incorrect Responses

Many candidates referred to an increase in the "amount" instead of an increase in the "concentration" of hydrogen peroxide, and did not link the increase in rate of reaction to the increase in the number of collisions between reactant molecules. Some of the incorrect responses included:

- Jonathan's experiment was performed with a catalyst and Karen's experiment was not.

Expected Responses

The slope of Jonathan's graph is steeper (greater) than Karen's, or, Jonathan's reaction is faster than Karen's. More oxygen is produced for Jonathan's reaction. The faster rate of reaction in Jonathan's experiment is due to the increased concentration of hydrogen peroxide.

Part (a) (v) (b)

Candidates' Performance

Many candidates did not recognize that the question was making reference to the volume of oxygen (8 cm^3) that was read from Karen's graph, while a number of candidates had difficulty converting from cm^3 to dm^3 or *vice versa*. TWO common errors, when calculating the number of moles of oxygen, was using the relative atomic mass (R.A.M) of oxygen and/or using the concentration of the 0.04 mol dm^{-3}.

Expected Responses

The correct volume of oxygen gas from the graph is 8 cm^3, and the molar volume of a gas at RTP was given as 24 dm^3. The correct calculation of the number of moles of oxygen, requires either the conversion of the volume of oxygen to dm^3, or the molar volume to cm^3.

$1000\ cm^3 = 1\ dm^3$

Therefore, $1\ cm^3 = (1/1000) = 0.001\ dm^3$

Therefore, $8\ cm^3 = 8 \times (1/1000)\ dm^3 = 8 \times 0.001 = 0.008\ dm^3$

Since, 24 dm^3 contain 1 mole of oxygen gas at RTP

Then, 1 dm^3 would contain (1/24) moles of oxygen

Therefore, 0.008 dm^3 would contain $0.008 \times (1/24)$ moles = 0.00033 moles = 3.3×10^{-4} moles

Part (b)

Candidates were tested on qualitative analysis in this part of the question.

Candidates' Performance

This part was very poorly done, and probably reflects the under-preparation of the candidates, or the candidates' unfamiliarity with the required range of tests in qualitative analysis.

TEST 1: The majority of candidates did not identify the brown gas as nitrogen dioxide. The given observation was "brown gas which turns moist blue litmus red".

Common Incorrect Responses

- NO_2^- ions, NO ions
- Bromine gas
- Nitrogen gas

Expected Responses

The award of the 1 UK mark required one correct inference which could be one of the following:

- Acidic gas
- Nitrate (NO_3^-) present
- Nitrogen dioxide gas, $NO_2(g)$

TEST 2: The majority of candidates were not able to recognize that a precipitate of silver iodide would be formed by the addition of a solution containing silver ions to a solution that contains iodide ions. The given test "acidified silver nitrate is added to a solution of X, and aqueous ammonia is added until in excess".

Common Incorrect Responses

- White precipitate, insoluble in excess
- White precipitate, soluble in excess

Expected Responses

The award of the 2 XS marks required candidates to state that the observation would be "a <u>yellow precipitate</u>, <u>insoluble</u> in excess aqueous ammonia".
TEST 3: The test and observation were "aqueous lead nitrate is added to a solution of X" and "a bright yellow precipitate forms", respectively. An ionic equation was required for the 2 UK marks. Many candidates wrote some compound with both lead and iodide present but very few candidates had the correct, balanced, ionic equation.

Common Incorrect Responses

- $Pb^+ + I \rightarrow PbI$
- $Pb^{2+} + I \rightarrow PbI_2$

Expected Responses

The correct balanced equation is:

$$Pb^{2+}(aq) + 2\,I^-(aq) \rightarrow PbI_2(s)$$

Part (c)

This part tested the candidates' ability to plan and design an experiment to compare the effects of the catalysts, manganese (IV) oxide and catalase, on the rate of decomposition of hydrogen peroxide. Candidates were required to draw a clearly labelled diagram of a suitable experimental arrangement and state two variables that should be controlled during the experiment.

