2003 HSC Notes from the Marking Centre Chemistry

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Published by Board of Studies NSW
GPO Box 5300
Sydney 2002
Australia

Tel: (02) 9367 8111

Fax: (02) 9367 8484

Internet: www.boardofstudies.nsw.edu.au

ISBN 1 7409 9988 6

2004034

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2003 HSC NOTES FROM THE MARKING CENTRE CHEMISTRY

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Chemistry. It provides comments with regard to responses to the 2003 Higher School Certificate Examination, indicating the quality of candidate responses and highlighting the relative strengths and weaknesses of the candidature in each section and each question.

It is essential for this document to be read in conjunction with the relevant syllabus, the 2003 Higher School Certificate Examination, the Marking Guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Chemistry.

General Comments

In 2003, 9328 candidates attempted the chemistry examination.

This year candidates seemed to have a greater awareness of the importance of the key words in the examination. Spelling, grammar and scientific expression were very poor from some candidates, with handwriting being more illegible than in the past.

Candidates need to read the question thoroughly and respond to each part. The best responses provided evidence that the candidate had planned out an answer to fit into the space provided. Responses that used extra booklets rarely provided additional worthwhile material.

Candidates need to set out their work clearly in calculation questions. Where appropriate, it is advisable to write balanced chemical equations, including the correct states of matter, to support an answer.

The variation in the quality of responses seems to suggest that candidates who have actively planned and performed a first-hand investigation are more likely to have retained knowledge and understanding of the experience than those who have rote learnt an expected answer. In addition, the development of the Chemistry skills will be more evident and rewarded with marks.

Teachers and candidates should be aware that examiners may write questions that address the syllabus outcomes in a manner that requires candidates to respond by integrating their knowledge, understanding and skills developed through studying the course. This reflects the fact that the knowledge, understanding and skills developed through the study of discrete sections should accumulate to a more comprehensive understanding than may be described in each section separately. This aspect needs to be more fully appreciated by all systems and candidates.

Section I – Core

Part A – Multiple choice

Question	Correct Response
1	B
2	D
3	B
4	B
5	D
6	C
7	C
8	A

Question	Correct Response
9	A
10	A
11	B
12	D
13	D
14	C
15	A

Part B

General Comments

Overall, the candidates' responses indicated that the majority had a grasp of chemical concepts, appropriate for HSC candidates.

Specific Comments

Question 16

(a) Many candidates did not provide a valid procedure for this first hand investigation.

(b) The equation was generally well done, although many candidates ignored, or used incorrect, states of matter.

Question 17

(a) The identification was well done.

(b) The best responses provided the features of a process and included a thorough knowledge of the three step radical addition polymerisation or the Ziegler-Natta catalysis or of the conditions needed in gas-phase polymerisation.

(c) The better responses gave a reason for the distribution of molecular weights.

Question 18

Better responses demonstrated a thorough knowledge of transuranic elements, commercial radioisotopes, nuclear reactors, accelerators and the bombarding particles required in each case. Many candidates knew one specific radioisotope but few could define a transuranic element.

Question 19

(a) The majority of the candidates correctly identified the silver cathode; however, a significant number nominated lead with some incorrectly identifying an ion as the cathode.

(b) Most responses demonstrated that candidates can transfer information from the Data Sheet. Poorer responses did not include balanced equations with the correct number of electrons and subscripts were omitted from the net equation.

Better responses demonstrated that the value should be positive for the half-cell reactions. It is advised that if states of matter are not shown in the equation that the aqueous state is assumed. In this question the identification of the solid state is an essential part of the chemistry required.

Question 20

Generally well answered. Most candidates used alcohol, biopolymers and ethene. Better responses introduced some potential chemicals produced from biomass and related these to the energy and industrial uses and production of these chemicals. Poor responses indicated a limited knowledge of the chemical use of biomass through the use of general statements and lack of detail or structure in their answer.

Question 21

(a) Many responses focused on the naming of the ester and left out the water.

(b) Best responses included a fully labelled diagram to gain full marks. Many responses indicated the lack of knowledge of the investigation with a minority of responses providing diagrams of apparatus for distillation rather than refluxing.

(c) The better responses outlined more than one advantage of refluxing. Poorer responses suggested that candidates had written a memorised unit of information about refluxing rather than answer the question asked.

Question 22

(a) Most candidates correctly answered the question.

(b) A significant number of responses did not use the correct data provided on the Data Sheet. Poorer responses demonstrated little chemical knowledge of mole ratios and a lack of understanding of the need to show steps in the calculations used to achieve their answer.

Question 23

(a) The majority of candidates answered this question correctly. The equation posed a problem for those who did not know the chemical formula for nitric acid.

(b) Common errors included using the dilution formula, and not taking into account the mole ratio in the calculation. The better responses discarded the first titre value from their calculations.

Question 24

This question was poorly answered. Few responses demonstrated a sound understanding of this area of the syllabus, and many could not link knowledge of neutralisation to the cleaning up of a chemical spill. The best responses demonstrated a knowledge of amphiprotic substances and the benefits of using a solid such as sodium hydrogen carbonate to clean up both acidic and basic spills. The majority of responses provided features of safety procedures, such as wearing safety goggles, and problems associated with run-off to the environment.

Question 25

This question was poorly done, with many responses written beyond the available space without any benefit. The better responses indicated a clear understanding of the interactions between and within molecules. Poorer responses used the term 'hydroxide ion' rather than 'hydroxy group' indicating a lack of understanding about the bonding issues involved. Many responses described the slopes and shapes of the graphs but did not relate these to reasons for the trends within and between the graphs.

