(3)

CATHOLIC SECONDARY SCHOOLS ASSOCIATION

2002 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

CHEMISTRY MARKING GUIDELINES

Section I
Part A
Questions 1-15 (1 mark each)

Question	Correct Response	Outcomes
1	C	H8, H9
2	A	H9
3	C	H8
4	D	H6
5	C	H7
6	B	H12
7	B	H8
8	C	H11

Question	Correct Response	Outcomes
9	A	H6
10	D	H10, H12, H14
11	B	H11
12	A	H12
13	B	H6
14	D	H8
15	B	H6

Section I
Part B (Total marks 60)

Question 16 (5 marks)
(a) (1 mark)
Outcomes Assessed: H4, H9
Targeted Performance Bands: 2-3

Criteria	Marks
• Correct response of chloroethene	1

(b) (2 marks)
Outcome Assessed: H4
Targeted Performance Bands: 3-4

Criteria	Marks
• Identifies use and relates to physical property	2
• Identifies a correct use OR • Identifies a property of the plastic	1

Sample Answer:
PVC is used in underground piping. It is useful because PVC is stiffer than polyethene because of the Cl side chain. It is best used underground because the Cl side chain makes it susceptible to weakening in the presence of UV-light.

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(c) (2 marks)
Outcomes Assessed: H4, H9, H14
Targeted Performance Bands: 2-4

Criteria
• Clearly establishes link between plastics being made from ethene/ethene derivatives and the source of ethene being fossil fuels eg crude oil
• Identifies plastics as polymers based on hydrocarbons OR • Identifies plastics as coming from fossil fuels

Sample Answer:
Many plastics are based on the polymerisation of ethene or monomers based on eth chloroethene. The major source of ethene is crude oil ie a fossil fuel. By recycling plas reduce the use of ethene and hence fossil fuels.

Question 17 (a) (1 mark)
Outcome Assessed: H11
Targeted Performance Bands: 2-3

Criteria
• Correctly identifies hazard

Sample Answer:
The concentrated sulfuric acid is extremely corrosive to skin, clothing and eyes

(b) (2 marks)
Outcome Assessed: H12
Targeted Performance Bands: 2-3

Criteria
• Correctly identifies a safety precaution related to the chosen hazard
• Correctly identifies a safety precaution

Sample Answer:
Use a dropper to administer the concentrated sulfuric acid, since it is less likely that a s will occur and only small quantities are added.

(c) (3 marks)
Outcome Assessed: H14
Targeted Performance Bands: 3-6

Criteria
• Identifies that the results do not demonstrate the breakdown of cellulose in wood AND • Explains that the reaction of the negative control sample (untreated wood) to iodine did not allow the decomposed cellulose products to be identified, since wood already contains substances that react with iodine
• Explains that the results for treated and untreated wood were the same AND • Identifies that the results do not demonstrate the breakdown of cellulose in wood
• Explains that the results for treated and untreated wood were the same OR • Identifies that the results do not demonstrate the breakdown of cellulose

Question 18 (3 marks)
Outcome Assessed: H4
Targeted Performance Bands: 3-4

Criteria	Marks
• Describes process	3
• Outlines process	2
• Identifies the use of a reactor	1

Sample Answer:
In this example, salt containing non-radioactive sodium-23 would be taken to a nuclear reactor such as the one at Lucas Heights in Sydney and placed in the core of the reactor. It is then bombarded with neutrons. When a sodium-23 atom gains a neutron to form sodium-24, the nucleus becomes unstable and emits beta particles.

