2001 HSC Notes from the Examination Centre Chemistry

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2001 HSC NOTES FROM THE EXAMINATION 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 2001 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 2001 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.

In 2001, 9017 candidates presented for the examination in Chemistry.

General Comments

Most candidates were successful in responding to questions that involved the provision of specific knowledge, rather than questions requiring evaluation, justification or explanation.

Some candidates had difficulty using the language of chemistry ie chemical equations. Equations should be used to help chemical communication. This can include answers to questions that do not specifically include the direction ‘include relevant chemical equations in your answer’.

Many candidates had difficulty setting out calculations in a logical fashion so that they could be easily understood. Others had difficulty restricting their answers to the ruled space provided on the examination paper. It should be noted that point-form presentation, and the use of diagrams and/or tables, when appropriate, enables candidates to communicate their knowledge and understanding in a logical and coherent manner.

It was obvious from some responses that some first-hand investigations had not been done by candidates. In the options, questions requiring candidates to distinguish between accuracy and reliability were poorly answered.

Teachers and candidates should be aware that examiners may ask 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.

Section I – Core

Part A – Multiple Choice

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

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

Part B

Question 16

In general, this question was answered quite well, with relatively few candidates scoring 0 or 1 marks out of three. Many candidates had difficulty recalling more than one property. Candidates who did so, usually only related one property to the radioisotope's use. A significant number of candidates included nuclear equations unnecessarily.

Question 17

(a) A significant proportion of candidates gave very general responses such as 'inaccurate measuring' or 'human error', which did not provide sufficient detail to be awarded the mark.

(b) Some candidates suggested replacing the beaker with a styrofoam cup. This may demonstrate knowledge of insulating properties but little experience with practical first-hand investigation.

(c) Most candidates successfully attempted the calculation although many used 4.18 or 4.2 rather than the value 4.18×10^3 J kg^{-1} K^{-1} provided in the data sheet.

Question 18

(a) Almost all candidates drew an identifiable salt bridge although many lacked appropriate detail.

(b) Even though copper(II) was specified, a sizeable number of candidates used a half equation involving copper(I). Candidates who used $E_{total} = E_{red} - E_{ox}$ rather than manipulating half equations were more prone to errors in their calculations.

(c) Many candidates showed a good understanding of the concepts but failed to identify that the applied external voltage was responsible for reversing the reaction.

Question 19

Many candidates need to better organise their response to questions requiring a sustained response. Candidates should spend at least a few minutes clarifying what the question requires, and planning how they will structure their response in the space provided. Candidates demonstrated a better knowledge of electrode materials than of the electrolytes used.

Question 20

(a) Most candidates answered this part correctly.

(a) Many candidates did not explain why the two solutions had different pH values.

Question 21

(a) This question part was answered well.

(b) Many candidates merely described the changes apparent in the graph rather than explaining the changes.

Question 22

Many candidates had difficulty identifying appropriate justifications for the procedure steps outlined.

The existence of dotted lines in the answer booklet does not preclude drawing a diagram to describe a procedural step. Candidates who drew a small, well-labelled diagram could describe the step more succinctly.

Many candidates were confused over the use of concentrated sulfuric acid. A surprising number used calcium carbonate rather than porous ceramic material as boiling chips.

Question 23

(a) This question part was well done.

(b) The setting out of answers was often quite poor, with a lack of logical reasoning. Common errors were: not providing a unit for the molar mass, and not allowing for the dilution factor (20 mL of 100 mL prepared solution titrated). Many candidates calculated the molar mass of the X rather than the base NaX used to prepare the solution.

Question 24

(a) Many responses to this part were too vague.

(b) Rather than providing an explanation, as required, many candidates described what happened. Many thought the liquefying occurred in the actual reaction chamber by cooling it, while others thought that the liquefying was caused by increasing pressure within the reaction chamber. The removal of ammonia on liquefaction from the equilibrium equation was missed by many, and was not related to an increase in yield.

(c) The compromise conditions were often stated, but students then had difficulty explaining the effects of temperature and pressure on both yield and rate.

Question 25

Most candidates' responses focused on the monitoring of a combustion reaction. The full range of marks was also awarded to responses based upon other suitable reactions such as ammonia synthesis.

The better responses demonstrated extensive knowledge of possible reaction products, either due to identified varying reaction conditions or due to the presence of impurities. They also explained the need to monitor the products to avoid problems.

Question 26

(a) This part was well done.

(b) This part was also answered well by most candidates.