Question 26

This question was poorly answered. Of serious concern was the proportion of candidates who learnt a definition given in one of the common texts which was not chemically correct. It is advisable to reinforce the need to access a 'wide variety of secondary resources' rather than rely on a single source of information. The best responses provided characteristics of eutrophication, stated two or more of the tests for BOD, DO, nitrate and phosphate, then made a judgement about the usefulness of the results gained.

Question 27

(a) The better responses clearly set out and correctly calculated the required mass from the correct formula for barium sulfate. Poorer responses did not indicate that mass of the sulfate depended on mass of sulfate ions present not the barium ions

(b) Better responses demonstrated knowledge of the relationship between repetition and reliability and made judgements based on their explanation

Question 28

(a) The best responses clearly plotted the point '0,0.00' and drew a line of best fit.

(b) The better responses related information from the graph in (a) to answer this question concisely. Many responses confused the sampling site with the source and some tried to include their understanding of causes of cadmium pollution into their responses without analysing the data provided.

Question 29

The better responses demonstrated that an evaluation of the monitoring and management of conditions in the Haber process would require a description of the process, an understanding of the chemistry behind the process and explanations of how the conditions were critical to the process.

Section II – Options

Specific Comments

Question 30 – Industrial Chemistry

(a) (i) Most candidates correctly identified one use.

(ii) Many candidates scored well on this part. The better responses gave evidence of up-to-date knowledge of current industrial processes and included a diagram. Some responses mixed the different ways in which the Frasch process is undertaken and created confusion over the use of terms 'compressed air', 'condensed air' and 'superheated steam'.

(b) (i) Most candidates gained a mark in this part. Better responses included precautions specific to the investigation in the question.

(ii) From the responses it was evident that most candidates had completed the investigation but some confused it with the commercial production method. Many responses did not include a full description of how the hydroxide ion is identified. Many responses included a statement about the test that was used but did not clearly show the result of that test, or they gave a result but no test was identified.

(c) This question was poorly answered. While many candidates provided a link between soaps and the development of detergents, very few candidates could give a clear analysis involving the structures of soaps and detergents as well as the cleaning action of soaps and detergents.

(d) (i) Most candidates successfully identified temperature or change in temperature as the factor.

(ii) A majority of candidates were able to describe two ways to increase yield. Many candidates elaborated and described, mainly using Le Chatelier's Principle, why these would affect yield.

(iii) Most responses included the equilibrium expression. Common errors included having the expression inverted and missing the 'powers'. Amongst the better responses, candidates were able to attempt the calculation of equilibrium concentrations and correctly insert in the algorithm and calculate a value for K. Very few candidates could arrive at the correct final K value.

(e) The better responses provided appropriate detail, balanced equations and included an appropriate judgement.
Poorer responses identified an environmental issue or outlined how one environmental issue was associated with an industrial method of preparation of either an acid or a base. In some cases, their knowledge was good for one method but weak for another.
Many responses lacked any detail as to why certain products actually caused problems.

Question 31 – Shipwrecks, Corrosion and Conservation

(a) (i) This was well answered with the majority of candidates being able to identify one passivating metal.

(ii) Many responses showed a basic understanding of active and passivating metals. They

generally understood the concept of non-protective layers but did not always attribute it to the formation of an oxide layer. There was poor use of technical language, e.g. porous/non-porous; pervious/ impervious. Aluminium and iron were the common examples cited. A significant number of candidates did not know that both form M(III) oxides. The required responses included a balanced equation or half-equation. There was confusion between 'active' relating to the activity series of metals and 'active' meaning 'not passivating'.

(b) (i) The better responses indicated precautions particular to their investigation, eg copper sulfate was placed in a waste bottle. Poorer responses focused on the possible dangers without considering appropriate strategies to minimise them.

(ii) This part of the question assessed practical work undertaken in the course, and therefore responses would include the particular electrolyte and electrodes used. It was also expected that they indicate the factor they were testing and how this could be measured or observed while controlling other factors. Many candidates indicated that 'electrodes were placed in an electrolyte' without being specific. Poorer responses did not adequately distinguish between factors affecting the rate of electrolysis and factors affecting the products produced. The use of a labelled diagram wherever possible is to be recommended.

(c) The better responses included 'old theories' and 'more recent theories' and included a number of significant factors such as:

- 'old theories' gave reasons for very low oxygen concentration, hence there was expected to be very little corrosion.
- 'more recent theories' account for the presence of sulfate-producing bacteria which still allows for the oxidation of iron to occur since the sulfate is being reduced. Half equations showing this process were included.

While many responses mentioned anaerobic bacteria some thought they produced oxygen which contributed to corrosion: therefore no change to the theory.

(d) (i) Most responses identified iron as the correct metal.

(ii) Most candidates found plastic difficult to deal with in the context of oxidation/reduction, as did they with the idea of 'limiting'. Some candidates reversed Cu/Al as more active/less active. Many candidates seemed confused by aluminium as active and /or passivating with respect to the corrosion of the hooks. In addition, many did not write about the corrosion of the hooks, only the containers. Only a small percentage of candidates used chemical equations in their responses and overall the use of chemical terminology, eg reductant, cathodic, etc, was poor.