Candidates' Performance

In general, diagrams were poorly drawn, which could be due to insufficient practice at drawing pieces of chemical apparatus and a 'set-up'. There was a general lack of an appreciation of metal oxides as being solids. The majority of candidates did not include catalase in the experimental set-up. Many candidates gave precautions or named responding variables, instead of the TWO variables to be controlled.

Common Incorrect Responses

Manganese (IV) oxide was represented as a liquid or a solution, which was being added from a burette or a pipette, into a solution of hydrogen peroxide.

Expected Responses

Suitable diagrams should allow for the generation and measurement of the volume of oxygen gas. The effect of the two different catalysts could be compared if

(i) the time is noted for a fixed volume of oxygen to be collected, and the shorter time would reflect the faster rate and hence the more effective catalyst, or
(ii) the volume of oxygen collected in a given time is noted, and the larger volume would reflect the more effective catalyst.

In both cases, the controlled variables would be temperature, concentration of hydrogen peroxide, volume of hydrogen peroxide. In (i) volume would be controlled, and in (ii) time would be controlled.

N.B. Both volume and time cannot be controlled simultaneously.

<u>Question 2</u>

Syllabus References: A: 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 4.1, 4.2, 4.3; B2: 4.1)

This question tested candidates' understanding of periodicity, reactions of metals, isotopes and radioisotopes, radioactivity and chemical bonding. All candidates attempted this question. The mode was 6 and the mean score was 5.5 out of 15, with 32 per cent of the candidates scoring 8 or more.

Part (a) (i)

Candidates' Performance

In this part, two incorrect statements were given and candidates were required to give the corrected version with reason(s). Most candidates were able to give the answer in terms of electronic configuration (EC) of the elements. However, some categorized the elements into two separate groups such as metals and non-metals. Some wrote the incorrect EC for the elements or omitted the EC of some and so could not be awarded the mark. It was noticed that many candidates used the incorrect terms, for example, 'atoms' or 'elements' in place of 'electrons' in the outer shell.

Expected Responses

Correct statement: The elements sodium to chlorine are in the same period of the periodic table, **OR**, the elements sodium to chlorine are not in the same group of the periodic table.

Reason: Elements in the same period have the same number of occupied energy levels (shells), **OR**, they have different numbers of electrons in their outer shells.

Part (a) (ii)

Candidates' Performance

This part was poorly done. Many candidates wrote that Mg was lower than Cu in the reactivity series or that copper was more reactive than Mg. Many did not state that metals were reducing agents and so answered in terms of which metal was a better oxidizing agent. Mg was compared to Zn instead of Mg to Cu as required. Very few candidates spoke of the electropositivity of Mg. Many also conceived the reactivity series to be the same as the periodic table.

Common Incorrect Responses

Most candidates simply changed around the names of the metals and gave this **incorrect** response:

- Of the elements magnesium and copper, copper will more readily **oxidize** an aqueous solution of zinc ions than magnesium would.

Expected Responses

Correct statement: Of the elements magnesium and copper, magnesium will more readily **reduce** an aqueous solution of zinc ions than copper.

Reason: Magnesium and copper are metals or reducing agents. Magnesium, being more electropositive, is the stronger reducing agent.

Part (b) (i)

Candidates' Performance

Candidates should be encouraged to read the questions carefully as this question specifically stated that the products of the reaction were a hydroxide and hydrogen gas, yet many wrote the products to be the oxide and hydrogen. Some displayed a lack of understanding of when to use atoms or ions although they were told to write a chemical equation and not an ionic equation. Some wrote the hydrogen molecule as H and some did not balance the equation. State symbols were often missing.

Common Incorrect Response

- $P + H_2O \rightarrow POH + H$

Expected Response

The correct equation for the reaction of the group one element P is

- $2P(s) + H_2O(l) \rightarrow 2POH(aq) + H_2(g)$

Part (b) (ii)

Candidates' Performance

Many candidates did not notice that P and Q were isotopes. Instead they spoke of P and Q as being metals in the same group, even though the question stated that P and Q had the same electronic configuration (2, 8, 1). Some candidates spoke of P and Q as having the same valence shell, which is simply another way of saying they are in the same group. Many candidates failed to make the connection between isotopes having the same chemical properties and so would have the same products in their reaction with water. Some used the words 'allotropes', 'isomers' or 'isotropes' instead of isotopes.