(c) Only a minority of candidates responded with a hypothesis. A small proportion of candidates gained the allocated marks.

Question 27

Some candidates wrote extensively about the diagram in a way that was unrelated to the question asked. The effect of the very different concentrations in the upper and lower atmosphere was insufficiently recognised in candidate responses.

Section II – Options

Question 28 – Industrial Chemistry

(a) (i) This part was poorly answered by many candidates.

(ii) This part, focusing on a 'column three' activity of the syllabus, was very poorly answered.

(b) (i) This part was well done.

(ii) Some candidates wrote excessively — up to three or four pages — in responding to this two-mark question.

(c) Good responses gave equations and a variety of uses/properties. Poor responses tended not to include equations.

(d) (i) This part was well answered by a majority of candidates.

(ii) This question part was generally well answered; however, many candidates failed to identify any of the equipment being used during the procedure outlined.

(iii) Generally, this part was well answered. A common error was not clearly identifying the risk associated with the hazard named.

(e) The better responses demonstrated an extensive knowledge of the chemistry of the Solvay process, and made judgements about the ways in which associated environmental issues may be addressed.

Weaker responses identified reactants and/or products of the Solvay process or stated a problem associated with the process.

Question 29 – Shipwrecks and Salvage

(a) (i) This part was very well done.

(ii) This part was well done.

(b) (i) This part was well done.

(ii) The concept of a sacrificial anode was well understood but many candidates did not relate this to reduction potentials, required to gain full marks.

(c) This part was well done by many candidates. Some candidates had a tendency to write long responses that contained little real chemistry.

(d) (i) Some candidates restricted their answer to the formation of rust.

(ii) All candidates need to write about 'what they did' rather than just give results when asked to outline a procedure.

(iii) Many candidates had difficulty distinguishing between the meanings of 'accuracy' and 'reliability'.

(e) Candidates needed to distinguish between the terms 'clean', 'stabilise' and 'preserve'. The better responses emphasised chemical processes including complete descriptions, and provided balanced equations for techniques such as acid cleaning and electrolysis.

Question 30 – The Biochemistry of Movement

(a) (i) Most candidates readily identified ATP but a few confused it with glucose.

(ii) Candidates answering the first part correctly generally also answered this part correctly.

(b) (i) This part was well done.

(ii) Better candidates explained the coupling with oxidation of NADH and $FADH_2$.

(c) Most candidates could name the 'lock and key' model but had problems relating the model to substrate specificity and catalytic properties. Many candidates used the terms 'specificity', 'active site' and 'substrate' but could not explain their significance.

(d) (i) Few candidates could define viscosity, most using analogies such as thickness.
(ii) Many candidates described a suitable method but it was questionable as to whether or not they had carried out the procedure in class.
(iii) Most candidates could suggest an improvement but very few could distinguish between reliability and accuracy.

(e) Many candidates analysed structure rather than energy output systems. Most could identify muscle type and related energy system. Candidates who could describe aerobic and anaerobic pathways did not use flow charts or equations.

Question 31 – The Chemistry of Art

(a) (i) This part was generally well answered.

(ii) Many candidates did not name or describe a separation process. Some candidates described a separation process but did not relate it to a pigment.

(b) (i) This question was well answered by most candidates.

(ii) Detailed answers were generally not given, with candidates often simply stating that electrons were excited. Many candidates did not relate energy transitions to frequency or wavelength.

(c) Many candidates used general terms not specific to Bohr's model. An answer such as 'did not work for elements other than hydrogen' in describing a limitation of Bohr's model lacks sufficient specificity and detail.

(d) (i) This part was very well done.

(ii) This part was very poorly done. Most candidates either left this part unanswered or chose inappropriate practicals eg flame test. Many did not know reactants for the demonstration, often basing answers on the half equations listed on the data sheet, and inappropriate acids.

(iii) Most candidates did not relate the risk assessment to their chosen practical. Candidates found it easier to find a safe work practice than a hazard, and only the better candidates could describe a safety risk.

(e) Many students discussed only one pigment. Very few students related oxidation state to their explanation of colour and only the best were able to explain the transition between the d orbitals in transition metals. Red ochre was often incorrectly described as $Fe_2O_3.H_2O$, which is yellow.

Question 32 – Forensic Chemistry

(a) (i) Many candidates had a poor understanding of the structure of organic compounds and incorrectly focused on the 'natural origin' of organic compounds. A significant number of candidates knew that carbon was the main element involved but included oxygen in their definition of elements present. This proved a difficult question; many candidates who scored well in other parts did not gain the mark.