(e) The best responses included an appropriate judgement about the use of electrolysis in cleaning and restoring artefacts, and demonstrated a thorough knowledge of it. Most responses did not distinguish between cleaning and restoring artefacts.

Question 32 – Biochemistry of Movement

(a) Most candidates answered both parts of the question correctly.

(b) (i) The better responses referred to their use of diagrams or models or these molecules.

(ii) Many candidates did not attempt this part at all whilst some responses included discussion of the polarity of the -OH bonds and hydrogen bonding.

(c) Most candidates answered this part poorly. The better responses demonstrated understanding of the sliding filament theory and the structure of proteins.

(d) (i) Most candidates answered this question correctly.

(ii) The better responses included word equations and demonstrated the difference between ADP and ATP.

(iii) Most responses to this part were poor. Candidates found it difficult to relate the role of the oxidation levels of the fats and carbohydrates to energy.

(e) The better responses demonstrated an extensive knowledge of two or more metabolic pathways. They showed an understanding of the unique role of ATP and made a judgement about its input in metabolic pathways.

Question 33 – Chemistry of Art

(a) (i) Generally well answered; however, a small number confused an orbital with a shell and some gave the answer '$2n^2$'.

(ii) While most responses focused on the jump in ionisation energy when an electron was removed from an inner shell, few did not relate this to the general increase in ionisation energies. Most responses described the graph but few answers related the increasing electrostatic attraction between inner shell electrons and the nucleus.

(b) (i) and (ii) Both parts were well done. The best responses stated a precaution and related this to the investigation. It was evident that a great diversity of investigations had been carried out.

(c) Most candidates had a good knowledge of the pigments used by Aboriginal people. Many candidates could give a property other than colour eg solubility, but few explained why this property was a feature of these pigments. Few responses explained the relationship between chemical composition and colour.

(d) (i) Extremely well done.

(ii) Generally well done. The best responses discussed oxidation and demonstrated an understanding of oxidation state.

(iii) The best responses gave a good explanation of the chemistry of chelation. Poorer responses indicated the role of the non-bonding electron pair was not well understood.

(e) The better responses were concise and showed evidence of planning to answer the question being asked. They included good descriptions of two or more technologies, their uses, advantages and disadvantages, then making a judgement about their usefulness in pigment identification.

Question 34 – Forensic Chemistry

(a) (i) The majority of candidates answered this correctly.

(ii) Some candidates tried to show a distinction between all of the classes of compounds indicated. Better responses clearly stated which classes of organic compounds were being distinguished with which test and the results of the tests.

(b) (i) Many responses adequately identified a safety precaution. Better responses included precautions specific to the investigation in the question.

(ii) The better responses outlined an identifying test to distinguish between reducing and non-reducing sugars, giving examples of each.

(c) Better responses demonstrated an extensive knowledge of emission spectra analysis of a mixture. The majority of the responses displayed a sound knowledge of the use of emission spectra analysis to identify elements.

(d) (i) Virtually all candidates were able to identify F2 as the more probable father.

(ii) Generally well done. Better responses demonstrated a sound knowledge of DNA structure and composition.

(iii) This part was not well answered by the majority of candidates. The better responses correctly referred to the importance of the non-coding sections of DNA as being important in the analysis of DNA. Few candidates referred to the stimulus material in their response.

(e) Generally well done. A number of candidates displayed a sound knowledge of chromatographic principles and applications. Better responses demonstrated a high appreciation of the developments in chromatography to advance Forensic Chemistry through the evaluation of methods in comparison to simpler methods and described the principles of these methods.

Chemistry

2003 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I Part A			
1	1	9.3.1	H8, H9
2	1	9.1, 9.2.5	H12
3	1	9.1, 9.2.5	H3, H11
4	1	9.4.4	H4
5	1	9.1, 9.4.5	H11
6	1	9.1, 9.2.3	H7, H9, H14
7	1	9.1, 9.3.2	H6, H14
8	1	9.1, 9.3.3	H8, H10, H12
9	1	9.4.4	H9, H12
10	1	9.1, 9.4.4	H14
11	1	9.1, 9.2.1	H9, H13
12	1	9.1, 9.4.4	H10, H12, H14
13	1	9.1, 9.2.4	H6, H8, H14
14	1	9.1, 9.3.4	H8, H11, H12
15	1	9.1, 9.3.4	H8, H10, H14

Question	Marks	Content	Syllabus outcomes
Section I Part B			
16 (a)	2	9.1, 9.2.3	H11
16 (b)	1	9.1, 9.2.3	H9, H10, H13
17 (a)	1	9.1, 9.2.3	H8, H9, H12
17 (b)	3	9.2.1	H3, H7, H8, H9, H10, H13
17 (c)	1	9.2.1	H9, H12
18	4	9.2.5	H3, H5, H8
19 (a)	1	9.1, 9.2.4	H11, H13, H14
19 (b)	2	9.1, 9.2.4	H7, H8, H10, H12
20	5	9.2.2	H1, H4, H5, H6, H8, H9, H13
21 (a)	1	9.2.2, 9.2.3, 9.3.5	H8, H9
21 (b)	2	9.1, 9.3.5	H11, H13
21 (c)	2	9.1, 9.3.5	H11, H12, H13
22 (a)	1	9.2.1, 9.2.3	H9, H10, H13
22 (b)	2	9.3.2	H7, H8, H9, H10, H12, H13
23 (a)	1	9.2.1	H10, H13
23 (b)	3	9.3.4	H8, H10, H11, H12, H13
24	4	9.3.3, 9.3.4	H4, H7, H8, H11
25	4	9.1, 9.3.5	H6, H12, H14
26	4	9.1, 9.4.5	H3, H5, H7, H8, H9, H11, H14
27 (a)	2	9.1, 9.4.3	H10, H12, H13
27 (b)	3	9.1, 9.4.3	H10, H12, H14
28 (a)	2	9.1, 9.4.3	H12, H13
28 (b)	2	9.1, 9.4.3	H4, H12, H14
29	7	9.3.2, 9.4.1, 9.4.2	H1, H2, H3, H4, H7, H8, H10