Expected Responses

P and Q are isotopes. Isotopes have the same chemical properties.

Part (b) (iii)

Candidates' Performance

Many candidates simply stated that 'radioactive' meant 'unstable nuclei' not adding that these must split to emit α, β or γ radiation. Some stated that radioactive meant reactive or unstable which is an inadequate answer.

Expected Response

Radioactive substances spontaneously emit small particles in order to become stable.

Part (b) (iv)

Candidates' Performance

A wide range of responses was given and most candidates were able to correctly state two uses of radioactive materials. The most popular responses included cancer treatment, tracers, blood flow and photosynthesis research.

Common Incorrect Responses

- Used in the sterilization of food
- Used for x-rays
- Used in photocopying machines
- Used in fertilizers

Part (c)

Candidates' Performance

Many candidates seemed to confuse 'ionic bonding' and 'covalent bonding'. Some candidates drew two diagrams depicting both ionic and covalent bonding. Some candidates started off with a diagram that correctly depicted the electron transfer then incorrectly showed sharing of electrons in the product. Many candidates drew the incorrect ion for Q. Others drew only one atom of Q, instead of two atoms of Q, donating one electron to the oxygen. Too many candidates incorrectly gave the electronic configuration of oxygen as 2,8,6 instead of 2,6. Many did not draw proper arrows depicting electron transfer and omitted the charges on the ions.

Question 3

Syllabus References: B1: 1.3, 1.6, 1.7, 1.8, 1.9, 2.7,

This question was not well done. The mean mark was 4.4 out of 15 with 0, 1 and 2 being the most frequent scores. Only 21 per cent of the candidates scored 8 or more. This question tested candidates' ability to recall scientific definitions, make two-dimensional representation of organic molecules, and identify the conditions (or reagents) in THREE organic reactions of ethanol.

Part (a) (i)

Candidates were required to define 'structural isomerism'.

Candidates' Performance

This part was generally well done. While most candidates understood that it involved 'same structural formula' and 'different molecular formula', many were unable to state what possessed these characteristics, and cited 'elements', 'atoms' and 'substances' in the definition. Frequently, candidates equated 'similar' with 'same'.

Expected Responses

Compounds which have the same molecular formula, but have different arrangement of atoms are said to display 'structural isomerism'.

Parts (a) (ii) and (iii)

In Part (ii), candidates were required to draw fully displayed structures of but-1-ene and but-2-ene, two isomers of butene, and draw and name one other structural isomer of C_4H_8 in Part (iii).

Candidates' Performance

While some candidates were able to draw the correct structures, this presented a challenge to most candidates. Some candidates did not associate the prefix in **but**-1-ene with FOUR carbon atoms, and **incorrectly** drew structures with three or five carbons. Many of the incorrectly drawn structures had carbon atoms with five bonds instead of four bonds.

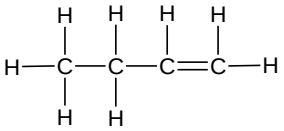
Common Incorrect Responses

A common **incorrect** name for the other structural isomer of C_4H_8 was **but-3-ene**, where candidates changed the backbone of the molecule from C=C-C-C to C-C-C=C, not realizing that it resulted in the same molecular structure of but-1-ene.

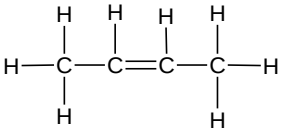
Some of the candidates, who were able to draw the correct structure of the other structural isomer, 2-methylpropene, gave **incorrect** names which included:

- methylpropane
- methylbutane
- 1-methylpropene

Expected Responses

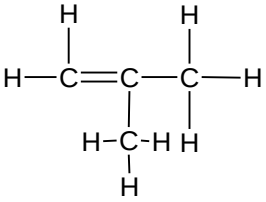


but-1-ene

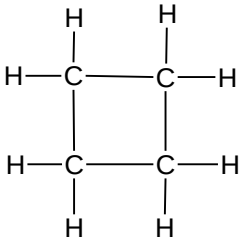


but-2-ene

There are TWO other possible structural isomers of C_4H_8:



2-methylpropene



cyclobutane

Part (a) (iv)

Candidates' Performance

This part was generally well done, but some candidates confused 'chemical property' with 'physical property'.

