2006 HSC Notes from the Marking Centre Chemistry

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2006 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 some questions in the 2006 Higher School Certificate Examination, indicating the quality of candidate responses and highlighting the relative strengths and weaknesses of the candidature in each section.

It is essential for this document to be read in conjunction with the relevant syllabus, the 2006 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 2006, 10 193 candidates attempted the chemistry examination. The most popular options were Shipwrecks, Corrosion and Conservation (43%) and Industrial Chemistry (39%).

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, including the Prescribed Focus Areas. 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. It is important to understand that the Preliminary HSC course is assumed knowledge for the HSC course.

Teachers and candidates should also be aware that questions may be asked that focus on the mandatory skills content in Module 9.1. In 2006, at least one question in Section I Part B and one part of the Section II option questions focused on the mandatory skills content in Module 9.1. Candidates who had actively planned and performed first-hand investigations clearly demonstrated a deeper knowledge and understanding of the content described in this module. The skills and understanding gained from first-hand practical experiences underpin the development of knowledge in Chemistry.

Overall, the level of understanding of Chemistry concepts indicated by responses was appropriate for most HSC candidates. Candidates need to be reminded that the answer space provided and the marks allocated are guides to the maximum length of response required. Similarly, the key word used in the question gives an indication of the depth of the required response. Candidates should use examination time to analyse the question and plan responses carefully, and then work within that framework to produce clear and concise responses. The plan may include the use of dot points, diagrams and/or tables, and will help avoid internal contradictions. This is particularly so in holistic questions which need to be logical and well structured.

There was evidence that some candidates had a very poor knowledge of basic definitions specific to terminology associated with the course. The confusion between ozone depletion and the greenhouse effect is of particular concern. Better responses provided balanced chemical equations which showed the states of matter.

Better responses indicate that candidates are following the instructions provided on the examination paper. In these responses, candidates:

- clearly set out all working where required by the question
- thought carefully about the units to be used and the correct number of significant figures
- did not repeat the question as part of the response
- looked at the structure of the whole question and noted that in some questions the parts follow from each other, ie responses in part (a) lead to the required response in part (b) etc
- used appropriate equipment, for example, pencils and a ruler to draw diagrams and graphs. (A clear plastic ruler would aid candidates to plot points that are further from the axes and rule straight lines of best fit.)

In Section II, the option question is divided into a number of parts. Candidates should clearly label each part of the question when writing in their answer booklets. In part (c) of the 2006 option questions, the best responses presented ideas coherently and included the correct use of scientific principles and ideas. Many candidates wrote a lot of information that was not relevant to the question. Some responses showed evidence of rote learning an anticipated answer based on a single source. These responses did not address the syllabus content and/or outcomes being assessed and hence did not score full marks. Candidates are required to attempt one question only in Section II, but some candidates responded to more than one option question. Candidates are strongly advised to answer the option they have studied in class.

Section I – Core

Part A – Multiple choice

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

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

Part B

Question 16

This question was poorly answered by many candidates. A common misconception was that the term ‘transuranic’ means ‘radioactive’.

Better responses defined the transuranic elements, identified the main features of two types of technology and provided relevant examples.

Question 17

(a) Most candidates were able to calculate pH. A significant number used the ln function instead of the $\log_{10}$ function on the calculator.

(b) The better responses included a correctly balanced equation, and showed all the working for the calculation. Some candidates calculated the excess number of moles of acid but did not calculate the new concentration of the solution, and thus, did not determine the final pH.

Question 18

(a) Most candidates were able to calculate the moles of CO_2.

(b) Many candidates were able to calculate the mass of glucose.

Question 19

(b) Better responses provided a clearly labeled diagram. Most candidates were able to label the salt bridge and voltmeter.

(c) Most candidates were able to write balanced equations and calculate the potential difference. Some candidates had difficulty with the balancing of the Ag equation.

(d) Very few responses linked the variation to the fact that the theoretical values were obtained under standard conditions and even fewer could state the conditions. The following sample demonstrates a coherent and logical response.

He could ensure that the electrolyte solutions are both 1.0 mol L^{-1} concentration and the entire setup is at 25^{o} C, as these are the conditions under which the standard potentials are taken. Additionally, ensuring that the pH of each electrolyte is 7 would minimise the variation, as acidic conditions would alter the values taken.

Question 20

Most responses identified the important uses of ethylene, and some of the chemicals formed from it. Better responses considered hydration, addition polymerisation and also substitution as important reactions based on ethylene.

Responses needed to consider the importance of the double bond present in ethylene, which enables such reactions to occur. Candidates are reminded that correct chemical equations should also be included to illustrate the chemical processes described. Weaker responses tended to concentrate on ethanol, rather than ethylene, and included large amounts of irrelevant information.

Question 21

(a) This part of the question was not well answered. Candidates and teachers are reminded that performing first-hand investigations, such as the one detailed in this question are mandated in the syllabus content.

(b) Better responses wrote a correctly balanced hydrolysis equation, and explained that H_3O^+ production caused the acidic properties of the salt solution. Mid-range responses included a balanced equation, but did not relate the production of H_3O^+ ions to the acidity observed. Weaker responses tended to include an incorrect formula for the salt named in (a), or did not represent the reaction using a hydrolysis equation.

Question 22

Better responses gave detailed descriptions and used balanced chemical equations showing the production of sulfurous acids and their effects upon carbonate materials. Weaker responses used vague terms, incorrect formulae and poorly balanced equation writing skills. The following sample is a holistic response incorporating balanced equations.

> *Smelting and fuel combustion (eg coal) has increases since then to make more metals and energy available. This has caused more SO_2 going into the air making rain acidic.*
>
> $CuS + O_2 \rightarrow Cu + SO_2$
>
> $SO_2 + H_2O \rightarrow H_2SO_3$
>
> *We see more of an effect of acid rain now. Metal and stone buildings are deteriorating quicker and forests are dying where more factories are.*

Question 23

(a) Better responses supported the selection of bromothymol blue as the best indicator to use by pointing out the inadequacies of the other two indicators at the pH of the pool water. Some candidates were confused with the stimulus material and misinterpreted that the indicators were colourless in the transition phase between their upper and lower pH ranges.

(b) (i) Most candidates recognised that chlorination is necessary to reduce the growth of micro-organisms.

(ii) Better responses stated that the pH rose as a consequence of a shift in the equilibrium to the right as the concentration of the hypochlorite OCl^- ion increased. Weaker responses did not answer the question's requirement to state the change in the pH but described a buffering action of the OCl^- ion or an increase in alkalinity. The equilibrium concept was poorly understood.

Question 24

(a) Better responses had the correct stoichiometry, all states present and correct with the equilibrium arrow included in the chemical equation.

(b) Better responses showed a coherent, logical progression of argument with correct historical facts and their significance. These responses included an explicitly stated judgement. The following sample demonstrates a concise and coherent response.