Question	Marks	Content	Syllabus outcomes
Section II Question 30 — Industrial Chemistry			
30 (a) (i)	1	9.5.3	H6
30 (a) (ii)	3	9.5.3	H8
30 (b) (i)	1	9.1	H8, H12, H13
30 (b) (ii)	3	9.5.4	H8, H12, H13
30 (c)	5	9.5.5	H1, H4, H9, H13
30 (d) (i)	1	9.5.2	H8
30 (d) (ii)	2	9.5.2	H8
30 (d) (iii)	3	9.5.2	H8, H10, H12
30 (e)	6	9.5.3, 9.5.4, 9.5.6	H4, H8, H13
Section II Question 31 — Shipwrecks, Corrosion and Conservation			
31 (a) (i)	1	9.6.2	H8
31 (a) (ii)	3	9.6.2	H6, H8, H13
31 (b) (i)	1	9.1	H8, H12, H13
31 (b) (ii)	3	9.6.3	H8, H12, H13
31 (c)	5	9.6.5, 9.6.6	H1, H2, H8, H13
31 (d) (i)	1	9.6.2	H8
31 (d) (ii)	5	9.6.4	H4, H8, H13, H14
31 (e)	6	9.6.1, 9.6.2, 9.6.3, 9.6.7	H3, H7, H8, H13
Section II Question 32 — The Biochemistry of Movement			
32 (a) (i)	1	9.7.2	H4, H9
32 (a) (ii)	3	9.7.2	H6, H9, H13
32 (b) (i)	2	9.7.3	H2, H9, H12, H13
32 (b) (ii)	2	9.7.3	H9
32 (c)	5	9.7.4, 9.7.5	H1, H7, H8, H9, H13
32 (d) (i)	1	9.7.7, 9.7.8, 9.7.9	H7, H9

Question	Marks	Content	Syllabus outcomes
32 (d) (ii)	2	9.7.1, 9.7.7	H7, H9, H10
32 (d) (iii)	3	9.7.3, 9.7.6	H2, H8, H9, H10, H12, H13
32 (e)	6	9.7.1, 9.7.3, 9.7.5, 9.7.6, 9.7.7, 9.7.8, 9.7.9, 9.7.10	H1, H7, H8, H9, H10
Section II **Question 33 — The Chemistry of Art**			
33 (a) (i)	1	9.8.3	H1, H6
33 (a) (ii)	3	9.8.3	H7
33 (b) (i)	2	9.1	H8, H12, H13
33 (b) (ii)	2	9.8.2	H8, H12, H13
33 (c)	5	9.8.1, 9.8.4, 9.8.5	H1, H2, H4
33 (d) (i)	1	9.8.4	H6
33 (d) (ii)	2	9.8.4	H6, H7, H8
33 (d) (iii)	3	9.8.5	H3, H4, H6, H8, H13
33 (e)	6	9.8.1, 9.8.2, 9.8.3	H1, H4, H6, H7, H13
Section II **Question 34 — Forensic Chemistry**			
34 (a) (i)	1	9.9.2	H9, H10
34 (a) (ii)	3	9.9.1	H8, H9
34 (b) (i)	1	9.1	H12, H13
34 (b) (ii)	3	9.9.2	H12, H13
34 (c)	5	9.9.6	H3, H4, H6, H7, H13
34 (d) (i)	1	9.9.4	H4, H12, H14
34 (d) (ii)	2	9.9.4	H2, H9, H10, H13
34 (d) (iii)	3	9.9.1, 9.9.4	H1, H3, H4, H5, H13
34 (e)	6	9.9.3, 9.9.5	H1, H3, H4, H8, H9, H13

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2003 HSC Chemistry
Marking Guidelines

Question 16 (a)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Correctly outlines the procedure for monitoring mass changes	2
• Partially outlines a procedure for monitoring mass changes	1

Question 16 (b)

Outcomes assessed: H9, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly writes the balanced equation	1

Question 17 (a)

Outcomes assessed: H8, H9, H12

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies ethanol by name or chemical formula	1

Question 17 (b)

Outcomes assessed: H3, H7, H8, H9, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a thorough description of the three key steps in free radical addition polymerisation or the steps in Ziegler/Natta polymerisation	3
• Provides a sound description of one step in either free radical addition polymerisation or Ziegler/Natta polymerisation OR • Provides a description of at least two conditions and reagents involved in either free radical addition polymerisation or Ziegler/Natta polymerisation	2
• Identifies an aspect of either free radical addition polymerisation or Ziegler/Natta polymerisation OR • High temperature/high pressure conditions OR • Identifies the three steps in free radical polymerisation OR • Simplified model of addition polymerisation	1

Question 17 (c)