Question 19 (6 marks)
Outcomes Assessed: H2, H14
Targeted Performance Bands: 2-6

Criteria	Marks
• Discusses advantages AND disadvantages, using examples	5 – 6
• Discusses advantages OR disadvantages, using examples OR • Discusses advantages AND disadvantages, WITHOUT examples OR • Identifies advantages AND disadvantages, using examples	3 – 4
• Identifies advantages OR • Identifies disadvantages OR • Gives examples of models used in chemistry.	1 – 2

Sample Answer:
Models can be used to show how monomers are linked to form polymers, they can be used to simulate the movement of the electrons during bond-breaking and bond-forming or the movement of protons during acid-base reactions particularly to distinguish between the ionisation of strong and weak acids. Models also give an indication of which atoms are joined to which and the general shape of the molecule is understood, to help in the understanding of isomers. They are used to visualise what is happening at the atomic or sub-atomic level. Models, however, are not to scale so they can only be used to give general ideas, not accurately measured information.

Question 20 (6 marks)
Outcome Assessed: H11
Targeted Performance Bands: 2-5

Criteria
• Distinguishes between destructive AND non-destructive procedures, with reference to bromothymol blue and the pH meter AND • Identifies the different results AND links them to the accuracy of the technique AND the strength of the acid
• Defines destructive AND non-destructive without examples OR • Defines destructive OR non-destructive with examples AND • Identifies different results AND links them to the accuracy of the technique OR the strength of the acid
• Defines destructive OR non-destructive AND • Identifies results using one of the testing procedures

Sample Answer:
Using bromothymol blue is a destructive testing method since once the indicator has be added to the test solution (the acid), it cannot be removed to return the solution to its or "state". The pH meter does not change the test solution, however, it allows for the colle of data. The bromothymol blue will give the same colour (yellow) in both solutions sin would both have pHs < 6.5 thus, they cannot be distinguished using this indicator. The meter is more sensitive and since HCl is a strong acid and acetic acid is a weak acid, th meter will record different readings for each acid – HCl ~ 1 and CH_3COOH >2.

Question 21 (4 marks)
Outcomes Assessed: H1, H2, H13
Targeted Performance Bands: 3-6

Criteria
• Explains amphiprotic behaviour using correct equations to illustrate OR • Provides two net ionic equations showing bicarbonate reacting with an acid and with a base
• Constructs one correct equation AND identifies that bicarbonate ion is capable of donating or gaining a proton OR • Constructs two equations showing amphiprotic behaviour but includes spectator ions
• Constructs one correct equation involving sodium bicarbonate or bicarbonate ions with either an acid or a base
• Defines amphiprotic

Sample answer:
In water, sodium hydrogen carbonate dissociates to produce sodium ions and hydrogen carbona
The HCO_3^- ion can act as a Bronsted-Lowry acid or base because it can accept or donate a prot

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

$HCO_3^-(aq) + OH^-(aq) \rightleftharpoons CO_3^{2-}(aq) + H_2O(l)$ in basic solution

Substances which can both donate and accept protons are called amphiprotic.

Question 22 (a) (3 marks)
Outcomes Assessed: H8, H14
Targeted Performance Bands: 3-5

Criteria	Marks
• Applies Le Chatelier's Principle to explain loss of CO_2	3
• Describes the effect of increasing temperature on the solubility of CO_2 and relates to observed change OR • Describes the effect of heating on the equilibrium position and relates to the observed change	2
• Outlines the effect of increasing temperature on the solubility of CO_2 OR • Outlines the effect of heating on the equilibrium position	1

Sample Answer:
As the temperature increases, the solubility of carbon dioxide decreases. This is because the solution reaction is exothermic.

$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

According to Le Chatelier's Principle, applying heat will favour the left as the equilibrium attempts to minimise the effects of heating. The CO_2 will come out of solution and will be lost to the atmosphere as the can is no longer a closed system.

(b) (2 marks)
Outcomes Assessed: H11, H12
Targeted Performance Bands: 2-4

Criteria	Marks
• Describes a control	2
• Identifies the need for a control	1

Sample Answer:
This is not a fair test because water will be lost to the atmosphere. A control can with water or flat cola with the same volume as the original cola should be placed on the hot plate and heated at the same time. The mass difference between the cans after the experiment is the loss due to CO_2.