(ii) Candidates who understood what a 'class' of organic compound was answered this question well. A wide range of classes was given. Misunderstanding of the term 'organic' led to a surprising number of students referring to organic matter in soil in answering (a)(i), (a)(ii) and (d).

(b) (i) This part was well answered.

(ii) Most candidates have a basic knowledge of fatty acid structure and solubility and scored some marks on this question. However many candidates confused triglycerides with fatty acids. Few candidates related the increasing length of the hydrocarbon chain to insolubility.

(c) This part was well answered, with candidates being able to assess the usefulness of mass spectroscopy.

(d) (i) This part was well answered by the majority of candidates. Some candidates misread the question and referred to identification of the components of a mixture in (i) and (ii), rather than separation techniques.

(ii) Most candidates outlined a procedure for chromatography. Candidates should, however, be aware that methods obtained from the internet are not necessarily valid. Where candidates described electrophoresis, it was obvious that this technique had not been performed as a first-hand investigation by many candidates.

(iii) Most candidates could describe some improvements to accuracy/reliability but very few distinguished between these as was needed to gain full marks.

(e) Many candidates were unsure of how to write a 'discussion' text but merely wrote down everything that they knew, without addressing the question and without any coherent structure.

Chemistry

2001 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
1	1	9.2.1	H9
2	1	9.2.2	H9
3	1	9.2.1	H9, H10
4	1	9.2.2	H2, H9
5	1	9.3.2	H8
6	1	9.3.1	H13, H14
7	1	9.3.1	H8
8	1	9.3.2	H10, H14
9	1	9.3.2	H1, H2
10	1	9.3.2	H8, H10
11	1	9.4.5	H3, H4
12	1	9.4.3	H1, H3, H4
13	1	9.4.3	H12, H14
14	1	9.4.5	H3, H12, H14
15	1	9.4.3	H8, H14
16	3	9.2.5	H3, H4, H6
17(a)	1	9.2.3	H7, H9, H10, H14
17(b)	2	9.2.3	H12
17(c)	3	9.2.3	H10, H12, H13
18(a)	1	9.2.4	H13
18(b)	2	9.2.4	H6, H8, H10
18(c)	3	9.2.4	H6, H8, H13, H14
19	7	9.2.4	H1, H3, H4, H5, H7, H8, H13
20(a)	1	9.3.3	H13
20(b)	3	9.3.3	H8, H10, H13
21(a)	1	9.3.4	H8
21(b)	3	9.3.4	H2, H8, H10, H13, H14
22	6	9.3.5	H8, H9, H11, H12, H13
23(a)	1	9.3.4	H1, H6
23(b)	3	9.3.4	H6, H10, H13
24(a)	1	9.4.2	H3
24(b)	2	9.4.2	H8, H13
24(c)	3	9.4.2	H4, H8, H10
25	6	9.4.1	H4, H8, H9, H13
26(a)	1	9.3.4	H13
26(b)	1	9.4.3	H12, H14
26(c)	2	9.4.3	H4, H14
27	4	9.4.4	H4, H5, H13, H14
28(a)(i)	1	9.5.4	H7, H13
28(a)(ii)	2	9.5.4	H7
28(b)(I)	2	9.5.2	H10

Question	Marks	Content	Syllabus outcomes
28(b)(ii)	2	9.5.2	H3, H8
28(c)	5	9.5.3	H3, H8, H10, H13
28(d)(i)	1	9.5.5	H9
28(d)(ii)	2	9.5.5	H12
28(d)(iii)	3	9.5.5	H12
28(e)	7	9.5.6	H4, H8, H13, H14
29(a)(i)	1	9.6.2	H6
29(a)(ii)	2	9.6.2	H6, H7
29(b)(i)	1	9.6.4	H8
29(b)(ii)	3	9.6.4	H4, H8
29(c)	5	9.6.2	H3, H8, H13
29(d)(i)	1	9.6.5	H8, H13
29(d)(ii)	2	9.6.5	H12
29(d)(iii)	3	9.6.5	H12
29(e)	7	9.6.7	H4, H8, H13, H14
30(a)(i)	1	9.7.1	H9
30(a)(ii)	2	9.7.1	H9
30(b)(i)	2	9.7.7	H9
30(b)(ii)	2	9.7.10	H4, H9
30(c)	5	9.7.4	H2, H9, H13
30(d)(i)	1	9.7.3	H13
30(d)(ii)	2	9.7.3	H12
30(d)(iii)	3	9.7.3	H12
30(e)	7	9.7.9	H7, H9, H13, H14
31(a)(i)	1	9.8.1	H8
31(a)(ii)	2	9.8.2	H8
31(b)(i)	2	9.8.3	H6, H14
31(b)(ii)	2	9.8.3	H2, H6
31(c)	5	9.8.3	H2, H6, H13
31(d)(i)	1	9.8.5	H6
31(d)(ii)	2	9.8.5	H12
31(d)(iii)	3	9.8.5	H12
31(e)	7	9.8.2	H6, H13, H14
32(a)(i)	1	9.9.1	H9, H13
32(a)(ii)	2	9.9.1	H9
32(b)(i)	1	9.9.3	H14
32(b)(ii)	3	9.9.3	H4, H9
32(c)	5	9.9.6	H2, H3, H6
32(d)(i)	1	9.9.4	H9
32(d)(ii)	2	9.9.4	H12
32(d)(iii)	3	9.9.4	H12
32(e)	7	9.9.5	H1, H3, H9, H13, H14

