CSSA

CATHOLIC SECONDARY SCHOOLS ASSOCIATION OF NSW
2013 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION
CHEMISTRY – MARKING GUIDELINES

Section I
Part A
20 marks

Questions 1-20 (1 mark each)

Question	Answer	Outcomes Assessed	Targeted Performance Band
1	D	H6, H9, H14	2-3
2	A	H6, H9, H11	2-3
3	C	H4, H5, H9	3-4
4	B	H7, H10, H14	4-5
5	B	H8, H13	4-5
6	A	H6, H14	3-4
7	D	H12, H13, H14	4-5
8	B	H4, H14	3-4
9	C	H4, H10, H12	5-6
10	B	H2, H8	3-4
11	D	H10, H12, H14	5-6
12	D	H8, H9, H14	4-5
13	A	H11, H12	3-4
14	C	H3, H12, H14	5-6
15	A	H3, H8, H12	4-5
16	B	H4, H12, H14	4-5
17	C	H3, H5	3-4
18	B	H1, H4, H6	3-4
19	D	H1, H4, H9	2-3
20	C	H10, H13	4-5

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Section I
Part B – 55 marks

Question 21 (4 marks)
(a) (1 mark)
Outcomes Assessed: H9, H14
Targeted Performance Bands: 2-3

Criteria	Mark
• Correct compound	1

Sample answer:
C_8H_{18}

(b) (1 mark)
Outcomes Assessed: H9
Targeted Performance Bands: 2-3

Criteria	Mark
• Correctly names compound identified in part (a)	1

Sample answer:
Octane (allow structural isomers eg. 2-methylheptane)

(c) (2 marks)
Outcomes Assessed: H4, H14
Targeted Performance Bands: 3-4

Criteria	Mark
• Identifies the need to alter the natural composition/proportion of hydrocarbons for industrial/economic reasons • Explains that catalytic cracking results in smaller chain hydrocarbons being produced	2
• Identifies crude oil as a mixture of hydrocarbons OR • Identifies the need to alter the natural composition/proportion of hydrocarbons for industrial/economic reasons OR • Explains that catalytic cracking results in smaller chain hydrocarbons being produced	1

Sample answer:
Crude oil is a mixture of many different hydrocarbons. The demand for certain fractions, such as octane and ethylene, outweighs the proportion to which they are naturally found in crude oil. To satisfy demand for these fractions, longer chain hydrocarbons are broken down into smaller chain hydrocarbons.

Question 22 (3 marks)
Outcomes Assessed: H4, H9, H10, H14
Targeted Performance Bands: 4-6

Criteria	Mark
• Correctly calculates the number of moles of each reactant present • Identifies the limiting reagent and uses it to calculate the mass of nylon produced • Correctly calculates the mass of nylon produced	3
• Correctly calculates the number of moles of each reactant present AND • Calculates the mass of nylon produced without identifying and using the limiting reagent	2
• Correctly calculates the number of moles of each reactant present	1

Sample answer:

n(hexane-1,6-diamine) = m/Mr = 250.0/116.20 = 2.15146...mol

n(hexandioic acid) = m/Mr = 250.0/146.14 = 1.71068...mol

1:1 ratio from equation so hexanedioic acid is the limiting reagent

n(nylon) = 1.71068...mol

m(nylon) = n x Mr

= 1.71068... x 244.31

= 417.9382... g

= 417.9 g (4 s.f.)