Question 23 (4 marks)
Outcomes Assessed: H10, H12, H14
Targeted Performance Bands: 2-5

Criteria	Marks
• Correct answer and all working shown clearly (units can be assumed)	4
• Applies n =m/M and c = n/v without considering the dilution factor or unit conversion OR • Applies n =m/M and c = n/v with an incorrect molecular weight	3
• Applies n =m/M or c = n/v without considering the dilution factor or unit conversion or with an incorrect molecular weight OR • Gives correct answer with no working	2
• Calculates molecular weight OR • Converts units OR • Calculates dilution factor (x 40)	1

Sample Answer:

Molecular mass of aspirin = $(9 \times 12) + (8 \times 1) + (4 \times 16) = 180$ g/mol
Mass of aspirin = 50 mg = 5×10^{-2} g
n = m/M = 5×10^{-2} g / 180 g/mol = 2.78×10^{-4} mol (in 25 mL sample)
The dilution factor is 40.
n = $40 \times 2.78 \times 10^{-4} = 0.0111$ mol (in original 100 mL sample)
c = n/v =0.0111 /0.1L
= 0.11 mol/L

Question 24 (a) (3 marks)
Outcomes Assessed: H3, H12
Targeted Performance Bands: 2-4

Criteria	Marks
• Identifies that diagram b is more relevant than photograph a and describes reasons for each diagram	3
• Identifies that diagram b is relevant AND outlines reasons for its relevance OR • Identifies that diagram b is relevant and photograph a is less relevant	2
• Identifies that diagram b is relevant	1

Sample Answer:

Diagram B is a typical water plant so it identifies features to look for in any local town water supply. It clearly identifies both physical and chemical processes. Therefore, it is relevant to the research task. Photograph A is less relevant because it relates to a specific water plant in England and has no detail about the chemical processes although it appears to be showing filtration.

Question 24 (b) (2 marks)
Outcomes Assessed: H3, H12
Targeted Performance Bands: 4-5

Criteria	Marks
• Identifies the need to compare to other sources AND identifies one or more of the following considerations: recency, publisher, author	2
• Identifies the need to compare to other sources OR • Identifies one or more of the following considerations: recency, publisher, author	1

Sample Answer:

To consider the reliability of the source material, you should consider the date of publication, the reputation of the publisher/author and compare the information to other sources.

Question 25 (7 marks)
Outcomes Assessed: H3, H8, H11, H12, H13
Targeted Performance Bands: 2-6

Criteria	Marks
• Justifies a procedure used to determine the nitrogen content in fertiliser AND • Includes all relevant equations AND • Identifies the assumptions made in the methodology	6 – 7
• Describes a procedure used to determine the nitrogen content in fertiliser AND • Includes at least one relevant equation OR • Identifies an assumption made in the methodology	4 – 5
• Describes a procedure used to determine the nitrogen content in fertiliser OR • Includes at least one relevant equation	2 – 3
• Identifies that titration is the technique used OR • Identifies ONE assumption made in methodology	1

Sample Answer:
A known mass of fertiliser is added to water then a known number of moles (in excess) of NaOH is added to the fertiliser solution. The reaction is:

$$NH_4^+ + OH^- \rightarrow H_2O(l) + NH_3(g)$$

It is assumed that all of the nitrogen in the fertiliser is present as ammonium and it all reacts with the sodium hydroxide. This solution is then titrated against standardised HCl. The excess NaOH reacts with the HCl according to the equation below:

$$H^+ + OH^- \rightarrow H_2O(l)$$

Thus, the quantity of nitrogen in the fertiliser can be determined:
n (N) = n (NH_4^+) = n (NaOH reacted with NH_4^+) = n (total NaOH) – n (NaOH reacted with HCl)

Question 26 (6 marks)
Outcomes Assessed: H3, H6, H7, H8, H10, H13
Targeted Performance Bands: 2-6

Criteria	Mark
• Assesses the significance of ammonia production to society, relating it to world events at the time the process was developed AND • Provides a balanced chemical equation for the Haber process	6
• Identifies the significance of ammonia production to society AND • Provides a balanced chemical equation for the Haber process	4-5
• Describes some uses of ammonia	2-3
• Identifies ammonia as the product of the Haber process	1