Common Incorrect Responses

- Burns with a sooty flame
- Liquid at room temperature
- High melting point, high boiling point
- Unsaturated
- Has double bonds

Expected Responses

Any one of the following physical properties was awarded the 1 KC mark – colourless gas, odourless gas, gas at room temperature, low melting point, low boiling point, soluble in non-polar solvents.

Part (b) (i)

Candidates were required to state what is meant by a 'functional group'.

Candidates' Performance

Many candidates were able to give a correct statement. However, the word 'group' caused some candidates to give responses which related to groups of the periodic table, and homologous groups.

Common Incorrect Responses

- Members of the same homologous series
- Functional group is alkanes, alkenes etc

Expected Responses

A 'functional group' is an atom or group of atoms in an organic compound whose reactions determine its overall chemical properties.

Part (b) (ii)

Candidates were required to give (a) the reagents and conditions, and (b) the fully displayed structures of the product for reactions of the conversion of ethanol to ethene, ethanoic acid and an ethyl ester.

Students' Performance

This part of the question was poorly done. In Section (a), many candidates had the correct reagents and conditions (conc. H_2SO_4, 170 ^oC; or conc. H_3PO_4) for the dehydration of ethanol to form ethene, and the majority of candidates gained the mark for the structure of ethane.

The oxidation of ethanol to ethanoic acid, posed a challenge for most candidates. Some candidates, recognized that this was an oxidation reaction, and simply wrote '[O]' instead of acidified potassium permanganate (VII) or acidified potassium dichromate (VI).

The conversion of ethanol to an ethyl ester was also challenging for the majority of the candidates. Some candidates had one of the reagents (conc. H_2SO_4) but did not have a carboxylic acid. In most cases, the partially displayed structure was written.

Question 4

Syllabus References: A: 6.8, 6.13, 6.14, 6.15, 6.16; B1: 3.4

This question tested candidates' understanding of redox (reduction-oxidation) reactions and the fermentation process.

Part (a) (i)

Candidates were required to identify both the reducing and oxidizing agents in a given equation, and explain their choices.

Eqn: $MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O$

Candidates' Performance

While many candidates were able to describe what happens during reduction and oxidation, some were unable to identify correctly the reducing and oxidizing agents.

Common Incorrect Responses

- MnO_4^- was the reducing/oxidizing agent because there was an increase from a negative charge to a positive charge (Mn^{2+}).
- Fe^{2+} was a metal and hence was a reducing agent.
- $Fe^{2+} \rightarrow Fe^{3+}$: The increase in oxidation number resulted from electron gain.
- Fe^{2+} was a reducing agent or an oxidizing agent.
- H^+ was the oxidizing/reducing agent.

Expected Responses

$Fe^{2+}(aq)$ is the reducing agent – The oxidation number on Fe increases from 2+ to 3+. It undergoes electron loss.

$MnO_4^-(aq)$ is the oxidizing agent – The oxidation number on Mn decreases from 7+ to 2+. It undergoes electron gain.

Parts (a) (ii) and (iii)

Candidates were required to write a balanced equation for the reaction of iron (II) oxide with dilute sulphuric acid, state whether the reaction was acid-base or redox, and explain their choice.

Candidates' Performance

Many candidates were unable to write the correct formula for iron (II) oxide as FeO. Several, incorrectly, had hydrogen gas as a reaction product. Still, many candidates correctly stated that the reaction was acid-base, since an acid and a base reacted to produce a salt and water. Some candidates stated that since the reaction was not redox, then it was acid-base. They were awarded the marks.

Common Incorrect Responses

Incorrect formulae for iron (II) oxide, such as Fe_2O, FeO_2, Fe_2O_3 and IO, were given instead of FeO.
The lack of understanding of redox chemistry, contributed to candidates calculating wrong oxidation states and so incorrectly inferred that the reaction was redox.