Question 23 (4 marks)
(a) (1 mark)
Outcomes Assessed: H9
Targeted Performance Bands: 3-4

Criteria	Mark
• Correctly balanced chemical equations for both reactions	1

Sample answer:

Ethanol: $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$

Octane: $C_8H_{18}(l) + 12.5O_2(g) \rightarrow 8CO_2(g) + 9H_2O(g)$

OR $2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$

(b) (3 marks)
Outcomes Assessed: H9, H10, H14
Targeted Performance Bands: 3-5

Criteria	Mark
• Identifies that the complete combustion of ethanol requires less moles of oxygen gas than that of octane • Relates this to an <u>increased likelihood</u> of complete combustion of ethanol • Identifies a benefit of complete combustion over incomplete combustion	3
• Identifies that the complete combustion of ethanol requires less moles of oxygen gas than that of octane • States that this results in the complete combustion of ethanol • Identifies a benefit of complete combustion over incomplete combustion OR • Identifies that the complete combustion of ethanol requires less moles of oxygen gas than that of octane • Relates this to an <u>increased likelihood</u> of complete combustion of ethanol	2
• Identifies that the complete combustion of ethanol requires less moles of oxygen gas than that of octane OR • Identifies a benefit of complete combustion over incomplete combustion OR • Identifies that ethanol is more likely to undergo complete combustion than octane without reference to moles of oxygen gas required	1

Sample answer:

As seen in the above equations, the complete combustion of ethanol requires 3 moles of oxygen gas per mole of fuel compared to the complete combustion of octane which requires 12.5 moles of oxygen gas per mole of fuel. This significant difference in oxygen requirement means that complete combustion of ethanol is more likely to occur than the complete combustion of octane.

This is of benefit as complete combustion does not release pollutant products, such as CO(*g*) *or* C(*s*) *into* the environment and is more energy efficient than incomplete combustion.

Question 24 (4 marks)
(a) (1 mark)
Outcomes Assessed: H3, H7, H14
Targeted Performance Bands: 3-4

Criteria	Mark
• Identifies the error in the table	1

Sample answer:
In the combination of tin and silver, silver would be the cathode rather than the anode and tin would be the anode, not the cathode.

(b) (3 marks)
Outcomes Assessed: H8
Targeted Performance Bands: 4-5

Criteria	Mark
• Identifies that the conclusion is invalid and gives a thorough explanation of the reasons	3
• Identifies that the conclusion is invalid and gives a sound explanation of the reasons	2
• Identifies that the conclusion is invalid and makes a link to the incorrect assumption made by the student in part (a)	1

Sample answer:
The student's conclusion is not valid because of the incorrect assumption made about the tin/silver cell in part (a). Calculating the cell potential by assuming that tin was the cathode would give a negative value of -0.94 V. This means that the reaction is not spontaneous and will not proceed. The potential actually measured by the student is for a cell with a tin anode and a copper cathode which has a positive value of 0.94 V. The student's conclusion that the most reactive metals were those anodes with the highest cell potentials only applies when each anode is compared to a tin cathode. Since this was not the case for the tin/silver cell, the student's conclusion is only correct for magnesium, zinc and nickel.

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Question 25 (3 marks)
Outcomes Assessed: H1, H5, H7
Targeted Performance Bands: 3-4

Criteria	Mark
• Identifies a specific transuranic element • Identifies the device used to produce the transuranic element and relates changes to the target nucleus to conditions within the device • Includes a balanced nuclear equation to demonstrate the formation of the chosen transuranic element	3
• Identifies a specific transuranic element AND • Identifies the device used to produce the transuranic element and relates changes to the target nucleus to conditions within the device OR • Identifies a specific transuranic element AND • Identifies the device used to produce the transuranic element AND • Includes a balanced nuclear equation to demonstrate the formation of the chosen transuranic element OR • Identifies a specific transuranic element AND • Includes a balanced nuclear equation to demonstrate the formation of the chosen transuranic element	2
• Includes a balanced nuclear equation to demonstrate the formation of a transuranic element OR • Identifies a device within which transuranic elements may be produced	1