Early in the 20th century there was need for an industrially synthesized fertilizer to feed the world's growing population. Also the growing militancy in Germany needed a product for explosives. Haber's discovery was able to meet these demands. The method also contributed to Germany's effort in WWI as it insulated Germany from the cutting off of the import saltpeter (the current natural fertiliser) from South America and allowed explosives to be made from nitric acid. Therefore Haber's discovery had a significant impact on Germany in the early 20th century.

Question 25

(a) Most responses correctly plotted all the values given. Better responses recognised that a curve of best fit was appropriate.

(b) Better responses indicated the greater validity of interpolated estimates as opposed to those extrapolated from the graph. The following response demonstrates this.

Sample 1 – 13.5 ppm
Sample 2 – 27.5 ppm
The estimate at Sample 1 is quite valid because it is obtained from the line of best fit that is obtained by measuring absorbance at concentrations of copper ranging from 0 to 25 ppm. The measured absorbance and concentration lies within this range. However, estimate at Sample 2 cannot be considered to be as valid because the absorbance and thus the concentration lies outside the measure range. It assumes that the line of best fit sustains even for concentrations higher than 25 ppm. Hence, it is not as valid. Measuring the absorbance at 30 and 35 ppm of copper concentration would make the results more valid.

Question 26

(a) Most responses identified the gas, in words or using a chemical formula.

(b) Better responses provided two specific reasons for the tests being carried out in the indicated order. Mid-range responses indicated that more than one ion may precipitate, but were not specific in naming the precipitates or giving reasons for the test order. Poorer responses repeated the question, rather than explaining.

Question 27

(a) Most candidates were able to calculate the number of moles from the data supplied.

(b) Some responses showed a calculation of concentration, but were unable to use the correct units in their calculations.

(c) Better responses stated a specific reason based on this titration. Poorer responses gave reasons such as those they have encountered in the school laboratory. Many responses gave valid general sources of error in titrations, but not this titration specifically.

Question 28

Better responses clearly outlined ozone concentration change over time, and identified an instrument that detected stratospheric ozone. Some responses did not describe how the instrument worked, or how the data was handled. Mid-range responses outlined how ozone concentrations have changed or explained the chemistry of ozone depletion, although this was not asked. There was some confusion between ozone depletion and the greenhouse effect.

Section II – Options

General Comments

Part (a) of each question in Section II options related to first-hand investigations. Responses to these questions demonstrated that many candidates had not performed the mandated first-hand investigations and had either not carried out any risk assessments or had little understanding of them.

Specific Comments

Question 29 – Industrial Chemistry

(a) (i) Better responses outlined a formal risk assessment, although most responses wrote more informally about risks and hazards. Mid-range responses often only mentioned one specific hazard and its control.

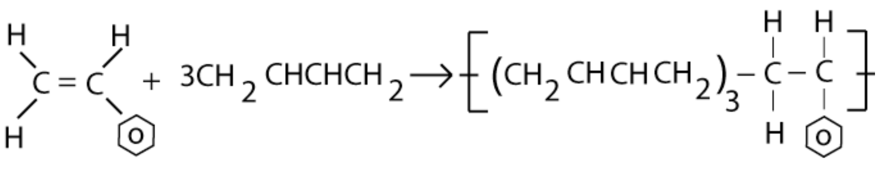
(ii) Better responses gave an accurate observation and conclusion linked to the observation. Responses in the low range were limited in their observations or confused observations and conclusions.

(b) (ii) Very few responses demonstrated knowledge of the hydrophobic and hydrophilic parts of the detergent to account for the formation of the micelle.

(iii) Better responses identified that an emulsion was formed and explained this in terms of all the different intermolecular interactions that occur with the oil, detergent and water. Mid-range responses outlined the formation of an emulsion but with limited explanation in terms of interactions. Weaker responses identified that an emulsion would form.

(c) Better responses gave coherent answers covering many aspects of the products including economic and cultural. It was clear from these responses that candidates had researched widely and had found a large variety of interesting natural products. In weaker responses, candidates made poor choices for a 'natural product' – often unable to replace the material given and were also limited in issues related to it. The following sample is a response that incorporates balanced equations as part of a holistic question.

A natural product is one that is used with little or no modification. Raw rubber is an addition polymer that is also a natural product. Raw rubber is obtained from the sap of the rubber tree and is a very useful natural product. It is used in balls, shoes, tyres and as elastic bands.
In the early 20th century demand for rubber outstripped supply. The supply of rubber was limited as rubber trees could only produce a certain amount of rubber each year. In addition, this production was mainly from Asia. As the demand for rubber grew, new alternatives needed to be produced. This situation became crucial during the first and second world wars. Rubber was needed for tyres for military vehicles and the limited supply of rubber greatly influenced the war. In the second world war, the Japanese had control of rubber producing areas which resulted in other nations needing scientists to develop synthetic rubber.
Another issue that caused the rising demand for rubber was that the automobile industry was growing and car manufacturers needed rubber.
Steps to solve the limited supply of rubber involved the development of synthetic rubbers. In the 1950s SBR (styrene butadiene rubber) was formed.



Synthetic rubber improved the properties of natural rubber as the rubber was vulcanised. Short sulfur chains formed crosslinks between polymer chains. This improved the properties of synthetic rubber, making it more durable, more resistant to chemical attack and stronger.

The progress made to improve and increase the supply of rubber has been very effective as the demand for synthetic rubber as a total percentage of rubber is around 80%.

Synthetic rubber has allowed the production of rubber to meet demand and maintain a low cost. New developments to rubber involve the use of non-petrochemicals as the cost of petroleum products has increased.

(d) (i) Most candidates correctly identified X as sulfur.

(ii) Better responses described the two step process and provide both balanced equations. Mid-range responses identified that oleum was formed as an intermediate.

(iii) Most candidates appeared to have knowledge of Le Chatelier's Principle. The best responses separated the identified conditions in terms of yield and rate. They addressed temperature, pressure and catalyst, provided a correctly balanced equilibrium equation, and specified the compromise of conditions necessary for temperature due to the exothermic nature of the reaction, all in terms of Le Chatelier's Principle. Mid-range responses were more general rather than specific for both yield and rate. Weaker responses did not provide support for the conditions stated.

Question 30 – Shipwrecks, Corrosion and Conservation

(a) (i) Better responses identified specific hazards in their risk assessment and linked them to a control for the experimental procedure. Weaker responses identified either a hazard or an experimental control.

(ii) Most responses provided a conclusion for the first-hand investigation.

(b) (i) Most responses correctly identified a gas that causes corrosion.

(ii) Most responses indicated the main features of the effect of temperature and pressure on the solubility of gases. Responses had to clearly identify that they were referring to 'solubility of gases' rather than 'concentration of gases'.

(iii) Most responses identified the effect of the two named microenvironments on the rate of corrosion. Better responses explained how or why the chemistry of the two microenvironments affected the rate of corrosion.