Expected Responses

Correct equation: $FeO(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2O$
The reaction is acid-base. A basic oxide (base) and an acid reacted to produce salt and water.

Parts (b) (i), (ii) and (iii)

Candidates were required to state what was meant by 'fermentation' as it relates to the manufacture of rum, write an equation for the fermentation process, and give with reason, one material that could be used to produce wine by fermentation.

Candidates' Performance

The majority of candidates indicated that the anaerobic respiration of yeast was essential, and that the products were ethanol and carbon dioxide. However, many candidates did not mention the importance of sugars as the starting material, and they were penalized for this omission.

The equation for fermentation, reflected unfamiliarity with the formulae of glucose and ethanol, and sometimes water was incorrectly included as either reactant or product. Several candidates had the correct reactants and products, but the equation was unbalanced.
The majority of candidates gave a correct material, usually a fruit source, for wine making although many did not indicate that the sugar content was the important factor for fermentation.

Common Incorrect Responses

Most of the incorrect responses for a material for making wine included the use of a flavouring agent (for example, pimento, and hibiscus) instead of a fruit source with high sugar content.

Expected Responses

Fermentation is the conversion of sugars (in molasses) into smaller molecules like ethanol and carbon dioxide, by the anaerobic respiration of yeast.

Equation: $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (An enzyme is placed over the arrow)

Any suitable fruit source that has reasonably high sugar content, for example, bananas, grapes, cherries may be used.

Question 5

Syllabus References: B2: 2.2, 5.1, 5.2, 8.1

The question tested candidates' knowledge of the extraction of iron from its ore using a blast furnace, the uses of iron and its alloys and the function and importance of iron in blood. Ninety-five per cent of the candidates attempted this question. The mean mark obtained for this question was 5.2 (out of 15).

Part (a)

Candidates' Performance

Approximately 60 per cent of the candidates were unable to give a correct formula for the iron ore – Fe_2O_3. Many candidates knew the name of the ore but were unable to write its formula.

Common Incorrect Responses

FeO, Fe_3O_2 and FeO_2

Expected Responses

Hematite, Fe_2O_3; magnetite, Fe_3O_4; siderite, $FeCO_3$ or Fe_2S_3 (1 KC mark)

Part (b)

Candidates' Performance

Most candidates who attempted this question, omitted Part (b) and many of those who described the process did not give the correct balanced equations. In addition, many candidates erroneously wrote carbon dioxide reacting *with oxygen* (instead of carbon) to give carbon monoxide. Some of the better responses included the formation of slag (but were not awarded any marks). Some candidates used the process of electrolysis for the extraction of iron from its ore but only a few explained the process properly. Consequently, they gained very little marks because they failed to state the types of electrodes used as well as the correct electrolyte. The relevant equation(s) for this process proved to be challenging for the candidates.

Common Incorrect Responses

- Carbon dioxide reacts with oxygen to give carbon monoxide.

Expected Responses

The three steps are:

- Coke is burned in air to produce carbon dioxide.

  $C(s) + O_2(g) \rightarrow CO_2(g)$

- Carbon dioxide is reduced by coke to form more carbon monoxide.

  $C(s) + CO_2(g) \rightarrow 2CO(g)$

- Carbon monoxide reduces the iron ore, forming iron and carbon dioxide.

  $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$

  Or

  $Fe_3O_4(s) + 4CO(g) \rightarrow 3Fe(l) + 4CO_2(g)$

Part (c)

Candidates' performance

Most candidates gained at least one KC mark for stating that iron rusts. However, some candidates confused the terms "corrosive" and "corrosion".

Common Incorrect Responses

A few candidates incorrectly noted that stainless steel is a better conductor of heat than iron (a common misconception), and that it is not as easily stained as the name suggested.

Expected Responses

Stainless steel

- is more rust resistant
- is stronger
- is more attractive
- reduces the transfer of iron to our bodies.

Part (d)

Nearly all the candidates who attempted this question gave a correct use of iron and were awarded the allotted 1KC mark.

Part (e)

The majority of candidates who attempted this question gained the 1 mark for correctly stating the name of the iron compound found in the blood, but spelling of the word **haemoglobin** was challenging for many. While some candidates received the 2 marks for correctly stating the effect of a lack of iron in the blood, most obtained at least 1 mark.