Sample answer:
Transuranic elements may be produced by bombarding a target nucleus with a neutron. This often occurs in a nuclear reactor where large numbers of neutrons are released from the decay of other radioisotopes. An example of a transuranic element produced by neutron bombardment is Neptunium. It is formed according to the following equation:

$$^{238}U + {}^{1}n \rightarrow {}^{239}U \rightarrow {}^{239}Np + \beta$$

OR

Transuranic elements may be produced by bombarding a target nucleus with a nucleus of a smaller atom. This is carried out in a particle accelerator as it requires a large amount of energy to fuse the nuclei of two atoms together. An example of a transuranic element produced in a particle accelerator is Califonium. It is formed according to the following equation:

$$^{238}U + {}^{12}C \rightarrow {}^{246}Cf + 4{}^{1}n$$

Question 26 (7 marks)
Outcomes Assessed: H4, H7, H8, H14
Targeted Performance Bands: 3-6

Criteria	Mark
• Identifies, compares and accounts for the trends in the graphs using stoichiometric concepts and an understanding of the industrial sources of oxides of sulfur and nitrogen	6-7
• Identifies and accounts for the trends in the graphs using stoichiometric concepts and an understanding of the industrial sources of oxides of sulfur and nitrogen	4-5
• Identifies and compares the trends in the graph and provides some qualitative justification for the differences	2-3
• Identifies some trends in the graphs OR • Compares some of the quantities in the graphs	1

Sample answer:
Both power stations burn the same amount of coal each day over the ten-day period, which would explain why the energy production for both power stations is the same each day. The coal consumption increases from day 1 to 4, stays constant between days 4 – 6 and generally decreases again over the remaining four days. The energy production from each power station would follow the same pattern over the ten days as they seem to be linked by a linear relationship.

The production of oxides of sulfur follows the same pattern as the coal consumption for both power stations but Power Station B produces three times the mass of oxides of sulfur than Power Station A. Coal contains varying concentrations of sulfur and when combusted, the sulfur also burns to form oxides of sulfur as follows:

$$S(s) + O_2(g) \rightarrow SO_2(g) \text{ and } 2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

Since the sulfur content of Power Station B (1.5%) is three times larger than Power Station A (0.5%) by mass, the molar ratios in the above equations show that Power Station B should therefore produce three times as much as sulfur dioxide and trioxide. This is evidenced by both graphs showing that while the trends over the ten-day period follow the same pattern, Power Station B is always producing three times the quantity of oxides of sulfur.

The production of oxides of nitrogen follows the same trend as the oxides of sulfur and is linked again with the trend in coal consumption each day. However, there is little difference between the production of oxides of nitrogen between the two power stations. Air is used as a source of oxygen in a coal burning power stations and the heat energy in the furnace provides enough energy for the nitrogen and oxygen in the air to react as follows:

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \text{ and } 2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

Since both power stations are burning the same amount of coal each day they would require the same amount of oxygen. The molar ratios in the above equation indicate that if the same amount of oxygen was needed, they should produce the same amount of oxides of nitrogen as shown on the graph for each power station.

Question 27 (4 marks)
(a) (2 marks)
Outcomes Assessed: H2, H8
Targeted Performance Bands: 3-4

Criteria	Mark
• Correctly identifies a basic oxide and writes a balanced chemical equation to show it acting as a base	2
• Correctly identifies a basic oxide OR • Correctly identifies a basic oxide but writes a chemical equation to show it acting as a base that is not balanced or has incorrect formulae for some species	1

Sample answer:
Sodium oxide is a basic oxide and reacts with hydrochloric acid as follows:

$Na_2O(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l)$

(b) (2 marks)
Outcomes Assessed: H2, H8
Targeted Performance Bands: 4-5

Criteria	Mark
• Provides a definition of an amphoteric oxide and correctly identifies the acidic and basic behaviour in each equation	2
• Provides a definition of an amphoteric oxide OR • Correctly identifies the behaviour of zinc oxide in each equation	1

Sample answer:
An amphoteric oxide is an oxide that can act as either an acid or a base in a chemical reaction. The first equation shows zinc oxide acting as a base as it is reacting with sulfuric acid in a neutralisation reaction. In the second equation, zinc oxide is acting as an acid because it is reacting with the base potassium hydroxide in another neutralisation reaction. These two reactions show zinc oxide behaving as an acid in one reaction and as a base in another.