Outcomes assessed: H9, H12

MARKING GUIDELINES

Criteria	Marks
• Gives a reason for the distribution	1

Question 18

Outcomes assessed: H3, H5, H8

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of methods of production of both transuranic elements and commercial radioisotopes	4
• Demonstrates a sound knowledge of methods of production of both transuranic elements and commercial radioisotopes	2–3
• Identifies the location of the transuranic elements in the Periodic Table OR • Identifies a transuranic element and/or commercial radioisotope and its use OR • Identifies a method or piece of equipment used to produce transuranic elements and/or commercial radioisotopes	1

Question 19 (a)

Outcomes assessed: H11, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies cathode	1

Question 19 (b)

Outcomes assessed: H7, H8, H10, H12

MARKING GUIDELINES

Criteria	Marks
• Writes correct net redox equation including correct states of matter • Calculates correct potential	2
• Writes correct net redox equation including correct states of matter OR • Calculates correct potential	1

Question 20

Outcomes assessed: H1, H4, H5, H6, H8, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of how biomass can be used to provide energy and chemicals • Provides an assessment of problem and/or a benefit	4–5
• Demonstrates a sound knowledge of why alternative compounds are needed OR • Identifies compounds derived from biomass • Provides an explanation of problems or benefits associated with the use of biomass	2–3
• Identifies a compound derived from biomass OR • Identifies cellulose as the main component of biomass OR • Identifies one reason for needing an alternative source of chemicals and/or energy OR • Identifies one advantage of using biomass OR • Identifies one disadvantage of using biomass	1

Question 21 (a)

Outcomes assessed: H8, H9

MARKING GUIDELINES

Criteria	Marks
• Names or writes correct formulas (not molecular) for BOTH ester AND water	1

Question 21 (b)

Outcomes assessed: H11, H13

MARKING GUIDELINES

Criteria	Marks
• Draws correctly labelled diagram of apparatus for reflux (essentials identified)	2
• Draws a partially correct, labelled diagram of apparatus of reflux (heat source, condenser, water flow) OR • Appropriate reflux arrangement implied with 3 of 6 essentials OR • Equipment drawn correctly	1

Question 21 (c)

Outcomes assessed: H11, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Outlines two advantages of reflux	2
• Outlines one advantage of using reflux	1

Question 22 (a)

Outcomes assessed: H9, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Writes the correct balanced chemical equation	1

Question 22 (b)

Outcomes assessed: H7, H8, H9, H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates volume of carbon dioxide (working to be shown)	2
• Shows one correct step in the calculation	1

Question 23 (a)

Outcomes assessed: H10, H13

MARKING GUIDELINES

Criteria	Marks
• Provides the correct balanced equation	1

Question 23 (b)

Outcomes assessed: H8, H10, H11, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Accurately calculates the concentration of nitric acid as 0.33 mol L^{-1} • Rejects the first titre in calculating the average volume	3
• Calculates the concentration of nitric acid as 0.32 mol L^{-1} (Student did not eliminate the first titre in calculating the average volume) OR • Calculates the concentration of nitric acid as 0.3 mol L^{-1} OR • Makes one error in calculating the concentration of nitric acid OR • Calculates the moles of nitric acid correctly	2
• Writes a correct, relevant mathematical formula (eg moles = molarity × volume) OR • Calculates an average titre (including or excluding first titre)	1

Question 24

Outcomes assessed: H4, H7, H8, H11

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of the factors and issues that must be considered when using neutralisation reactions to safely minimise damage in chemical spills	3–4
• States some factors that must be considered when using neutralisation reactions	1–2

Question 25

Outcomes assessed: H6, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a thorough explanation of the trends in boiling points BETWEEN AND WITHIN the three series of compounds	4
• Provides thorough explanation of the trends in boiling points BETWEEN each series OR • Provides sound explanation of the trends in boiling points BETWEEN the three series of compounds and identifies an aspect of the trends in boiling points WITHIN each series	2–3
• Identifies the relationship between boiling points and intermolecular forces OR • Identifies that boiling points increase as molecular weight increases OR • Identifies the following trend in boiling points: Alkanoic acids > Alkanols > Alkanes OR • Identifies hydrogen bonding as a strong intermolecular force	1

Question 26

Outcomes assessed: H3, H5, H7, H8, H9, H11, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a thorough description of the process of eutrophication • States two or more tests used to monitor eutrophication • Provides an assessment OR • Applications of tests OR • Explains one or both tests in detail	4
• Provides a thorough description of the process of eutrophication AND • States two tests used to monitor eutrophication OR • Explains one test in detail OR • Basic description AND states two tests and an assessment • Explains why one named test is useful for monitoring eutrophication	3
• Provides a thorough description of the process of eutrophication OR • States two tests used to monitor eutrophication OR • Explains why one named test is useful for monitoring eutrophication	2
• Provides a basic description of the process of eutrophication OR • States one appropriate test used to monitor eutrophication	1

Question 27 (a)

Outcomes assessed: H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates the percentage of sulfate	2
• Shows one correct step in the calculation	1

Question 27 (b)

Outcomes assessed: H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Explains clearly how reliability depends on repetition of the procedure OR • Refers to dependence of reliability on repetition and discusses appropriate valid procedures • Provides an evaluation	2–3
• States dependence of reliability of the procedure on repetition OR • Discusses an appropriate valid procedure	1

Question 28 (a)

Outcomes assessed: H12, H13

MARKING GUIDELINES

Criteria	Marks
• Plots data accurately • Draws a line of best fit	2
• Plots data accurately OR • Draws line of best fit	1