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NEW SOUTH WALES

2001 HSC Chemistry
Marking Guidelines

Question 16 (3 marks)

Outcomes assessed: H3, H4, H6

MARKING GUIDELINES

Criteria	Marks
• Correctly names a radioisotope and relates at least two properties to its use	3
• Correctly names a radioisotope and relates at least one property to its use OR • Correctly names a radioisotope and describes two properties OR • Correctly names a radioisotope and describes a use	2
• Correctly names a radioisotope OR • Describes a use of a radioisotope	1

Question 17 (a) (1 mark)

Outcomes assessed: H7, H9, H10, H14

MARKING GUIDELINES

Criteria	Marks
• A valid reason	1

Question 17 (b) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Two adjustments given which improve accuracy	2
• One adjustment given which improves accuracy	1

Question 17 (c) (3 marks)

Outcomes assessed: H10, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Calculates ΔH and the moles of ethanol and calculates $\Delta_c H$ for ethanol	3
• Calculates ΔH and the moles of ethanol OR • Correct method for calculating but minor error in calculation of ΔH or moles	2
• Calculates ΔH or moles of ethanol	1

Question 18 (a) (1 mark)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Correctly places salt bridge between the beakers and dipping into each solution	1

Question 18 (b) (2 marks)

Outcomes assessed: H6, H8, H10

MARKING GUIDELINES

Criteria	Marks
• Both half equations/values correct and final calculation correct	2
• At least one half equation value correct	1

Question 18 (c) (3 marks)

Outcomes assessed: H6, H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Illustrates that copper ions from solution form copper metal: $Cu^{2+} + 2e^{-}$ ------> Cu (s) • Explains that an applied voltage changes the direction of electron flow	3
• Gives correct half equation $Cu^{2+} + 2e^{-}$ ------> Cu with a statement that the cell reaction has been reversed	2
• Indicates that metallic copper forms from copper ions OR • States the copper electrode is now a cathode, not an anode OR • States the cell is now electrolytic not galvanic	1

Question 19 (7 marks)

Outcomes assessed: H1, H3, H4, H5, H7, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Evaluates both named cell types in terms of chemistry and impact on society • Answer illustrated with selected balanced symbol equations	6–7
• Names one other cell type and describes a number of features of it and one of the given cells in terms of chemistry and impact on society, illustrating answer with at least word equations and/or formulas OR • Names one other cell type, evaluates it and one of the given cells in one area stated in the question, illustrating answer with word equations and/or formulas, if appropriate	4–5
• Names one other type of cell and describes at least one feature of it and the dry cell or lead-acid cell OR • Describes a number of features of either the dry cell or lead-acid cell	2–3
• Names one other type of cell	1

Question 20 (a) (1 mark)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Any appropriate pH measuring device named	1

Question 20 (b) (3 marks)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Explains the relationship between $[H^+]$ and pH • Indicates that pH 1 means higher $[H^+]$ than pH 1.6 • Explains that HCl ionises more than citric acid	3
• Any two parts of the explanation	2
• Any one part of the explanation	1

Question 21 (a) (1 mark)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Any technically correct name given	1

Question 21 (b) (3 marks)

Outcomes assessed: H2, H8, H10, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Explains original conductivity, the equivalence point and subsequent increase using named chemicals from the reaction	3
• Explains two features of the graph in terms of chemicals involved OR • General explanation involving removal and addition of ions	2
• Explains either the decrease, equivalence point or increase conductivity in terms of chemicals involved OR • General overview in terms of ions given	1