(c) Most responses described how the artefacts had been affected.
Better responses demonstrated a thorough knowledge of procedures used to restore wood and metals. They recognised the activity of the metals, their biocidal properties and demonstrated a thorough knowledge of electrolysis. In addition they presented the information in a coherent and logical manner. Better responses used scientific terminology correctly, gave relevant balanced chemical equations and identified specific chemicals used in the restoration procedures. Some responses confused the chemical behaviour of copper and iron.

(d) (i) Most responses identified the term for alloys composed of iron and carbon.

(ii) Most responses indicated the main features of the process of rusting.

(iii) Better responses used words or relevant equations to demonstrate an understanding of the process of rusting rather than making general statements about the physical conditions required for rusting.

Question 31 – Biochemistry of Movement

(a) (i) Better responses identified the hazard present and then how to control the risk. Some responses were presented in a table form.

(ii) Better responses differentiated between specific observations and the related conclusions, including the concept that enzymes have an optimum working range under which they catalyse those reactions.

(b) (iii) Responses included reference to the Lock and Key model and/or the induced fit model as examples of current acceptable models. Good responses often included diagrams with the description, emphasising the complementary shapes at the active site. Better responses explained how this catalysed the specific reactions.

(c) Better responses demonstrated a thorough knowledge of carbohydrate metabolism using equations or flow charts to clearly illustrate the sequencing and the links between the stages. They also explained clearly the direct and indirect production of ATP at the relevant stages in the three step process.

Better responses clearly explained the structure of fats and fatty acids and illustrated ß-oxidation, differentiating between the roles of acyl–Co A and acetyl–Co A; including the incorporation of acetyl–Co A into the TCA cycle. Differences in short and longer term energy sources were clearly explained using numerical values to compare the quantity of ATP produced by typical molecules.

(d) (i) Most responses identified that actin and myosin belong to the protein class of molecules.

Question 32 – Chemistry of Art

(a) (i) Most candidates could identify a risk for this investigation and outlined an appropriate change to reduce the risk.

(ii) Better responses included detailed observations on which to base their conclusion.

(b) (i) Most candidates could identify a pigment from early times.

(ii) Better responses recognised that low absorbance of a colour results in reflection/transmission of that colour.

(iii) Better responses explained energy absorbance for d-d transitions and the production of the complementary colour.

(c) Most candidates could indicate the main features of the contributions of Bohr, Pauli and Hund. Better responses provided detail, logical historical progression and a sound judgement.

(d) (i) Most candidates could name the correct block.

(ii) Most responses related oxidising strength to multiple oxidation states. The better responses demonstrated an understanding of oxidation-reduction.

(iii) Better responses explain the ligand-metal ion interaction and drew a correct Lewis diagram indicating lone pair electrons used in bonding.

Question 33 – Forensic Chemistry

(a) (i) Better responses provided more than one hazard, and described an appropriate control for the hazard. Of concern were the responses that indicated that candidates (or their teacher) were heating either liquid mercury or mercury salts to produce a flame for spectroscopic analysis, instead of using a mercury vapour lamp.

(ii) Better responses stated an observation for the first hand investigation, and drew a valid conclusion from it. Poorer responses frequently gave incorrect observations, or drew conclusions that were not linked to the investigation performed. Some responses provided an explanation for the origin of spectra, instead of recognising that elements have unique spectra.

(b) (i) Many candidates were not able to provide the general formula for a carbohydrate.

(ii) Better responses stated the composition of glycogen and cellulose, and where they are found in nature. Poorer responses indicated a lack of understanding of their composition, with fructose and galactose frequently used, or even a misconception that glycogen was a protein.

(iii) Many candidates could identify that the structures were different, but very few were able to explain the linear or branched nature of the polysaccharides.

(c) Better responses drew on the information contained in the stimulus material. They correctly described two modern forensic chemistry techniques, and provided reasons for their suitability by relating their use to the crime scene. Weaker responses only provided descriptions of the application of the techniques, and not their chemical nature.

Some weaker responses described the techniques in terms of television show knowledge rather than from a deep understanding of the syllabus content.

(d) (ii) In better responses, candidates drew complete structural formulae for reactants and products, and clearly indicated that water was a by-product. A significant number of candidates used a general formula for amino acids, rather than using glycine.

(iii) Many responses correctly described how to perform a suitable test for proteins, as well as the result of the test. However, very few responses correctly described the colour changes that occurred, with most not stating the original colour of the solution. Better responses referred to using a control to assess the colour change.

Chemistry

2006 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I Part A			
1	1	9.2.1.2.2	H9
2	1	9.2.3.2.1, 9.2.3.2.2, 9.2.3.3.1	H9
3	1	9.2.5.2.1, 13.1 (d), 14.1 (a)	H6, H13, H14
4	1	9.2.3.2.7, 12.4 (b)	H9, H10, H12
5	1	9.4.4.2.9, 9.4.4.3.2, 13.1 (d)	H9, H13
6	1	9.2.2.2.3, 12.4 (b)	H8, H9, H10, H12
7	1	9.3.5.2.1	H9
8	1	9.3.3.2.4, 9.3.3.2.6	H8, H10
9	1	9.3.4.2.8, 9.3.4.3.3	H8, H10
10	1	9.3.2.2.1, 12.4 (b), 13.1 (d)	H10, H12, H13
11	1	9.3.4.2.1, 9.3.4.3.1	H1, H2, H8
12	1	9.4.2.2.8	H7, H8
13	1	9.4.5.2.4	H3
14	1	9.4.3.3.5, 12.4 (b)	H11, H12
15	1	9.4.2.5, 9.4.2.6, 9.4.2.7, 9.4.2.9, 12.3 (c)	H8, H12, H13
Section I Part B			
16	3	9.2.5.2.2, 9.2.5.3.1	H1
17 (a)	1	9.3.3.3.7, 9.3.3.2.5, 12.4 (b)	H12
17 (b)	3	9.3.3.3.7, 9.3.3.2.5, 12.4 (b)	H10, H12
18 (a)	1	9.2.3.3.4, 12.4 (b)	H9, H12
18 (b)	3	9.2.3.2.6, 9.2.3.3.4, 9.2.3.3.5, 12.4 (b)	H9, H10, H12
19 (a)	1	9.2.4.3.4	H8, H14
19 (b)	2	9.2.4.2.5, 9.2.4.3.2, 11.3 (a), 13.1 (e)	H11, H13
19 (c)	2	9.2.4.3.4, 9.2.1.3.1, 12.4 (b), 13.1 (d)	H10, H12, H13
19 (d)	2	9.2.4.3.1, 9.2.4.3.2, 9.2.4.3.4, 12.4 (e), 14.1 (d)	H11, H12, H14
20	7	9.2.1.2.1, 9.2.1.2.3–8, 9.2.3.2.2, 9.2.3.2.4	H3, H6, H8, H9
21 (a)	1	9.3.4.3.2, 9.3.4.2.4	H8
21 (b)	2	9.2.1.2.1, 9.3.4.3.2, 9.3.4.2.4	H8
22	4	9.3.2.3.2, 9.4.4.1, 9.4.5.1, 9.3.2.1, 9.3.2.2.8, 9.3.2.2.10	H4, H8
23 (a)	3	9.3.1.2.2, 9.3.1.3.3, 14.1 (a), (g)	H3, H14
23 (b) (i)	1	9.4.5.2.3, 9.4.5.3.3, 14.3 (d)	H8, H14