Question 28 (b)

Outcomes assessed: H4, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies the correct source of cadmium pollution • Justifies the conclusion with reference to the data table	2
• Identifies the correct source of cadmium pollution	1

Question 29

Outcomes assessed: H1, H2, H3, H4, H7, H8, H10

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive knowledge of the Haber process including factors that are monitored and managed. • Provides a comprehensive explanation of why reaction conditions are monitored or managed, relating these to the nature of the reaction • Provides an evaluation	6–7
• Demonstrates a thorough knowledge of the Haber process • Explains why some reaction conditions are monitored or managed	4–5
• Demonstrates a sound knowledge of the Haber process OR • Demonstrates a limited knowledge of the Haber process and identifies a reaction condition(s) that is (2 marks)/are monitored or managed (3 marks)	2–3
• Identifies the reactants and product of the Haber process OR • Gives one correct statement about the Haber process OR • Identifies one reaction condition that is monitored	1

Question 30 (a) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Identifies one use of sulfuric acid in industry	1

Question 30 (a) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Provides full description of the extraction of sulfur as sulfur dioxide by the roasting of mineral sulfides AND • Includes a balanced equation for the process • Provides a complete description of the Frasch process for extracting sulfur from mineral deposits. (Mentions underground deposits of elemental sulfur, melting and mobilising it with superheated water and air, piping it to the surface)	3
• Provides a partial description the Frasch process OR • Correctly describes the extraction of sulfur as sulfur dioxide by roasting of mineral sulfides	2
• Describes one feature of the Frasch process OR • Identifies sulfide ores as a source of sulfur	1

Question 30 (b) (i)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Describes one precaution that could minimise hazards OR • Describes one precaution for the safe disposal of reactants or products	1

Question 30 (b) (ii)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a complete sequence of steps in the investigation, including a description of techniques to identify at least two of the products OR • Correctly identifies three products AND gives the procedure used to identify each product	3
• Provides sequence of steps in the investigation AND • Shows how one product is correctly identified OR • Correctly names two products and outlines how each was identified	2
• Identifies a correct aspect of the procedure for this investigation OR • Correctly names one product and outlines how it was identified	1

Question 30 (c)

Outcomes assessed: H1, H4, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Displays thorough knowledge of the structure of soaps and synthetic detergents • Displays thorough knowledge of the cleaning action of soaps and synthetic detergents • Makes an analysis linking understanding to development	4–5
• Displays knowledge of the structure of soaps and synthetic detergents OR • Displays knowledge of the cleaning action of soaps and synthetic detergents	2–3
• Provides a correct chemical name or chemical formula of a soap or synthetic detergent OR • Displays limited knowledge of the cleaning action of soaps and synthetic detergents OR • Identifies that soaps form insoluble precipitates with Ca and Mg ions OR • Correctly identifies the structures of soaps or detergents	1

Question 30 (d) (i)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Identifies that only temperature changes affect the value of an equilibrium constant	1

Question 30 (d) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Describes any TWO of the following three: – An increase in pressure would increase the yield of NO_2 – Lowering the temperature would increase the yield of NO_2 – Selective removal/condensation of NO_2 from the mixture will increase its yield	2
• Describes any one of the above three points	1

Question 30 (d) (iii)

Outcomes assessed: H8, H10, H12

MARKING GUIDELINES

Criteria	Marks
• Gives the correct answer for the equilibrium constant, showing working	3
• Gives correct equilibrium concentration for gases OR • Correct working based on any equilibrium values • Gives correct equilibrium constant expression	2
• Correct working based on any equilibrium values OR • Gives correct equilibrium constant expression	1

Question 30 (e)

Outcomes assessed: H4, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Displays extensive knowledge about an industrial method of preparation of BOTH an acid and a base AND provides a assessment of how environmental issues are addressed for each OR • Displays sound knowledge about an industrial method of BOTH and acid and a base, and assesses how at least two environmental issues are addressed for each AND • Includes correct chemical equations in answer	5–6
• Displays a knowledge about an industrial method of preparation of BOTH an acid and a base, and describes how at least two environmental issues are addressed OR • Displays sound knowledge about an industrial method of preparation of BOTH an acid and a base, and describes how one environmental issue is addressed for both methods	3–4
• Outlines an industrial method of preparation of either an acid or a base OR • Outlines how one environmental issue associated with an industrial method of preparation of either an acid or a base is addressed OR • Identifies an environmental issue associated with an industrial method of preparation of BOTH an acid and a base	2
• Identifies an industrial method of preparation of either an acid or a base OR • Identifies an environmental issue associated with an industrial method of preparation of either an acid or a base	1

Question 31 (a) (i)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies ONE passivating metal	1

Question 31 (a) (ii)

Outcomes assessed: H6, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a sound explanation for the differences in corrosion of active and passivating metals • Includes a relevant balanced chemical equation	3
• Provides a sound explanation of the corrosion of EITHER active or passivating metals OR • Describes basic features of the corrosion of BOTH active and passivating metals OR • Describes basic features of the corrosion of EITHER active or passivating metals • Includes a relevant balanced chemical equation	2
• Identifies basic features of the corrosion of EITHER an active metal or a passivating metal	1

Question 31 (b) (i)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Describes ONE precaution that could minimise hazards OR • Describes ONE precaution for the safe disposal of reactants or products	1