Question 22 (6 marks)

Outcomes assessed: H8, H9, H11, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Detailed description of necessary equipment and the refluxing process or suitable labelled diagram • Justification given for equipment, chemicals (including catalyst) and refluxing • Specifies chemicals for making the ester including the catalyst • Answer illustrated with correct equation.	5–6
• Describes equipment and refluxing process or draws labelled diagram • Gives some reasoning for equipment and method used • Identifies some chemicals used	3–4
• Outlines some equipment or chemicals used in esterification in general	1–2

Question 23 (a) (1 mark)

Outcomes assessed: H1, H6

MARKING GUIDELINES

Criteria	Marks
• Correct definition stated	1

Question 23 (b) (3 marks)

Outcomes assessed: H6, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates the molar mass (units required)	3
• States the correct moles of HCl used and hence moles of NaX in titration and in 100 mL sample OR • Correct process used throughout, but error in calculation or transcription	2
• Balanced chemical equation for the reaction OR • States correct moles HCl used OR • Indicates moles in 100 mL is 5x moles in 20 mL sample OR • Provides a definition of molar mass OR • Gives correct answer and shows no working (units not required)	1

Question 24 (a) (1 mark)

Outcomes assessed: H3

MARKING GUIDELINES

Criteria	Marks
• Any relevant use stated	1

Question 24 (b) (2 marks)

Outcomes assessed: H8, H13

MARKING GUIDELINES

Criteria	Marks
• States that the yield is increased • Explains the increase in terms of Le Chatelier's principle and the removal of product	2
• States that the yield increased OR • Indicates that equilibrium shifts right	1

Question 24 (c) (3 marks)

Outcomes assessed: H4, H8, H10

MARKING GUIDELINES

Criteria	Marks
• Indicates the conflicting effect of temperature on reaction rate and yield • Explains the effect of pressure on yield • Identifies that a compromise set of conditions must be used in equilibrium reactions	3
• Identifies that reaction has optimum conditions of temperature and pressure that affect reaction rate OR yield OR safety conditions • Explains how temperature OR pressure affect yield OR reaction rate	2
• Identifies that reaction has optimum conditions of temperature and pressure that affect reaction rate OR yield OR safety conditions	1

Question 25 (6 marks)

Outcomes assessed: H4, H8, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Displays extensive knowledge of possible different reaction products, either due to identified varying reaction conditions or due to the presence of impurities using an appropriate example • Explains the need for monitoring these products to avoid problems	5–6
• Identifies at least one variation in reaction products using an appropriate example AND • Relates formation of this product to the need for monitoring to avoid problems	3–4
• Describes a specific chemical reaction OR • States purpose of monitoring	1–2

Question 26 (a) (1 mark)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• All points plotted correctly on grid provided • And line of best fit or points joined	1

Question 26 (b) (1 mark)

Outcomes assessed: H12, H14

MARKING GUIDELINES

Criteria	Marks
• Gives a value between 1.4 and 1.6	1

Question 26 (c) (2 marks)

Outcomes assessed: H4, H14

MARKING GUIDELINES

Criteria	Marks
• A hypothesis which could be tested and is logical based on the data	2
• Any inference based on the patterns shown in the table	1

Question 27 (4 marks)

Outcomes assessed: H4, H5, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Compares the environmental effects of ozone in the upper and lower atmosphere, relating these to concentrations	4
• Compares the environmental effects of ozone in the upper and lower atmosphere	3
• Identifies the concentration of ozone (in the upper atmosphere) and one related environmental effect OR • Identifies the concentration of ozone (in the lower atmosphere) and one related environmental effect OR • Identifies two environmental effects of ozone	2
• Identifies that the upper atmosphere has a higher concentration of ozone than the lower atmosphere OR • Identifies an environmental effect of ozone	1

Question 28 (a) (i) (1 mark)

Outcomes assessed: H7, H13

MARKING GUIDELINES

Criteria	Marks
• Any correct definition of electrolysis	1

NB. do not accept an example isolated from a definition.