Question	Marks	Content	Syllabus outcomes
23 (b) (ii)	2	9.3.2.2.3–4, 9.3.3.2.3	H8
24 (a)	1	9.2.1.2.1, 9.4.2.2.1–3, 13.1 (d)	H13
24 (b)	4	9.4.2.3.1	H1, H3, H4
25 (a)	2	9.4.3.2.2, 13.1 (f), (g)	H13
25 (b)	3	9.4.3.2.1–2, 9.4.3.3.5, 12.3 (c), 14.1 (a), (c)	H12, H13, H14
26 (a)	1	9.4.3.3.1, 9.4.3.2.1	H8, H9
26 (b)	3	9.4.3.2.1, 9.4.3.3.1, 11.2 (d), 14.2 (d)	H8, H11, H14
27 (a)	1	9.4.5.3.1, 9.3.4.3.3, 12.4 (b)	H10, H12
27 (b)	2	9.4.5.3.1, 9.3.4.3.3, 12.4 (b)	H10, H12
27 (c)	1	9.4.5.3.1, 11.3 (c), 14.1 (d), (g)	H11, H14
28	4	9.4.4.2.11, 9.4.4.1	H2, H3, H5
Section II Question 29 — Industrial Chemistry			
29 (a) (i)	3	9.5.4.3.1, 11.3 (b)	H11
29 (a) (ii)	2	9.5.4.3.1, 14.1 (c)	H7, H14
29 (b) (i)	1	9.5.5.2.5	H9
29 (b) (ii)	2	9.5.5.2.3, 9.5.5.2.6, 14.1 (d), (g)	H9, H14
29 (b) (iii)	3	9.5.5.2.4, 9.5.5.3.4, 14.1 (g)	H6, H9, H14
29 (c)	7	9.5.1.2.1, 9.5.1.3.1, 9.5.1, 14.3 (b)	H3, H5, H14
29 (d) (i)	1	9.5.3.2.3	H10, H12
29 (d) (ii)	2	9.5.3.2.3, 9.5.3.3.1, 12.3 (c), 13.1 (d)	H10, H12, H13
29 (d) (iii)	4	9.5.3.2.4, 9.5.3.2.5, 9.5.3.3.1, 14.1 (c), (d), (g)	H7, H8, H10, H14
Section II Question 30 — Shipwrecks, Corrosion and Conservation			
30 (a) (i)	3	9.6.3.3.1, 11.3 (b)	H11
30 (a) (ii)	2	9.6.3.3.1, 14.1 (c)	H8, H14
30 (b) (i)	1	9.6.2.2.4, 9.6.5.2.1, 9.6.5.2.3, 9.6.5.3.1	H6
30 (b) (ii)	2	9.6.5.2.1, 9.6.5.2.2, 9.6.5.2.3	H8
30 (b) (iii)	3	9.6.6, 9.6.6.2.1, 9.6.6.2.2, 9.6.6.2.3, 13.1 (d), 14.1 (d), (g)	H8, H13, H14
30 (c)	7	9.6.7, 14.3 (b)	H3, H4, H5, H14
30 (d) (i)	1	9.6.2.2.3, 9.6.2.3.3	H9
30 (d) (ii)	2	9.6.2.2.4, 9.6.2.3.2	H8, H10
30 (d) (iii)	4	9.6.4.2.1, 9.6.4.2.3, 9.6.4.2.4, 9.6.4.3.3, 9.6.4.3.4, 14.1 (c), (g)	H3, H8, H14
Section II Question 31 — The Biochemistry of Movement			
31 (a) (i)	3	9.7.4.3.2, 11.3 (b)	H11
31 (a) (ii)	2	9.7.4.3.2, 14.1 (c)	H8, H14

Question	Marks	Content	Syllabus outcomes
31 (b) (i)	1	9.7.7.2.1	H7, H9
31 (b) (ii)	2	9.7.1.2.3, 9.7.1.2.4, 9.7.1.3.1, 12.3 (c)	H7, H9, H12
31 (b) (iii)	3	9.7.4.2.4, 9.7.4.2.5, 9.7.4.3.3, 9.7.4.2.7, 9.7.4.2.8, 14.1 (g)	H8, H9, H14
31 (c)	7	9.7.6.3.1, 9.7.3.2.5, 9.7.3.2.6, 9.7.8.3.2, 9.7.9.2.2, 9.7.9.2.4, 14.3 (b)	H3, H4, H7, H8, H9, H14
31 (d) (i)	1	9.7.5.2.2	H9
31 (d) (ii)	2	9.7.5.3.1, 9.7.8.1, 9.7.10.1	H8
31 (d) (iii)	4	9.7.5.1, 14.1 (d), (g)	H7, H8, H9, H14
Section II Question 32 — The Chemistry of Art			
32 (a) (i)	3	9.8.4.3.4, 11.3 (b)	H11
32 (a) (ii)	2	9.8.4.3.4, 14.1 (c)	H8, H14
32 (b) (i)	1	9.8.1.3.2	H9
32 (b) (ii)	2	9.8.2.2.4, 9.8.2.2.9, 12.3 (c), 14.1 (d), (g)	H6, H12, H13, H14
32 (b) (iii)	3	9.8.1.1.8	H6, H14
32 (c)	7	9.8.2.2.5, 9.8.2.2.6, 9.8.2.3.4, 9.8.3.1, 14.3 (b)	H1, H3, H6, H14
32 (d) (i)	1	9.8.4.2.1	H6
32 (d) (ii)	2	9.8.4.2.5	H8
32 (d) (iii)	4	9.8.5.2.3, 9.8.5.2.4, 9.8.5.3.1, 13.1 (e), 14.1 (a), (e)	H6, H13, H14
Section II Question 33 — Forensic Chemistry			
33 (a) (i)	3	9.9.6.3.1, 9.9.6.3.2, 11.3 (b)	H11
33 (a) (ii)	2	9.9.6.3.1, 9.9.6.3.2, 14.1 (c)	H7, H14
33 (b) (i)	1	9.9.2.2.1	H9, H10
33 (b) (ii)	2	9.9.2.2.2, 9.9.2.2.4, 9.9.2.3.2	H9
33 (b) (iii)	3	9.9.2.2.2, 9.9.l2.2.4, 9.9.2.3.2, 13.1 (d)	H8, H9, H13
33 (c)	7	9.9.1, 9.9.3.2.5, 9.9.3.2.6, 9.9.4, 9.9.5, 9.9.6, 14.3 (b)	H3, H4, H8, H14
33 (d) (i)	1	9.9.3.2.2	H9
33 (d) (ii)	2	9.9.3.2.3, 9.9.3.3.1, 9.9.3.2.4, 13.1 (d), (e)	H9, H13
33 (d) (iii)	4	9.9.3.2.4, 9.9.3.2.6, 9.9.3.3.2, 11.2 (c), 11.3 (c), 14.1 (b), (d)	H8, H9, H11, H14