Question 28 (3 marks)
(a) (1 mark)
Outcomes Assessed: H8
Targeted Performance Bands: 3-4

Criteria	Mark
• Links the different pH values to the degree of ionisation and the concentration of hydrogen/hydronium ions	1

Sample answer:
The pH of each acid is measured using the concentration of hydronium ions in a solution of the acid. Since pH is a measure of the hydronium ion concentration and each acid ionises to a different degree, they will each have a different pH.

(b) (2 marks)
Outcomes Assessed: H2. H8, H12
Targeted Performance Bands: 5-6

Criteria	Mark
• Identifies a weak acid solution as an equilibrium system, uses Le Chatelier's principle to account for the increase in hydrogen ion concentration and links it to the pH change	2
• Identifies a weak acid solution as an equilibrium system and uses Le Chatelier's principle to account for the increase in hydrogen ion concentration	1

Sample answer:
When the concentration of hydronium ions changes by a factor of 10, the pH changes by a factor of one from the equation $pH = -\log_{10}[H^+]$. Diluting the acid 10 times should therefore increase the pH to 3.9. However, a solution of a weak acid is also an equilibrium system and diluting the acid will lower the concentration of hydronium ions causing a shift in the position of equilibrium to favour the products. This increases the concentration of hydronium ions and lowers the pH. The net effect of the dilution would therefore be an increase of 0.5 pH units rather than one.

Question 29 (4 marks)
(a) (1 mark)
Outcomes Assessed: 2-3
Targeted Performance Bands: H8, H14

Criteria	Mark
• Describes the function of a buffer	1

Sample answer:
A buffer is an aqueous solution able to keep the pH at a constant level when small quantities of acid or base are added.

(b) (3 marks)
Outcomes Assessed: H8, H14
Targeted Performance Bands: 4-5

Criteria	Mark
• Writes a chemical equation for the buffer system and uses equilibrium principles to explain how the pH is kept constant on the addition of acid and base	3
• Writes a chemical equation for the buffer system and uses equilibrium principles to explain how the pH is kept constant on the addition of an acid or base only	2
• Writes a chemical equation for the buffer system	1

Sample answer:
The buffer is an equilibrium system represented by the following equation.

$$H_2CO_3(aq) + H_2O(l) \rightleftharpoons HCO_3^-(aq) + H_3O^+(aq)$$

When acids are added to the system in the form of hydronium ions, their increasing concentration causes a decrease in pH and the system to shift toward the reactants. This lowers the concentration of hydronium ions and increases the pH back to its former level. When bases are added to the system in the form of hydroxide ions, their increasing concentration causes an increase in pH. They react with the hydronium ions to form water and this lowers the concentration of hydroxide ions and decreases the pH back to its former level.

Question 30 (6 marks)
(a) (1 mark)
Outcomes Assessed: H10
Targeted Performance Bands: 2-3

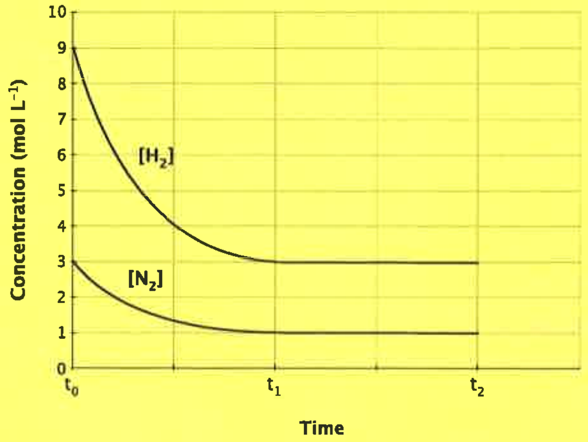
Criteria	Mark
• Identifies correct value	1