Question 28 (a) (ii) (2 marks)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies that both electrolyses produce chlorine gas but that the other product for each is different and names that product	2
• Correctly identifies one product for both reactions OR • Correctly identifies two products from one reaction	1

Question 28 (b) (i) (2 marks)

Outcomes assessed: H10

MARKING GUIDELINES

Criteria	Marks
• Writes the correct balanced equation using chemical symbols	2
• Writes a correct word equation OR • Gives the correct formula for carbon monoxide and for chlorine gas	1

Question 28 (b) (ii) (2 marks)

Outcomes assessed: H3, H8

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies one factor which influences the equilibrium and describes the way in which this factor can be used to maximise production of phosgene, using their answer in part (i)	2
• Correctly identifies one factor which influences the equilibrium OR • Relates Le Chatelier's principle to maximising production by indicating correct equilibrium shift	1

Question 28 (c) (5 marks)

Outcomes assessed: H3, H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Explains the importance of sulfuric acid as an industrial chemical based on a number of its properties and related use • Includes balanced chemical equations related to at least two properties	5
• Relates at least one use of sulfuric acid to its properties and includes a balanced chemical equation related to one property	4
• Relates one use of sulfuric acid to a property and includes a balanced equation for that property	3
• States one property and one use of sulfuric acid OR • States two properties of sulfuric acid OR • States two uses of sulfuric acid	2
• States one property of sulfuric acid OR • States one use of sulfuric acid OR • Correct relevant equation	1

Question 28 (d) (i) (1 mark)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Saponification	1

Question 28 (d) (ii) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Identifies suitable equipment and identifies both reactants and the heating process	2
• Identifies both reactants OR • Identifies one reactant and correct process	1

Question 28 (d) (iii) (3 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Describes a safety risk relevant to the procedure outlined and suggests a safe working practice to minimise the risk	3
• States one hazard and one safe work practice	2
• States one hazard or one safe work practice	1

Question 28 (e) (7 marks)

Outcomes assessed: H4, H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive knowledge of the Solvay process supported by at least one relevant chemical relationship • Describes environmental issues or potential issues associated with the process • Makes a judgement about the value of the way in which the environmental issues are addressed	6–7
• Demonstrates a knowledge of the Solvay process • Identifies environmental issues or potential environmental issues associated with either reactants, intermediates or products of the process • Demonstrates knowledge of procedures used to address environmental issues	4–5
• Identifies some reactants and/or products of the Solvay process OR • Some knowledge of procedures used to control environmental issues or potential environmental issues OR • States some environmental issues associated with the process	2–3
• Identifies a reactant or product of the Solvay process OR • States a procedure used to control a potential environmental problem associated with the process OR • States an environmental problem associated with the process	1

Question 29 (a) (i) (1 mark)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Iron or steel	1

Question 29 (a) (ii) (2 marks)

Outcomes assessed: H6, H7

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies formation of an oxide which creates an impervious layer to oxygen	2
• Correctly identifies the formation of an oxide layer OR • Correctly identifies the formation of an impervious layer OR • Correctly identifies that aluminium is a passivating metal	1

Question 29 (b) (i) (1 mark)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies a metal	1

Question 29 (b) (ii) (3 marks)

Outcomes assessed: H4, H8

MARKING GUIDELINES

Criteria	Marks
• Identifies that corrosion is prevented by preferential oxidation of the sacrificial anode AND • Relates this to the relevant reduction potentials for an appropriate sacrificial anode, and iron	3
• Identifies that corrosion is prevented by preferential oxidation of the sacrificial anode OR • States relevant reduction potentials for an appropriate sacrificial anode, and iron	2
• Identifies that corrosion of the hull metal is prevented	1

Question 29 (c) (5 marks)

Outcomes assessed: H3, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Identifies carbon as an essential component of steel and demonstrates a detailed knowledge of the effect of addition of two or more elements (one of which may be carbon) to iron on the properties and subsequent use of steel	5
• Describes 2 or more examples of how the addition of different elements changes the properties of iron and determines the subsequent use of the steel OR • Describes how the addition of different proportions of an element to iron can produce varying properties and different uses of steels OR • Provides a detailed description of how the added element alters the properties of the steel	4
• Describes how the addition of at least one other element changes the properties of iron and determines the subsequent use of the steel OR • Gives 2 or more examples of how the addition of an element changes the properties of iron OR • Gives 2 or more examples of how the addition of an element determines the subsequent uses of iron	3
• Identifies 2 or more elements that are added to iron to form a steel OR • Identifies how the addition of an element changes the properties of iron OR • Identifies that the addition of an element to iron determines the subsequent use of the steel	2
• Identifies one element that is added to iron to form a steel OR • Identifies one property of iron that can be enhanced OR • States one use of a steel	1