BOARD OF STUDIES
NEW SOUTH WALES

2006 HSC Chemistry Marking Guidelines

Section I, Part B

Question 16

Outcomes assessed: H1

MARKING GUIDELINES

Criteria	Marks
• Describes how technology, including nuclear reactors and particle accelerators have allowed for the production of transuranic elements	3
• Outlines a method used to produce transuranic elements including the name of a technology	2
• Identifies a transuranic element (by name or symbol) OR • Defines transuranic element OR • Identifies an example of a technology used to produce a transuranic element	1

Question 17 (a)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Calculates correct pH	1

Question 17 (b)

Outcomes assessed: H10, H12

MARKING GUIDELINES

Criteria	Marks
• Writes correct balanced equation • Calculates correct pH of resulting mixture with sufficient working	3
• Calculates incorrect pH of resulting mixture as a result of one error in calculation and writes correct balanced equation OR • Calculates the moles of HCl in excess (no formula) and writes correct balanced equation OR • Calculates the moles of HCl and writes correct balanced equation	2
• Calculates moles of either HCl or NaOH OR • Writes balanced chemical equation	1

Question 18 (a)

Outcomes assessed: H9, H12

MARKING GUIDELINES

Criteria	Marks
• Calculates correct moles of CO_2	1

Question 18 (b)

Outcomes assessed: H9, H10, H12

MARKING GUIDELINES

Criteria	Marks
• Calculates the correct mass of glucose with sufficient working • Provides balanced chemical equation • Correct units given for answer	3
• Writes balanced chemical equation, and • Calculates moles of $C_6H_{12}O_6$ OR • Writes balanced chemical equation, and • Calculates incorrect mass of glucose due to one error but provides correct units OR • Write correct balanced chemical equation, and • Calculates correct mass of glucose but does not provide correct units OR • Write incorrect equation, and • Calculate correct mass with correct units	2
• Calculates moles of $C_6H_{12}O_6$ OR • Calculates incorrect mass of glucose with one error and no units OR • Correct number of moles of CO_2 provided not in 18 (a) OR • Writes balanced chemical equation for fermentation	1

Question 19 (a)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Correct combination of metals	1

Question 19 (b)

Outcomes assessed: H11, H13

MARKING GUIDELINES

Criteria	Marks
• Sketches an experimental setup with all important features including: – salt bridge – voltmeter – named metals – named electrolytes	2
• Sketches an experimental setup with at least TWO features from the list above	1

Question 19 (c)

Outcomes assessed: H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Writes a balanced chemical reaction AND • Correctly calculates the expected potential difference	2
• Writes a balanced chemical reaction OR • Correctly calculates the expected potential difference	1

Question 19 (d)

Outcomes assessed: H11, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO steps to minimise differences	2
• Outlines ONE step to minimise differences	1

Question 20

Outcomes assessed: H3, H6, H8, H9

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of the use of ethylene as a starting material for addition reactions • Provides characteristics and features of the use of ethylene as a starting material for production of polyethylenes (includes styrene, vinyl chloride) • Provides TWO chemical equations for reactions using ethylene as a starting material • Relates the reactivity of the double bond of ethylene to its widespread use in the chemical industry for production of new materials and fuels	6–7
• Provides characteristics and features of the use of ethylene as a starting material for addition reactions • Provides characteristics and features of the use of ethylene as a starting material for production of polyethylenes • Provides ONE chemical equation for a reaction using ethylene as a starting material OR • Outlines the use of ethylene for producing new materials and fuels • Provides TWO chemical equations for reactions using ethylene as a starting material • Identifies that ethylene is reactive because of its double bond	4–5
• Provides characteristics and features of the use of ethylene as a starting material for addition reactions OR • Provides characteristics and features of the use of ethylene as a starting material for production of polyethylenes OR • Outlines the use of ethylene for producing new materials and fuels OR • Provides TWO chemical equations for reactions using ethylene as a starting material OR • Provides ONE chemical equation for a reaction using ethylene as a starting material • Identifies that ethylene is reactive because of its double bond	2–3
• Identifies that ethylene has a double bond OR • Identifies ONE compound that can be prepared from ethylene excluding ethanol OR • ONE correct balanced equation using ethylene as a starting material OR • Identifies ethylene can be polymerized OR • States that ethylene is readily available from catalytic cracking of crude oil	1

Question 21 (a)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Recognises an acidic salt	1

Question 21 (b)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Relates acidity of salt to presence of acid and production of H_3O^+ ions • Writes a relevant correctly balanced chemical equation	2
• Relates acidity of salt to presence of acid and production of H_3O^+ ions OR • A link of H_3O^+ to acidity OR • Writes a balanced chemical equation	1

Question 22

Outcomes assessed: H4, H8

MARKING GUIDELINES

Criteria	Marks
• Provides evidence for and/or against statement that acidic oxides of sulfur have been increasing in concentration • Provides TWO balanced chemical equations leading to formation of acid rain or to the effect of acid rain	4
• Provides a relevant chemical equation • Describes several effects of oxides of sulfur in the atmosphere OR • Provides multiple sources of SO_2 leading to ONE effect OR • Provides evidence for and/or against statement that acidic oxides of sulfur have been increasing in concentration	3
• States an effect of oxides of sulfur in the atmosphere • Provides a relevant chemical equation OR • Describes several effects of an oxide of sulfur	2
• Identifies that the Industrial Revolution led to increased combustion of coal (which contains sulfur) or to increased smelting OR • States an effect of oxides of sulfur in the atmosphere OR • Identifies an oxide of sulfur	1

Question 23 (a)

Outcomes assessed: H3, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies bromothymol blue as the best indicator • Provides a reason why bromothymol blue is the best indicator • Provides a reason why each of the other indicators are not suitable	3
• Identifies bromothymol blue as the best indicator AND • Provides a reason why bromothymol blue is the best indicator OR • Provides a reason why the other indicators are not suitable	2
• Identifies bromothymol blue as the best indicator OR • Identifies the colour shown by one indicator at pH 7.0–7.6	1

Question 23 (b) (i)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• States a valid reason	1

Question 23 (b) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Identifies that the pH of the water will increase • Relates the pH increase to the effect of adding hypochlorite on the equilibrium position	2
• Identifies that hypochlorite is a base OR • Solution becomes alkaline OR • Identifies that the pH of the water will increase OR • Identifies that adding hypochlorite will shift the equilibrium to the right	1