Sample answer:
9 mol L^{-1}

(b) (1 mark)
Outcomes Assessed: H10, H12, H13
Targeted Performance Bands: 3-4

Criteria	Mark
• Draws line correctly reflecting correct concentrations and time to reach equilibrium	1

Sample answer:



(c) (2 marks)
Outcomes Assessed: H8, H14
Targeted Performance Bands: 2-4

Criteria	Mark
• Explains the lack of change to the curves by stating that a catalyst will not shift the position of equilibrium only increase the rate of reaching equilibrium	2
• Identifies no change to the curves OR that a catalyst will not shift the position of equilibrium	1

Sample answer:
A catalyst is able to increase the rate of the forward and reverse reactions but it cannot shift the position of equilibrium. As the system is at equilibrium (as shown by the horizontal lines), both curves will continue to be horizontal as there will be no change in the concentration of either reactant.

(d) (2 marks)
Outcomes Assessed: H3, H8, H14
Targeted Performance Bands: 3-4

Criteria	Mark
• Identifies and explains a method for increasing the concentration of ammonia	2
• Identifies a method for increasing the concentration of ammonia	1

Sample answer:
(Various answers)
Increasing the pressure will increase the concentration of ammonia. The balanced equation has four reactant molecules and two product molecules. According to Le Chatelier's principle, an increase in pressure will force the system to reduce the pressure by reducing the total number of molecules in the system. This is achieved by favouring the forward synthesis reaction thereby increasing the equilibrium concentration of ammonia.

Question 31 (2 marks)
Outcomes Assessed: H12
Targeted Performance Bands: 2-3

Criteria	Mark
• Identifies an Australian practising scientist and outlines their area of research	2
• Identifies an Australian practising scientist	1

Sample answer:
(various answers)
Veena Sahajwalla at the University of NSW. Professor Sahajwalla's research has involved the properties of carbon materials including coals, cokes, graphites, plastics and rubber tyres. She has demonstrated how waste plastics and waste rubber can be used as partial replacements for coal and coke in steelmaking.

Question 32 (3 marks)
Outcomes Assessed: H11, H14
Targeted Performance Bands: 3-4

Criteria	Mark
• Outlines a procedure that correctly identifies each reagent, includes expected results and does not destroy the entire reagent sample	3
• Outlines a procedure that correctly identifies each reagent and includes expected results	2
• Identifies a reagent that could be used to distinguish between the other two reagent solutions OR • Outlines a procedure that does not contaminate the reagent bottles	1

Sample answer:
A small sample of each unknown should be taken and added to each of two test tubes so as not to contaminate each reagent bottle. A few drops of barium chloride solution should be added to each test tube. The test tube where a precipitate of barium sulfate forms would indicate that the reagent was sodium sulfate. The other test tube containing sodium chloride would have no reaction.

Question 33 (4 marks)
(a) (3 marks)
Outcomes Assessed: H1, H8, H9, H10, H16
Targeted Performance Bands: 4-5

Criteria	Mark
• Correctly defines CFCs and gives a detailed account including equations to show the formation of chlorine radicals and the steps involved in ozone depletion	3
• Correctly defines CFCs and gives a partial account including at least one equation to show the steps involved in ozone depletion	2
• Correctly defines CFCs AND/OR describes steps involved in the depletion of ozone	1

Sample answer:
CFC stands for chlorofluorocarbon. They are compounds that contain only carbon, chlorine and fluorine. They may be thought of as hydrocarbons that have had all of the H atoms replaced by Cl and F.

In the stratosphere, UV energy is able to cleave a Cl from the molecule resulting in a chlorine radical, for example:

$CCl_3F + UV \rightarrow Cl\bullet + \bullet CCl_2F$

The chlorine radical is then able to react with ozone molecules as shown below:

$Cl\bullet + O_3 \rightarrow \bullet ClO + O_2$

$ClO + \bullet O \rightarrow O_2 + Cl\bullet$

As can be seen by these equations, the chlorine radical is reformed during the reaction scheme.