Question 29 (d) (i) (1 mark)

Outcomes assessed: H8, H13

MARKING GUIDELINES

Criteria	Marks
• Any correct definition of corrosion	1

Question 29 (d) (ii) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Identifies a suitable corrosive medium • Identifies suitable equipment • Describe how the rate of corrosion will be monitored	2
• Identifies a suitable corrosive medium and identifies suitable equipment	1

Question 29 (d) (iii) (3 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Clearly distinguishes between accuracy and reliability with examples of how to improve both	3
• States one way to improve accuracy and one way to improve reliability OR • States more than one way to improve accuracy OR • States more than one way to improve reliability OR • Distinguishes between accuracy and reliability in general terms	2
• States one way to improve accuracy or one way to improve reliability	1

Question 29 (e) (7 marks)

Outcomes assessed: H4, H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive knowledge and correct order of the steps in all 3 processes for a named metal AND • Makes a judgement on the relevance of each step in the recovery of the artefact	6–7
• Demonstrates a thorough knowledge of a number of steps in all 3 processes OR • Describes two processes with an evaluation of one process.	4–5
• Outlines cleaning or preserving or stabilising, and describes at least one step in each of the other two processes OR • Gives examples of isolated steps across cleaning, preserving and stabilising	2–3
• States one step in cleaning or preserving or stabilising.	1

Question 30 (a) (i) (1 mark)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Adenosine triphosphate	1

Question 30 (a) (ii) (2 marks)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the biologically important part AND • Explains the reaction that releases energy OR • An equation outlining the process (not including water)	2
• Correctly identifies the biologically important part OR • An equation outlining the process	1

Question 30 (b) (i) (2 marks)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Identifies the molecule and states its function	2
• Identifies the molecule OR • States its function	1

Question 30 (b) (ii) (2 marks)

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Relates oxidative phosphorylation to ATP production and identifies the link to the oxidation of NADH or $FADH_2$	2
• Relates oxidative phosphorylation to ATP production or to the oxidation of NADH or $FADH_2$	1

Question 30 (c) (5 marks)

Outcomes assessed: H2, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Relates properties of enzyme specificity and catalysis to how the model works	4–5
• States one property of an enzyme and describes/draws a model of enzyme activity	2–3
• Describes/draws a model of enzyme activity	1

Question 30 (d) (i) (1 mark)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Defines viscosity	1

Question 30 (d) (ii) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Describes an appropriate procedure	2
• States a time comparison is necessary OR • States identical experimental conditions	1

Question 30 (d) (iii) (3 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Clearly distinguishes between accuracy and reliability with examples of how to improve both	3
• States one way to improve accuracy and one way to improve reliability OR • States more than one way to improve accuracy OR • States more than one way to improve reliability OR • Distinguishes between accuracy and reliability in general terms	2
• States one way to improve accuracy or one way to improve reliability	1

Question 30 (e) (7 marks)

Outcomes assessed: H7, H9, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Relates type 1 and type 2 skeletal muscle to the correct respiratory pathways and rate and amount of ATP production by both aerobic and anaerobic pathways during different types of exercise AND • Shows how these respiratory pathways are interrelated. Equations or a flow chart are used to summarise the respiratory pathways	6–7
• Summarises both aerobic and anaerobic respiratory pathways and interrelates these in terms of their energy production. Molecules are correctly identified OR • Identifies both types of muscle and describes the energy requirement for different types of exercise and connects these to the correct respiratory pathways and amount of ATP produced without necessarily showing the interrelationship of the pathways	4–5
• Relates the type of muscle to the correct respiratory pathway and amount of ATP OR • Identifies all reactants and products including the number of ATP either anaerobic or aerobic respiration OR • Compares energy production in both aerobic and anaerobic respiration OR • Compares the type of muscle used and the energy requirement for different type of exercise	2–3
• Identifies a muscle type OR • Mentions a condition for energy production in muscle OR • Identifies a reactant or product of glucose metabolism	1

Question 31 (a) (i) (1 mark)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Any suitable mineral source of a pigment	1

Question 31 (a) (ii) (2 marks)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Describes how a separation process can be used to obtain a pigment	2
• Partially correct description of a separation process	1

Question 31 (b) (i) (2 marks)

Outcomes assessed: H6, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies barium and chromium only	2
• 1 correct element identified OR • Identifies 2 correct elements and 1 other that is incorrect	1

Question 31 (b) (ii) (2 marks)