Expected Responses

The lack of iron may cause:

- Less oxygen to be transported
- Tiredness or fatigue
- Anaemia

Question 6

Syllabus References: C1: 1.1, 1.2, 1.5, 1.6, 1.7, 1.9

This question tested candidates' knowledge of the chemistry of cooking, more specifically, the effect of heat on egg whites, the tenderizing of meat by enzymes and the pressure cooker, and the effect of heat on vitamin C. Ninety-six per cent of the candidates attempted this question. The modal score for this question was 8, and a mean score of 8.4, out of a maximum 15 marks. Sixty per cent of the candidates had a score of 8 or higher.

Part (a)

Candidates' Performance

The majority of candidates were able to give two reasons for cooking food before consumption.

Expected Responses

- Destroys harmful organisms
- Improves digestibility
- Improves appearance
- Improves flavour

Part (b) (i)

Candidates' Performance

The majority of candidates were able to describe the changes that occurred when egg white is heated.

Common Incorrect Responses

Some candidates described the whole, cooked egg as a yellow ball surrounded by a white layer, instead of describing the whites. This type of response was awarded no credit. Other incorrect responses described the cooked egg white as:

- Cloudy
- Milky
- Gel-like
- Plastic-like

Expected Responses

Egg white changes from clear to an opaque, white solid.

Part (b) (ii)

Candidates' Performance

Many candidates were able to state correctly that heat caused egg white to undergo denaturation or coagulation or loss of solubility.

Common Incorrect Responses

- Heat destroyed the protein.
- Heat killed the protein.

Part (c) (i)

Candidates' Performance

Most candidates were able to infer correctly that cooking meat would take longer if neither the pineapple nor a pressure cooker were used.

Part (c) (ii)

Candidates' Performance

Most candidates were unable to explain the principles involved in the functioning of the pressure cooker. Some candidates did not understand the meaning of 'principles' and gave instructions on how to use a pressure cooker.

Common Incorrect Responses

- Air (gas) is prevented from escaping.
- The seal prevents the escape of pressure.
- Heating the closed container creates a pressure.
- There is an increase in atmospheric pressure.
- The heat is locked in.
- There is a build-up of heat.
- The steam passes through the meat.

Expected Responses

The **steam** is trapped and prevented from escaping. This causes an **increase** in pressure inside the pressure cooker, which causes an increase in boiling point of the water, which allows the food to be cooked in a shorter time.

Part (c) (iii)

Candidates' Performance

Most candidates were able to state TWO benefits of using a pressure cooker. These include, reducing cooking time, saving energy, and tenderizing foods faster.

Part (c) (iv)

Candidates' Performance

Candidates performed poorly on this part of the question. Only a small number of candidates correctly identified the enzyme in pineapple as bromelin. Fewer still were able to correctly explain that this enzyme

hydrolyses the amide bonds in protein – stating instead that '*it increased the rate of the reaction*' or '*it loosens the bonds in collagen*'. Very few candidates were able to correctly state that, in a pressure cooker, the heat causes the insoluble collagen in the connective tissue to be converted into soluble gelatin thereby softening the texture of the meat. The responses which suggest that the use of the pineapple is a chemical reaction while the use of the pressure cooker is a physical or mechanical reaction received no credit.

Common Incorrect Responses

- Pineapple adds flavour.
- The enzyme *bromelin* was incorrectly referred to as *papain*, *pepsin*, *pectin*, *bromine*.

Expected Responses

Enzymes in the pineapple break the longer meat fibres into smaller ones, making the fibre more soluble. Pressure cookers tenderize meat by converting the insoluble collagen in the meat to soluble gelatine.

Part (c) (v)

Students' Performance

Most candidates were able to obtain one mark for stating that heat causes the oxidation or decomposition or destruction of vitamin C. Very few candidates were able to obtain the second mark for stating that the rate of oxidation or destruction of vitamin C increased with increasing temperature.

Common Incorrect Responses

Heat kills vitamin C.