Question 24 (a)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Provides a balanced chemical equation for the Haber process • Includes states of matter • Uses equilibrium arrows in equation	1

Question 24 (b)

Outcomes assessed: H1, H3, H4

MARKING GUIDELINES

Criteria	Marks
• Outlines a social or political issue at the time of development of the Haber process • Explains restrictions on supplies • Outlines the impact of the Haber process at the time of its discovery • Provides a judgement	4
• Outlines a social or political issue at the time of development of the Haber process • Outlines the impact of the Haber process at the time of its discovery • Explains restrictions on supplies	2–3
• Identifies a use for ammonia OR • Identifies a social or political issue at the time of development of the Haber process OR • Identifies an advantage of the Haber process	1

Question 25 (a)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Plots points correctly and draws a curve of best fit through the points	2
• Correctly plots points on the grid OR • Incorrectly plots points but correctly draws a curve of best fit through the points	1

Question 25 (b)

Outcomes assessed: H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides an accurate estimate for both samples based on the student's graph • Provides a judgement for both estimates • Provides a reason for both judgements	3
Any TWO of: • Provides an accurate estimate for either sample based on the student's graph • Provides a judgement for either estimate • Provides a reason for the judgement	2
• Provides an accurate estimate for either sample based on the student's graph OR • Provides a reason why results obtained by AAS will be valid	1

Question 26 (a)

Outcomes assessed: H8, H9

MARKING GUIDELINES

Criteria	Marks
• Carbon dioxide correctly identified	1

Question 26 (b)

Outcomes assessed: H8, H11, H14

MARKING GUIDELINES

Criteria	Marks
• Provides specific reasons to show that if the tests are done out of order, they will not identify each of the three ions	3
• Gives an example where two of the ions will not be distinguished if the tests are done out of order OR • Correctly identifies the anions detected by each of steps 1, 2 and 3	2
• Identifies the anion detected by step 1 or 2 or 3	1

Question 27 (a)

Outcomes assessed: H10, H12

MARKING GUIDELINES

Criteria	Marks
• Correct answer given OR • Correct working with a substitution error	1

Question 27 (b)

Outcomes assessed: H10, H12

MARKING GUIDELINES

Criteria	Marks
• Calculates correct concentration of calcium	2
• A correct step shown	1

Question 27 (c)

Outcomes assessed: H11, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies Mg^{2+} or another cation capable of reacting with EDTA was also present	1

Question 28

Outcomes assessed: H2, H3, H5

MARKING GUIDELINES

Criteria	Marks
• Identifies an instrument that could have been used to obtain the information • Provides the characteristics and features of how data can be obtained using the instrument identified • Outlines how ozone concentrations above Antarctica have changed over time	3–4
• Outlines how the information could have been obtained OR • Outlines how ozone concentrations have changed over time OR • Outlines how CFCs can decrease the concentration of ozone	2
• Identifies an instrument used to obtain information about ozone levels OR • Identifies that ozone concentrations above Antarctica have decreased OR • Identifies that the rate of depletion is less due to phasing out of CFCs OR • Identifies that ozone concentrations above Antarctica are less than other places on earth OR • Identifies that ozone hole is getting bigger	1

Section II

Question 29 (a) (i)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO specific hazards for this first-hand investigation, AND provides a specific method for control of each hazard	3
• Outlines ONE specific hazard for this first-hand investigation, AND provides a method for its control OR • Outlines TWO specific hazards for this first-hand investigation	2
• Provides ONE method of controlling a specific hazard for this first-hand investigation OR • Identifies ONE specific hazard for this first-hand investigation	1

Question 29 (a) (ii)

Outcomes assessed: H7, H14

MARKING GUIDELINES

Criteria	Marks
• Provides ONE set of observations and a conclusion based on that set of observations for this first-hand investigation	2
• Provides ONE set of observations for this first-hand investigation	1

Question 29 (b) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 29 (b) (ii)

Outcomes assessed: H9, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies the parts of the molecule that are hydrophobic and hydrophilic • States that the structure of the micelle minimises contact between the hydrophobic parts of the detergent and water OR • States that the hydrophobic parts of the detergent are attracted to each other	2
• Identifies part of the molecule as being hydrophobic (non-polar) OR • Identifies part of the molecule as being hydrophilic (polar)	1

Question 29 (b) (iii)

Outcomes assessed: H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies that an emulsion is formed • Relates formation of an emulsion to the different intermolecular interactions that occur when oil is added to water and a detergent	3
• Outlines the formation of an emulsion	2
• States that the hydrocarbon end of the detergent molecule is attracted to the oil molecules OR • Identifies that an emulsion is formed	1

Question 29 (c)

Outcomes assessed: H3, H5, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies an appropriate natural product • Provides a judgement • Provides characteristics and features of at least TWO issues associated with shrinking world supplies of the natural product • Provides characteristics and features of progress being made to find replacement materials • Provides a response that demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Identifies an appropriate natural product • Provides characteristics and features of at least TWO issues associated with shrinking world supplies of the natural product OR • Identifies an appropriate natural product • Provides characteristics and features of progress being made to find replacement materials • Provides characteristics and features of ONE issue associated with shrinking world supplies of the natural product	4–5
• Identifies an appropriate natural product and a replacement material • Identifies an issue associated with shrinking world supplies of the natural product OR • Identifies an appropriate natural product • Provides characteristics and features of ONE issue associated with shrinking world supplies of the natural product OR • Identifies an appropriate natural product • Provides characteristics and features of progress being made to find replacement materials	2–3
• Identifies an appropriate natural product	1

Question 29 (d) (i)

Outcomes assessed: H10, H12

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 29 (d) (ii)

Outcomes assessed: H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Outlines the chemistry involved in both steps involved in the conversion OR • Provides balanced chemical equations for both steps	2
• Provides ONE appropriate balanced chemical equation OR • Identifies that oleum is formed as an intermediate OR • Identifies ONE of the steps involved in the conversion	1

Question 29 (d) (iii)

Outcomes assessed: H7, H8, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Uses Le Chatelier's principle to justify one set of reaction conditions that will maximise the yield of SO_3 • Writes a balanced chemical equation • Justifies the need to use an intermediate reaction temperature to maximise yield because of the exothermic nature of the reaction • Identifies that a catalyst should be used to maximise reaction rate	3–4
• Uses Le Chatelier's principle to justify ONE set of reaction conditions that will maximise the yield of SO_3 OR • Identifies that the reaction is exothermic and explains the effect of a change in temperature on reaction yield OR • Any TWO of the statements from 1 mark guidelines below	2
• Identifies that the reaction is exothermic OR • Writes a balanced chemical equation for the second step in the Contact process OR • States Le Chatelier's principle OR • Identifies that adding a catalyst will maximise reaction rate OR • Identifies that an increase in concentration of either reactant will increase the yield	1