The chlorine radical is able to undergo this cycle many times before encountering a species that can inactivate it. Thus, one Cl radical can destroy thousands of molecules of ozone.

(b) (1 mark)
Outcomes Assessed: H8, H9
***Targeted Performance Bands*: 3-4**

Criteria	Mark
• Correctly identifies CFC as stable compounds that persist in the troposphere for long periods of time allowing them the opportunity to diffuse into the stratosphere	1

Sample answer:
CFCs were used because of their chemical stability. Under the conditions found in the lower atmosphere they are chemically inert and so are very stable and persist in the atmosphere for long periods of time. This stability allows them to diffuse into the upper atmosphere over time allowing them to become involved in the reaction mechanism shown earlier. The CFCs released into the troposphere are likely to remain a problem for the next 50 to 100 years.

Question 34 (4 marks)
(a) (3 marks)
Outcomes Assessed: H3, H4, H16
***Targeted Performance Bands*: 3-5**

Criteria	Mark
• Outlines a method of determining DO levels and discusses the link between DO and water quality	3
• Outlines a method of measuring DO and addresses the link between DO and water quality OR • Discusses the link between DO and water quality	2
• Outlines a method of measuring DO OR • Addresses the link between DO and water quality	1

Sample answer:
Dissolved oxygen levels report the amount of oxygen dissolved in a water sample. The unit used is ppm or mg of oxygen per litre of water. The two most common methods used to measure this are using an electronic meter or titration. Oxygen sensitive probes may be used to directly determine dissolved oxygen levels. Alternatively the dissolved oxygen levels may be determined by titrating measured samples of water which has been treated with an alkaline solution of manganese (II) ions and iodide ions which is then titrated against a thiosulfate standard using starch as the indicator.

Good quality drinking water needs to have a reasonable level of DO oxygen as it makes the water taste better. Aquatic environments need DO oxygen levels well above 5 ppm to sustain life. Aquatic life has a requirement for oxygen in respiration and at low levels can compromise reproduction or even cause death. The death of plant life in particular can further reduce DO levels through eutrophication.

(b) (1 mark)
Outcomes Assessed: H10, H13
***Targeted Performance Bands*: 2-3**

Criteria	Mark
• Calculates the concentration of dissolved solids in the sample	1

Sample answer:
Total dissolved solids in sample = 0.46-0.35 = 0.11g
Concentration = 0.11/0.2 = 0.55 gL^{-1}

Question 36 - Shipwrecks, Corrosion and Conservation (25 marks)
(a) (i) (1 mark)
Outcomes Assessed: H6
***Targeted Performance Bands*: 2-3**

Criteria	Mark
• Identifies correctly	1

Sample answer:
Aluminium (or copper, zinc, titanium, magnesium)

(a) (ii) (2 marks)
Outcomes Assessed: H6, H8
***Targeted Performance Bands*: 2-4**

Criteria	Mark
• Accounts for the slow rate of corrosion by describing the oxide coating as non-permeable and strongly adhering	2
• Describes the formation of an oxide coating	1

Sample answer:
Aluminium reacts with the atmosphere to form an oxide coating which is non-permeable and strongly adheres to the surface. This coating forms a physical barrier preventing contact by water and oxygen and thus stopping any further corrosion of the underlying metal.

(b) (4 marks)
Outcomes Assessed: H6, H8
***Targeted Performance Bands*: 2-6**

Criteria	Mark
• Evaluates by relating the information in the source to the contributions of Davy to our understanding of electron transfer reactions AND • Making a sound judgment of relevance	4
• Evaluates by relating the information in the source to Davy AND • Making a judgment of relevance	3
• Evaluates the relevance based on limited knowledge of Davy's contributions to electron transfer reactions	2
• Describes a contribution of Davy to our understanding of electron transfer reactions	1

Sample answer:
Davy's contribution to the understanding of electron transfer reactions was significant. Whilst the electron and the structure of the atom were yet to be discovered, Davy recognised that the electricity from the voltaic pile was the result of a chemical reaction. He also proposed that this electricity brought about the reaction that decomposed molten salts and produced pure metals. His work with electrolysis had a significant impact as it led to future investigations about the nature of this electrolysis reaction and the eventually to the discovery of the electron transfer mechanism.