Sample Answer:
The Haber process produces ammonia from nitrogen and hydrogen, as shown in the equation below.

$$N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$$

Ammonia is used in the production of fertilisers and explosives. At the beginning of the 1900s, the world's population was increasing. There was a need to develop an industrial process to produce ammonia since the natural supplies of nitrogen based compounds were in short supply. The ammonia would be used to fertilise crops to produce food for the world's increased population. It was also a militarily unstable time, thus countries felt that they needed to develop and stockpile explosives for defence purposes. The industrial production of ammonia was successfully developed by a German and hence enhanced the German war efforts of 1914, since they were no longer dependent on importing nitrogen-based compounds from abroad.

Question 27 (3 marks)
Outcomes Assessed: H9, H13
Targeted Performance Bands: 2-5

Criteria	Mark
• Explains why CFCs can destroy ozone whilst HFCs do not (identifying the role of chlorine in the destruction of ozone) AND • Describes an effect of ozone destruction on living things	3
• Describes the beneficial role that ozone plays in the stratosphere	2
• Identifies that CFCs destroy ozone OR • HFCs do not destroy ozone	1

Sample Answer:
Ozone (O_3) in the stratosphere absorbs the harmful UV radiation from the Sun, namely UV-b and some UV-c. Depletion of the ozone layer allows some of these harmful UV-rays to reach the Earth's surface. CFCs diffuse through the atmosphere to the stratosphere. They contain chlorine atoms that react with the ozone to break it down to oxygen (O_2), reforming the chlorine atom so that the destruction process can continue. HFCs can be used for the same purposes as CFCs, however, they do not contain chlorine so they do not react with ozone.

(d) (6 marks)

Outcomes Assessed: H8, H12

Targeted Performance Bands: 2-6

Criteria	Marks
• Thoroughly describes a valid investigation AND • Describes ways in which accuracy AND reliability could be improved (makes link)	5 – 6
• Describes a valid investigation AND • Describes ways in which accuracy AND reliability could be improved	3 – 4
• Describes a valid investigation OR • Describes ways in which accuracy OR reliability could be improved	1 – 2

Sample Answer:

Place a piece of metal in separate containers with

a) distilled water
b) seawater
c) acidified seawater

Place all containers together and record observations every day for a week

The accuracy could be improved by using a pH meter to record the pHs of the solutions and the reliability could be improved by repeating the experiment at least three times to compare results

(e) (7 marks)

Outcomes Assessed: H1, H7, H13

Targeted Performance Bands: 2-6

Criteria	Marks
• Analysis of the contribution of Galvani, Davy AND Faraday in relation to electron transfer reactions	6 – 7
• Analysis of the contribution of two of Galvani, Davy and Faraday in relation to electron transfer reactions OR • Description of contributions of Galvani, Davy AND Faraday	4 – 5
• Analysis of the contribution of one of Galvani, Davy AND Faraday in relation to electron transfer reactions OR • Identifying the contribution of two of Galvani, Davy and Faraday	2 – 3
• Identifying the contribution of Galvani OR Davy OR Faraday	1

Sample Answer:

Galvani performed a series of investigations on the effect of static charge on the muscles and nerves in the legs of frogs. He also observed that the frog's legs continually twitched when the frog's spinal cord was attached to an iron railing by brass hooks. He concluded that animal tissue contained 'animal electricity'.

Davy explored applications of the Voltaic pile. He constructed the largest battery ever built and passed a strong electric current through the molten salts of various compounds (potassium hydroxide and sodium hydroxide) he suspected of containing undiscovered elements. His contribution was significant because he was able to isolate the metals potassium, sodium, strontium, calcium , magnesium and barium.

Faraday was Davy's assistant and delved into the quantitative aspects of electrochemistry. Faraday developed laws of electrolysis: that the amount of an element produced by electrolysis was dependent on the quantity of electricity passed through the circuit and the atomic weight of the element and its valency. This is important in industrial applications of electrochemistry.