Question 30 (a) (i)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO specific hazards for this first-hand investigation, and provides a specific method for control of each hazard	3
• Outlines ONE specific hazard for this first-hand investigation, and provides a method for its control OR • Outlines TWO specific hazards for this first-hand investigation	2
• Provides ONE method of controlling a hazard for this first-hand investigation OR • Identifies ONE hazard for this first-hand investigation	1

Question 30 (a) (ii)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides ONE set of observations and a conclusion based on that set of observations for this first-hand investigation	2
• Provides ONE set of observations for this first-hand investigation OR • Provides a conclusion for this first-hand investigation	1

Question 30 (b) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Identifies appropriate gas	1

Question 30 (b) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Outlines the effect of both pressure and temperature on solubility of gases	2
• Outlines the effect of temperature on solubility of gases OR • Outlines the effect of pressure on solubility of gases	1

Question 30 (b) (iii)

Outcomes assessed: H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Relates the chemistry of both microenvironments to their effects on the rate of corrosion • Provides characteristics and features of both microenvironments • Provides ONE balanced chemical equation or ONE relevant cathodic equation	3
• Outlines the chemistry of both types of microenvironments OR • Provides characteristics and features (including a balanced chemical equation or ONE relevant cathodic equation) of one type of microenvironment OR • Relates the chemistry of ONE microenvironment to its effect on the rate of corrosion	2
• Identifies the effect of a microenvironment on the rate of corrosion OR • Provides ONE relevant balanced chemical equation OR • Provides ONE relevant cathodic equation	1

Question 30 (c)

Outcomes assessed: H3, H4, H5, H14

MARKING GUIDELINES

Criteria	Marks
• Outlines how all THREE artefacts have been affected • Provides characteristics and features of procedures for restoration of the metallic objects and the wooden chest • Relates selection of restoration method to the composition of the artefact and/or corrosion products • Provides a response that demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Outlines how the wooden chest has been affected and provides characteristics and features of a procedure for restoring it, and Either • Outlines how the other TWO artifacts have been affected OR • Provides details of the process of electrolysis for the removal of the products of corrosion of metals OR • Provides the chemicals required and/or the equations for the restoration processes	4–5
• Outlines how ONE artefact has been affected • Provides characteristics and features of a procedure for restoring that artefact OR • Outlines how electrolysis can be used to restore metallic artifacts • Outlines a procedure to restore the wooden chest OR • Outlines how all THREE artefacts have been affected	2–3
• Identifies how ONE of the artefacts has been affected OR • Identifies a procedure for restoring ONE of the artefacts	1

Question 30 (d) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Names the alloy	1

Question 30 (d) (ii)

Outcomes assessed: H8, H10

MARKING GUIDELINES

Criteria	Marks
• Identifies that rusting of iron involves oxidation of iron metal to produce Fe(II) ions or Fe(III) ions, and Either • Identifies that the electrons produced by oxidation of iron are then used to reduce oxygen molecules OR • Provides a balanced redox reaction for the rusting of iron OR • Provides both half equations	2
• Identifies that rusting of iron results in production of Fe(II) ions or Fe(III) ions OR • Identifies that oxygen is reduced to water during rusting of iron OR • Identifies that rusting is an oxidation-reduction process OR • Provides ONE relevant equation	1

Question 30 (d) (iii)

Outcomes assessed: H3, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of TWO methods of preventing corrosion of iron • Provides points for or against for TWO methods for preventing corrosion of iron • Provides a judgement for both methods for preventing corrosion of iron	3–4
• Provides characteristics and features of ONE method of preventing corrosion of iron • Provides a point for or against for ONE method for preventing corrosion of iron OR • Provides characteristics and features of TWO methods of preventing corrosion of iron	2
• Identifies ONE method of preventing corrosion of iron OR • Provides a point for or against for ONE method for preventing corrosion of iron	1

Question 31 (a) (i)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO specific hazards for this first-hand investigation and provides a specific method for control of each hazard	3
• Outlines ONE specific hazard for this first-hand investigation and provides a method for its control OR • Outlines TWO specific hazards for this first-hand investigation	2
• Provides ONE method of controlling a hazard for this first-hand investigation OR • Identifies ONE hazard for this first-hand investigation	1

Question 31 (a) (ii)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides ONE set of observations and a conclusion based on that set of observations for this first-hand investigation	2
• Provides ONE set of observations for this first-hand investigation	1

Question 31 (b) (i)

Outcomes assessed: H7, H9

MARKING GUIDELINES

Criteria	Marks
• Names part of cell	1

Question 31 (b) (ii)

Outcomes assessed: H7, H9, H12

MARKING GUIDELINES

Criteria	Marks
• Identifies that the phosphodiester bonds in ATP are high energy bonds • Identifies that hydrolysis of ATP to form ADP and phosphate releases energy that can be used for metabolism	2
• Identifies that ATP is a high energy molecule OR • Identifies that hydrolysis of ATP produces energy OR • Writes an equation for hydrolysis of ATP	1

Question 31 (b) (iii)

Outcomes assessed: H8, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Outlines the lock and key model of enzyme function or other acceptable model of enzyme function • Outlines the importance of amino acid composition and intermolecular forces in determining the shape of an enzyme	3
• Outlines the lock and key model of enzyme function or other acceptable model of enzyme function	2
• Identifies that substrates bind to a region of the enzyme known as the active site OR • Identifies the importance of the shape of either/both the substrate and active site in determining enzyme substrate specificity	1

Question 31 (c)

Outcomes assessed: H3, H4, H7, H8, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of how carbohydrates are metabolised to provide energy • Provides characteristics and features of fat metabolism • Relates how a diet low in carbohydrates may lead to increased fat metabolism and weight loss • Provides a response that demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Provides characteristics and features of how carbohydrates are metabolised to provide energy • Identifies that a diet low in carbohydrates may result in fats being metabolised instead OR • Outlines the complete process by which carbohydrates are metabolised to provide energy • Identifies that a diet low in carbohydrates may result in fats being metabolised instead • Provides characteristics and features of fat metabolism	4–5
• Outlines the complete process by which carbohydrates are metabolised to provide energy OR • Provides characteristics and features of glycolysis OR • Provides characteristics and features of the TCA cycle OR • Provides characteristics and features of oxidative phosphorylation OR • Provides characteristics and features of fat metabolism	2–3
• Makes a correct statement about carbohydrate metabolism OR • Makes a correct statement about fats or fat metabolism	1

Question 31 (d) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Names a class of molecules	1

Question 31 (d) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Provides ONE point of difference or similarity in the appearance or function of type 1 and type 2 skeletal muscle cells • Shows how type 1 and type 2 skeletal muscle cells have different functions	2
• Provides ONE point of difference or similarity in the appearance or function of type 1 and type 2 skeletal muscle cells OR • Identifies the function of either type 1 or type 2 skeletal muscle cells	1

Question 31 (d) (iii)