Outcomes assessed: H2, H6

MARKING GUIDELINES

Criteria	Marks
• Explains that an element must be excited for a subsequent emission to occur and that only certain energies are emitted from an element and that these correspond to certain frequencies/wavelength of light	2
• States that an element must be excited to a higher energy state OR • States that only certain energies are emitted from an element	1

Question 31 (c) (5 marks)

Outcomes assessed: H2, H6, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a detailed description of the Bohr model of the atom • Identifies a merit of the model and a limitation of the model	5
• Describes the Bohr model of the atom and identifies a merit of the model OR • Describes the Bohr model and identifies a limitation	3–4
• Partially describes the Bohr model of the atom	2
• States the Bohr model refers to electrons	1

Question 31 (d) (i) (1 mark)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Any transition element given	1

Question 31 (d) (ii) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Nominates reactants and colour change	2
• Nominates reactants OR • Correctly links a colour to a metal's oxidation state	1

Question 31 (d) (iii) (3 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Describes a safety risk and suggest a safe working practice to minimise the risk	3
• States one hazard and one safe work practice	2
• States one hazard OR • One safe work practice	1

Question 31 (e) (7 marks)

Outcomes assessed: H6, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Discusses the composition of 2 pigments including the formula of each coloured compound, and the oxidation state of each metal involved AND • Relates the colour of each pigment to electronic transitions eg between d orbitals in transition metals	6–7
• Discusses the composition of 2 pigments including the formula of each coloured compound, and the oxidation state of each metal involved OR • Relates the colour of each pigment to electron transition eg between d orbitals in the two transition metals	4–5
• Names two pigments and gives the chemical composition of one of the pigments	3
• Names two pigments OR • Names two transition metals OR • Names a pigment and gives its chemical composition	2
• Names a pigment OR • Names a transition metal	1

Question 32 (a) (i) (1 mark)

Outcomes assessed: H9, H13

MARKING GUIDELINES

Criteria	Marks
• A correct definition is given	1

Question 32 (a) (ii) (2 marks)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies a class of organic compounds AND • Describes a correct test with correct results to identify that class	2
• Correctly identifies a class of organic compounds OR • States a test that identifies a class of organic compounds	1

Question 32 (b) (i) (1 mark)

Outcomes assessed: H14

MARKING GUIDELINES

Criteria	Marks
• Tallow	1

Question 32 (b) (ii) (3 marks)

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Relates the fatty acid structure and length of hydrocarbon chain in fatty acids and the carboxyl group to the solubility of fatty acids in water	3
• Describes the fatty acid molecule and describes solubility in water of the carboxylic acid group OR • Relates the length of hydrocarbon chain in fatty acids to the solubility of fatty acids in water	2
• Describes the fatty acid molecule OR • Describes solubility in water of the carboxylic acid group	1

Question 32 (c) (5 marks)

Outcomes assessed: H2, H3, H6

MARKING GUIDELINES

Criteria	Marks
• Assess the usefulness of mass spectrometry in forensic chemistry in terms of a number of its advantages such as determining RMM, range of elemental isotopes present, relative amounts of isotopes, very small samples	4–5
• Describes the usefulness of mass spectrometry in forensic chemistry with a suitable example	2–3
• Identifies one area of usefulness of mass spectrometry e.g. very small samples or range of elemental isotopes present	1

Question 32 (d) (i) (1 mark)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• A technique correctly identified	1

Question 32 (d) (ii) (2 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Describes the method and details of the materials used	2
• Gives details of the materials used	1

Question 32 (d) (iii) (3 marks)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Clearly distinguishes between accuracy and reliability with examples of how to improve both	3
• States one way to improve accuracy and one way to improve reliability OR • States more than one way to improve accuracy OR • States more than one way to improve reliability	2
• States one way to improve accuracy or one way to improve reliability OR • Distinguishes between accuracy and reliability in general terms	1

Question 32 (e) (7 marks)

Outcomes assessed: H1, H3, H9, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Relates the unique nature of individual DNA to the use of DNA analysis in forensic chemistry • Discusses the role of DNA analysis in forensic chemistry by comparing it to another method and referring to points for and against the use of the technique	6–7
• Relates the unique nature of individual DNA to the use of DNA analysis in forensic chemistry AND • Compares the role of DNA analysis in forensic chemistry with another method	4–5
• Identifies the unique nature of individual DNA and describes at least one use of DNA analysis in forensic chemistry	2–3
• Identifies the unique nature of individual DNA OR • Identifies a use of DNA analysis in forensic chemistry	1