Question 31 (b) (ii)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a complete sequence of steps in the investigation • States that other variables are controlled • Identifying how the observed variable is measured	3
• Provides an incomplete sequence of steps in the investigation including identifying how the observed variable is measured • OR • Provides an incomplete sequence of steps in the investigation, including stating that other variables are controlled	2
• Identifies a correct aspect of the procedure for an electrolysis investigation	1

Question 31 (c)

Outcomes assessed: H1, H2, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of the factors that affect corrosion in deep water • Includes relevant equations (sulfate reduction; water and oxygen) • Analyses how theories have changed	4–5
• Demonstrates sound knowledge of more than one factor that affects corrosion in deep water have changed AND • Compares two theories of corrosion	3
• Demonstrates a sound knowledge of ONE factor that affects corrosion in deep water OR • Demonstrates a limited knowledge of how theories about corrosion at great ocean depth have changed	2
• Identifies ONE factor that affects the rate of corrosion	1

Question 31 (d) (i)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Correct identifies the metal	1

Question 31 (d) (ii)

Outcomes assessed: H4, H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a thorough description of the effectiveness of each container in limiting corrosion, and provides a comparison	4–5
• Provides a thorough description of corrosion in ONE container AND • Provides a limited description of corrosion in TWO containers	2–3
• Provides a limited description of corrosion in ONE container	1

Question 31 (e)

Outcomes assessed: H3, H7, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Displays a thorough knowledge of electrolysis • Provides an assessment of how an understanding of electrolysis has contributed to the development of methods for restoring and cleaning marine artefacts	5–6
• Displays sound knowledge of two or more of: electrolysis, corrosion of metallic objects, methods of restoration and cleaning of marine artefacts • Provides an assessment of how an understanding of electrolysis has contributed to the development of methods for restoring and cleaning marine artefacts	4
• Displays sound knowledge of two or more of: electrolysis, corrosion of metallic objects, methods of restoration and cleaning of marine artefacts	3
• Displays sound knowledge of one of: electrolysis, corrosion of metallic objects, methods of restoration and cleaning of marine artefacts	2
• Displays limited knowledge of electrolysis OR • Displays limited knowledge of corrosion of metallic objects OR • Displays limited knowledge of methods of restoring and cleaning marine artefacts	1

Question 32 (a) (i)

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Identifies the role of glycogen molecules in human muscle and liver	1

Question 32 (a) (ii)

Outcomes assessed: H6, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates knowledge of bond formation between glucose molecules to give glycogen, including: – identifying that it involves a condensation reaction between hydroxyl groups on different glucose molecules – identifying and describing the glycosidic bond produced OR • Fully labelled structured equation	3
• Demonstrates knowledge of bond formation between glucose molecules (diagrams acceptable) to give glycogen, including: – identifying that it involves a condensation reaction between hydroxyl groups on different glucose monomers OR • Demonstrates knowledge of bond formation between glucose monomers and that it is a glycosidic bond that is produced	2
• Identifies that a condensation reaction is involved OR • Identifies that water is produced OR • Identifies that a glycosidic bond is produced	1

Question 32 (b) (i)

Outcomes assessed: H2, H9, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Describes the structures of fatty acids and glycerol including a difference or similarity between structures	2
• Describes the structure of either fatty acids OR glycerol	1

Question 32 (b) (ii)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Identifies that glycerol is polar because it is a smaller molecule and has three hydroxyl groups • Identifies that fatty acids are not polar because of their long hydrocarbon chain	2
• Identifies that glycerol is polar because it is small and has three polar hydroxyl groups OR • Identifies that fatty acids that are commonly found in the body are non-polar because of their long hydrocarbon chain OR • Identifies that the solubility of a substance in water increases with its polarity	1

Question 32 (c)

Outcomes assessed: H1, H7, H8, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Displays thorough knowledge about protein composition and structure • Displays thorough knowledge about the theory of muscle contraction • Makes an analysis linking understanding to the current theory	4–5
• Displays knowledge about protein composition and structure OR • Displays knowledge the sliding filament theory of muscle contraction	2–3
• Identifies one fact about protein composition or structure OR • Identifies one or more proteins involved in muscle contraction OR • Identifies the sliding filament theory of muscle contraction	1

Question 32 (d) (i)

Outcomes assessed: H7, H9

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies glycolysis	1

Question 32 (d) (ii)

Outcomes assessed: H7, H9, H10

MARKING GUIDELINES

Criteria	Marks
• Constructs an equation that shows that 2 molecules of ATP and 2 molecules of pyruvate are produced from one molecule of glucose, two molecules of ADP and two molecules of phosphate OR • 1 glucose + 2 ADP + 2 phosphate $\rightarrow$ 2 pyruvate + 2 ATP	2
• Constructs an equation that identifies both ATP AND pyruvate as the products of glycolysis	1

Question 32 (d) (iii)

Outcomes assessed: H2, H8, H9, H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Compares the number of ATP produced per carbon atom in fatty acids and in carbohydrates • Identifies one associated pathway OR • Relates the difference in number of ATP molecules produced to the oxidation level of carbon in fatty acids and carbohydrates	2–3
• Calculates that 8.1ATP are produced per carbon of stearic acid and 6 ATP are produced per carbon of glucose OR Identifies that: • Fats (fatty acids) release more energy when they are oxidised than glucose OR • Carbon atoms in fatty acids exist in a lower oxidation state OR • Fatty acids require 2ATP to produce 148 ATP OR • Glucose requires 2ATP to produce 38 ATP OR • Explanation of diagram	1