Outcomes assessed: H7, H8, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies that muscle contraction is initiated by the release of calcium ions • Identifies that hydrolysis of ATP provides the energy for muscle contraction • Shows that muscle contraction involves contraction of temporary bonds between actin and myosin molecules, which result in movement of actin fibres across myosin • Identifies that the lighter areas in the illustrated muscle cell become thinner	3–4
• Identifies that muscle contraction involves movement of actin fibres across myosin OR • Any TWO of the following: – Identifies that muscle contraction is initiated by the release of calcium ions – Identifies that hydrolysis of ATP provides the energy for muscle contraction – Identifies that the lighter areas in the illustrated muscle cell become thinner	2
• Identifies that muscle contraction is initiated by the release of calcium ions OR • Identifies that hydrolysis of ATP provides the energy for muscle contraction OR • Identifies that the lighter areas in the illustrated muscle cell become thinner	1

Question 32 (a) (i)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO specific hazards for this first-hand investigation and provides a specific method for control of each hazard	3
• Outlines ONE specific hazard for this first-hand investigation and provides a method for its control OR • Outlines TWO specific hazards for this first-hand investigation	2
• Provides ONE method of controlling a hazard for this first-hand investigation OR • Identifies ONE hazard for this first-hand investigation	1

Question 32 (a) (ii)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides ONE set of observations and a conclusion based on that set of observations for this first-hand investigation	2
• Provides ONE set of observations for this first-hand investigation	1

Question 32 (b) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Names pigment or gives formula	1

Question 32 (b) (ii)

Outcomes assessed: H6, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a supporting argument for choice of colour • Identifies pigment as green in colour	2
• Identifies the pigment has low absorbance in the green portion of the spectrum OR • Identifies the pigment has high absorbance in other portions of the spectrum (other than green) OR • Identifies that the pigment is green	1

Question 32 (b) (iii)

Outcomes assessed: H6, H14

MARKING GUIDELINES

Criteria	Marks
• States that the presence of transition metal ions in pigments often causes their colour • Accounts for colour in terms of d-d electron transitions	3
• Describes features of the electron arrangement of transition metal ions OR • Accounts for colour in pigments in terms of removal of some parts of the visible spectrum OR • Accounts for mineral use in terms of transition metal colour, local availability and insolubility in medium	2
• Identifies presence of transition metal ion results in the pigment's colour OR • Identifies transition metal ions as having incompletely filled d orbitals OR • Identifies mineral use or local availability or insolubility in medium	1

Question 32 (c)

Outcomes assessed: H1, H3, H6, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of the contributions of Bohr, Pauli and Hund • Provides points for and/or against the work of Bohr • Provides a judgement of any kind • Provides a response that demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Provides characteristics and features of the contribution of Bohr • Provides points for and/or against the work of Bohr • Provides a judgement OR • Provides characteristics and features of the contributions of Bohr, Pauli and Hund	4–5
• Provides characteristics and features of the contribution of Bohr OR • Provides characteristics and features of the contributions of Pauli and Hund	2–3
• Identifies a contribution of Bohr or Pauli or Hund	1

Question 32 (d) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Names the block	1

Question 32 (d) (ii)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Relates the presence of a transition metal in a high oxidation state to the ability of the complex ion to attract electrons and oxidise other species	2
• Identifies that in transition metal ion complexes which act as oxidising agents, the transition metal is in a high oxidation state OR • Identifies that transition metal ions can have multiple oxidation states OR • Identifies effective charge, radius etc	1

Question 32 (d) (iii)

Outcomes assessed: H6, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of coordinate covalent bonds in metal complexes • Draws a correct Lewis diagram for an identified complex ion	3–4
• Provides characteristics and features of coordinate covalent bonds in metal complexes OR • Draws a correct Lewis diagram for an identified complex ion	2
• States that a ligand has at least ONE non-bonding electron pair OR • Identifies that the bonds present in metal complex ions are coordinate covalent bonds OR • Draws a partially correct Lewis diagram of a chosen ion (eg diagram shows a non-bonding electron pair on the nitrogen or oxygen)	1

Question 33 (a) (i)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Outlines TWO specific hazards for this first-hand investigation and provide a specific method for control of each hazard	3
• Outlines ONE specific hazard for this first-hand investigation and provides a method for its control OR • Outlines TWO specific hazards for this first-hand investigation	2
• Provides ONE method of controlling a specific hazard for this first-hand investigation OR • Identifies ONE specific hazard for this first-hand investigation	1

Question 33 (a) (ii)

Outcomes assessed: H7, H14

MARKING GUIDELINES

Criteria	Marks
• Provides ONE set of observations and a conclusion based on that set of observations for this first-hand investigation	2
• Provides ONE set of observations for this first-hand investigation OR • Provides relevant chemical information for this investigation or without link to observation	1

Question 33 (b) (i)

Outcomes assessed: H9, H10

MARKING GUIDELINES

Criteria	Marks
• Provides correct general formula	1

Question 33 (b) (ii)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• States that both polysaccharides are composed entirely of glucose • Names the different places in nature where both polysaccharides are found	2
• States the composition of one polysaccharide OR • Names where ONE polysaccharide is found in nature	1

Question 33 (b) (iii)

Outcomes assessed: H8, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Describes the structures of both polysaccharides • Explains the differences in structure between both polysaccharides	3
• Outlines the structures of both polysaccharides OR • Explains why the above polysaccharides have different structures	2
• Outlines the structure of ONE of the two polysaccharides	1

Question 33 (c)

Outcomes assessed: H3, H4, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of TWO suitable modern forensic chemistry techniques • Provides reasons why both techniques are suitable for forensic investigations • Provides a response that demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Provides characteristics and features of ONE suitable modern forensic chemistry technique • Provides reasons why this technique is suitable for forensic investigations OR • Provides characteristics and features of TWO modern forensic chemistry techniques	4–5
• Provides characteristics and features of ONE suitable modern forensic chemistry technique OR • Outlines ONE suitable modern forensic chemistry technique • Provides a reason why this technique is suitable for forensic investigations	2–3
• Outlines ONE suitable modern forensic chemistry technique OR • Identifies an important property of a suitable forensic chemistry technique	1

Question 33 (d) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Names the functional group A	1

Question 33 (d) (ii)

Outcomes assessed: H9, H13

MARKING GUIDELINES

Criteria	Marks
• Writes a balanced chemical equation • Shows the structure of the dipeptide	2
• Identifies that water is a by-product of the reaction OR • Shows the structure of the dipeptide	1

Question 33 (d) (iii)

Outcomes assessed: H8, H9, H11, H14

MARKING GUIDELINES

Criteria	Marks
• Provides the characteristics and features of a chemical test for proteins • Relates the use of enzymes to their ability to distinguish between the proteins	3–4
• Outlines a chemical test for proteins with results OR • Outlines how enzymes can be used to analyse proteins OR • Identifies that enzymes can be used to cleave proteins • Identifies that different enzymes cleave proteins at different positions	2
• Identifies a chemical test for proteins OR • Identifies that enzymes can be used to cleave proteins	1