Paper 03/1 - School-based Assessment (SBA)

GENERAL COMMENTS

There were some centres which showed improvement in many areas. However, there were still a few centres which presented significant problems for moderation. The main problems were:

1. Inadequate marking schemes were submitted.

2. Laboratory exercises tested objectives from other disciplines such as Biology and Integrated Science. This occurred in the assessment of the PD skill.

3. AI skills were assessed as ORR skills and ORR skills as AI.

4. The marking of laboratory notebooks was incomplete.

5. One activity was assessed for more than 2 skills.

6. The mark schemes were not <u>synchronized</u> with all the laboratory notebooks from a centre, especially in centres where there is more than one teacher. Teachers are encouraged to collaborate and use common mark schemes.

<u>Mark Schemes</u>

There were a few schools with very good and detailed mark schemes, but more than 50 per cent of those submitted were inappropriate for at least one of the skills moderated.

Planning and Design Skills

Of the centres assessed for this skill, 64 per cent of them were good or very good, while 36 per cent were unsatisfactory.

Analysis & Interpretation Skills

Of the centres assessed for this skill, 81 per cent of them were good or very good, while 19 per cent were unsatisfactory.

Use of Equations

Of the centres assessed, 78 per cent presented samples where equations were used satisfactorily.

Emphasis on Graph Work

Of the centres assessed, 72 per cent placed satisfactory emphasis on the use of graphs, that is, at least three or more graphs were used over the two years.

Standard of Practical

Of the centres assessed, 100 per cent of the presented samples were of a satisfactory standard. However, teachers are still having difficulty assessing PD according to CXC standard.

Reminders

1. CXC does not award ½ marks.

2. A minimum of 2 laboratory assignments should be assessed for each skill per year.

3. All laboratory assignments should be numbered, dated and listed in the Table of Content.

4. All laboratory assignments, whether being assessed for SBA or not, should be corrected so that students can benefit from the corrections.

5. Skills assessed for various laboratory assignments in the students' books should match those highlighted in the mark schemes.

6. Mark schemes should be explicit and unambiguous, that is, marks should not be lumped, but each should be assigned to a specific content area.

7. In qualitative analysis, the mark schemes should include the names of the unknowns as well as the expected observations and inferences.

Paper 03/2 - Alternative to SBA

Question 1

The highest mark awarded for this question was 17 out of a maximum of 23.

The marks awarded for experimental skills were higher than those testing the use of knowledge.

For the experimental skills, only one candidate earned the full four marks for Part (a).

The candidates did not seem to fully understand the question, and the relative atomic masses given were frequently used in the calculation of the mass of the salt required.

In completing Table 1, most candidates recorded the correct burette readings. A few added the initial and final burette readings to obtain the volume of Solution X used. Many of them used the volume of Solution Y (25 cm^3) stated in the question as their calculated volume of Solution X.

For use of knowledge, Part (iii) (b) produced the best answer, while one candidate answered Part (f) correctly.

Question 2

This question was very poorly done. The majority of the candidates appeared not to have been exposed to basic chemical tests. This was reflected in the marks which varied from zero to three. It was also evident that some candidates had difficulty differentiating between observations and inferences.

In Question 2 (a) (iii), only one candidate was awarded the full two marks for stating that barium sulphate was formed. In cases where candidates inferred that a carbonate, sulphate or sulphate could have been formed from the first test and the sulphate compound was confirmed in the second test, they were credited.

In Question 2 (b) (ii), many candidates did not attempt the ionic equation, and if they did, many of these equations were not balanced.

Question 3

Overall, the performance on this question was poor. Many candidates did not include a combustion reaction in their design. Candidates placed the fuels in a water bath or simply heated them. They showed understanding that a temperature change is involved, but were describing procedures which seem quite impractical, such as measuring the temperature of the burning fuel or of burning wood soaked in the fuel.

Unsuitable procedures, or procedures not clearly described led to many incorrect answers in Parts (c) and (d).

Candidates seemed not to understand Part (e). This was reflected in the poor discussion which lacked reference to the results from the experiment as described.

Candidates had little difficulty providing the apparatus and materials needed for the procedure described.