Question 32 (e)

Outcomes assessed: H1, H7, H8, H9, H10

MARKING GUIDELINES

Criteria	Marks
• Demonstrates extensive knowledge of two or more metabolic pathways (processes) and of the chemistry of ATP • Provides an evaluation, linking the importance of the chemistry of ATP to metabolic processes	5–6
• Demonstrates sound knowledge of two or more metabolic pathways (processes) and of the chemistry of ATP OR • Demonstrates a sound knowledge of one metabolic pathway (process) AND evaluates the importance of the chemistry of ATP	3–4
• Identifies two or more metabolic processes (or pathways) OR • Identifies a metabolic pathway (or process) and that ATP acts as an energy store in the body	2
• Identifies a metabolic pathway (or process) OR • Identifies that ATP acts as an energy store in the body OR • Identifies that ATP stands for adenosine triphosphate	1

Question 33 (a) (i)

Outcomes assessed: H1, H6

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the maximum number of electrons	1

Question 33 (a) (ii)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Provides a complete explanation of how data can be used to provide information about the arrangement of electrons around the atoms	3
• Provides a partial explanation of how data can be used to provide information about the arrangement of electrons around the atoms	2
• Identifies the number of electrons in the outer shell correctly for Na, Al and Mg OR • Identifies that ionisation energy increases as the number of electrons removed increases OR • Identifies that ionisation energy increases sharply as an electron is removed from an inner shell	1

Question 33 (b) (i)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Explains two precautions correctly	2
• Explains one precaution OR • States two precautions	1

Question 33 (b) (ii)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a complete sequence of steps in the investigation	2
• Identifies a correct aspect of the procedure for this investigation	1

Question 33 (c)

Outcomes assessed: H1, H2, H4

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of the relationship between properties and chemical composition of pigments used in traditional art by Aboriginal people	4–5
• Demonstrates a sound knowledge of the relationship between properties and chemical composition for at least one named pigment used in traditional art by Aboriginal people	2–3
• Names a pigment and gives its chemical composition correctly OR • Gives the correct colour and chemical composition for a pigment (not named) OR • Gives a brief description of a property (other than colour) OR • Names TWO pigments without their chemical composition	1

Question 33 (d) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the block in which mercury is present	1

Question 33 (d) (ii)

Outcomes assessed: H6, H7, H8

MARKING GUIDELINES

Criteria	Marks
• Provides a complete explanation of why transition metals have more than one oxidation state	2
• Provides a partial explanation of why transition metals have more than one oxidation state	1

Question 33 (d) (iii)

Outcomes assessed: H3, H4, H6, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Explains why chelating ligands are used to treat poisoning by heavy metals	2–3
• Identifies one correct aspect of ligand bonding	1

Question 33 (e)

Outcomes assessed: H1, H4, H6, H7, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive knowledge of the range of technologies • Provides an evaluation of these technologies	5–6
• Describes two or more technologies and how they are used to identify pigments	3–4
• Describes a technology used to identify pigments OR • Identifies two or more technologies used to identify pigments	2
• Identifies one technology used to identify pigments	1

Question 34 (a) (i)

Outcomes assessed: H9, H10

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the class of compounds	1

Question 34 (a) (ii)

Outcomes assessed: H8, H9

MARKING GUIDELINES

Criteria	Marks
• Describes two different tests. The second test must demonstrate different reagents and conditions	3
• Describes one test • Outlines a second test for a separate class of compounds	2
• Identifies one distinguishing test for a specific class	1

Question 34 (b) (i)

Outcomes assessed: H12, H13

MARKING GUIDELINES

Criteria	Marks
• Describes one precaution that could minimise hazards for this specific test OR • Describes one precaution for the safe disposal of reactants or products for this specific test	1

Question 34 (b) (ii)

Outcomes assessed: H12, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a complete sequence of appropriate steps in the investigation, including class of sugars which has the correct colour change (blue to orange)	3
• Provides an incomplete sequence of steps in the investigation	2
• Identifies a correct aspect of the procedure for this investigation	1

Question 34 (c)

Outcomes assessed: H3, H4, H6, H7, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of emission spectra of elements and how they can assist in the identification of the origins of a mixture	4–5
• Demonstrates a sound knowledge of emission spectra and how they are used to identify elements	2–3
• Identifies a feature of emission spectra	1

Question 34 (d) (i)

Outcomes assessed: H4, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the more probable father	1

Question 34 (d) (ii)

Outcomes assessed: H2, H9, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Outlines the structure (helical strands/connection between helices; at complementary N bases) and composition (sugar groups, phosphate, four different N bases) of DNA	2
• Outline the structure of DNA OR • Outlines the composition of DNA OR • Basic knowledge of both structure and composition of DNA	1

Question 34 (d) (iii)

Outcomes assessed: H1, H3, H4, H5, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a thorough description of how DNA analysis can be used to show that two people belong to the same family by providing at least three steps in DNA analysis (including PCR, electrophoresis and introns, isolation of DNA…)	2–3
• Outlines one relevant aspect of DNA analysis OR • Outlines the similarities in DNA material amongst family members compared with non-related people	1

Question 34 (e)

Outcomes assessed: H1, H3, H4, H8, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Demonstrates extensive knowledge of how chromatographic methods have advanced forensic science	5–6
• Describes two or more chromatographic methods	3–4
• Describes a chromatographic method OR • Identifies two or more chromatographic methods	2
• Identifies one chromatographic method	1