The information from the secondary source varies in its relevance.

The first paragraph is relevant as it refers to Davy's work where he refined the first battery and used it to electrolytically isolate two new metals from their molten salts. Whilst this information is relevant it lacks the detail required for a satisfactory analysis.

The section about chlorine is less relevant. Whilst the reaction used to produce the chlorine was an electron transfer reaction (redox) it is unknown whether Davy used electrochemistry to determine whether the substance was indeed an element or whether he suspected that the reaction was in any way related to the "electrical forces" in chemical compounds.

The final section about hydrochloric acid is not relevant as it pertains to Davy's work on acids where he rejected Lavoisier's theory that all acids contain oxygen.

(c) (4 marks)
Outcomes Assessed: H3, H4
***Targeted Performance Bands*: 2-4**

Criteria	Mark
• Designs an appropriate investigation including quantitative directions for the solutions, repetition, controls and instructions for recording results	4
• Designs an appropriate investigation that achieves most of the above	3
• Designs an investigation that achieves some of the above	2
• Identifies some steps in an investigation to compare corrosion in different salt concentrations	1

Sample answer:

1. Dissolve 35g of solid sodium chloride in water until it reaches a final volume of 1000mL.
2. Repeat step 1 with 300g of sodium chloride.
3. Pour each of the salt solutions into ten labelled petri dishes.
4. Completely submerge a freshly cleaned iron nail into each petri dish.
5. Cover, place all dishes in the same location and observe and photograph for two weeks.
6. Compare the amount and rate of development of orange rust on the nails.

(d) (i) (1 mark)
Outcomes Assessed: H3
***Targeted Performance Bands*: 2-3**

Criteria	Mark
• Identifies correctly	1

Sample answer:
Anode or sacrificial anode or magnesium electrode or zinc electrode

(d) (ii) (1 mark)
Outcomes Assessed: H8, H13
***Targeted Performance Bands*: 3-4**

Criteria	Mark
• Writes a correct chemical equation	1

Sample answer:
$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

(d) (iii) (4 marks)
Outcomes Assessed: H3, H4
***Targeted Performance Bands*: 2-5**

Criteria	Mark
• Compares BOTH methods thoroughly identifying advantages and disadvantages of BOTH	4
• Compares BOTH methods identifying an advantage and disadvantage of BOTH	3
• Compares BOTH methods	2
• Identifies a feature of each method	1

Sample answer:

Feature	Method A	Method B
name	cathodic protection using a sacrificial anode	cathodic protection using an impressed current
maintenance	Requires regular replacement of the anode which will require a diver to undertake infrequent inspections and replacements.	Requires a constant supply of electricity which can be monitored frequently from above the water. The use of an inert anode should almost eliminate the need for replacement of the anode.
coverage	will only protect a region close to the attachment of the anode so large structures will need multiple anodes	Size of protected region depends on the size of the impressed current and large structures will need multiple batteries
cost	Inexpensive to set up and inexpensive to maintain aside from labour costs	More expensive to set up and maintain
environments	Less effective in poor electrolytes (fresh water and terrestrial locations)	More effective in poor electrolytes (fresh water and terrestrial locations)

(e) (i) (1 mark)
Outcomes Assessed: H14
***Targeted Performance Bands*: 2-3**

Criteria	Mark
• Identifies an appropriate reason	1

Sample answer:
The coral formed an impervious layer that prevented seawater and hence oxygen, water and chloride ions from coming into contact with the iron cannon.