

Independent Trial 2010 Chemistry Marking scheme

Section 1 – Part A

1	B	6	D	11	C	16	B
2	C	7	A	12	D	17	A
3	A	8	B	13	C	18	C
4	B	9	D	14	B	19	D
5	C	10	A	15	A	20	D

One mark each

Section 1 – Part B

- 21 a)** water (H₂O) is the by-product 1
- the monomer units are linked by an ester group (–COO–) so PGA is a polyester 1
- 21 b)** $\text{rmw C}_2\text{H}_2\text{O}_2 = 58$, for $\text{rmw} 60\,000$, number of units = $60000/58 \approx 1000$ units (1058) 1
- 21 c)** biodegradable means a substance can be broken down into simpler substances by factors in the environment 1
- esterification is a reversible process, fluids in the body such as water in blood, can provide conditions suitable for reversing the esterification. 1
- 22 a)** ethanol **OR** methane 1
- fermentation of sugars from biomass in anaerobic conditions 1
- fermentation (digestion) of biomass by anaerobic bacteria
- 22 b)** ethanol is a chemically stable liquid that can be transported in tanks or pipes, methane is a gas fuel that can be easily transported in pipes, biomass provides solid fuel that requires handling to be made useful 1
- 22 c)** TWO problems may include; biofuel requires land, fertilizer and water, adding pressure to the supply of these resources. Competition for food production due to production of biomass. Biofuel production requires energy and produces greenhouse gases. 2
- 23 a)** Labelled diagram of a Galvanic cell with one zirconium electrode 1
- correct labels on the diagram 1
- 23 b)i)** $\text{Mg}_{(s)} \rightarrow \text{Mg}_{(aq)}^{2+} + 2\text{e}^-$ 1
- 23 b) ii)** Zirconium is less active than magnesium but more active than nickel or zinc 1
- Magnesium electrode is oxidised with zirconium, but nickel and zinc are reduced 1

23 c) Copper produces potential difference 1.1V with zinc, zinc produces 0.7V with zirconium 1

Zirconium / copper cell will reduce copper (cathode, +ve) and produce $1.8V E^{\ominus}$ 1

24 a) the product nucleus will consist of 90 protons and 137 neutrons 1

24 b) alpha radiation is blocked by a layer of aluminium foil while beta is transmitted 1

Set the Geiger counter a fixed distance from the actinium source; measure the total activity of the unshielded source and the activity of the shielded source. The activity of the shielded source is beta radiation, while the difference between the activities of the unshielded and shielded sources is the alpha radiation. 2

s Sulfur dioxide is removed from the atmosphere by rain water;

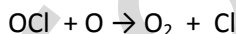


The rivers and lakes affected by acid rain have lower pH, leading to the death of aquatic life. Acid rain also damages susceptible buildings and monuments e.g those made of limestone.1

CFCs remain in the atmosphere for long periods of time and can react with UV light to produce chlorine atoms $CCl_2F_2 \rightarrow CClF_2 \cdot + Cl$

Chlorine atoms can react with atmospheric ozone; $Cl + O_3 \rightarrow O_2 + OCl$

The perchlorate formed can remove the oxygen atoms needed to make ozone



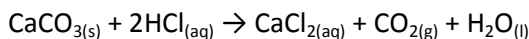
In this way, the CFCs can cause significant deterioration in the levels of atmospheric ozone, exposing terrestrial animals and plants to damaging UV radiation 1

26 Must identify and justify 4 steps;

Step taken	Justification
Rinse the burette with diluted vinegar solution	Increases the accuracy of the titration by ensuring that the titre is not contaminated or diluted
Rinse the conical flask with distilled water	Remove any contaminant from the inside of the glassware
Rinse the pipette with standard NaOH solution	To remove any contaminant and ensure that the concentration of the standard solution is not altered by pipetting it between containers.
Standardise the NaOH solution against a primary standard prior to its use in the titration	Ensure that the concentration of the NaOH solution is known as the solution may change concentration with contact with air.
Phenolphthalein indicator is used	Phenolphthalein changes colour in the pH range of 9 – 11 so it will indicate when the titration reaches equivalence point.

The titration was repeated and an average titre used to calculate the concentration of the acetic acid in the solution	Increases the reliability of the results.
White paper was placed under the conical flask	To more accurately observe the colour change of the indicator in the titrant

27 a) Reaction stoichiometry to calculate moles of $\text{CO}_{2(g)}$;

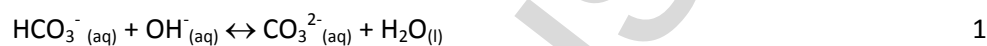


$$n_{\text{CaCO}_3} = m/M = 5.00\text{g} / 100.09\text{g mol}^{-1} = 0.0500 \text{ mol} \quad 1$$

Since ratio $\text{CaCO}_3:\text{CO}_2 = 1:1$, moles $\text{CaCO}_3 = \text{moles CO}_2$

$$\text{Volume of gas produced at } 25^\circ\text{C} = 0.0500 \text{ mol} \times 24.75\text{L} = 1.24\text{L of CO}_2 \text{ gas} \quad 1$$

27 b) $\text{HCO}_3^-_{(aq)}$ is amphoteric 1

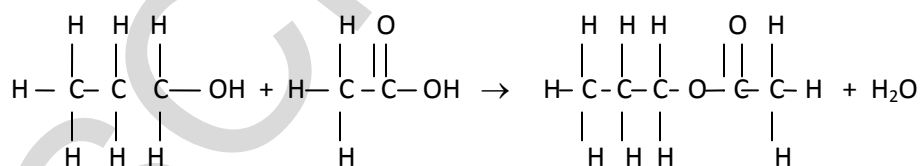


27 c) Procedure for removing CO_2 gas from a measured volume of drink 1

Measurements and basis for calculating mass of CO_2 gas 1

Example: A can of soft drink was weighed and the mass recorded. With the top of the can open, it was warmed to 40°C in a water bath and then the can was reweighed. Assuming that all of the mass change is due to CO_2 loss, the mass of CO_2 was calculated. The volume of CO_2 lost can be calculated using $V = (\text{mass loss} / 40 \text{ g mol}) \times 24.79 \text{ L mol}^{-1}$

28 a) structural formulae for 1 – propanol and acetic acid 1



1 – propanol acetic acid propyl ethanoate (propyl acetate) 1

28 b) explanation: Catalysts are used in esterification because the ester product forms slowly as a bond in the hydroxyl group of each molecule must be broken. The catalyst lowers the energy requirement for the reaction and so with heating the reaction occurs more quickly. 1

29 a) Haber process equation $3\text{H}_{2(g)} + \text{N}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$ 1

A decrease in pressure will shift equilibrium in favour of greater total moles of gas according to Le Chetallier's principle 1

29 a) so more hydrogen and nitrogen gas will be present in the reaction. 1

29 b) exothermic 1

As temperature increases, percentage yield of ammonia decreases indicating that the reaction is slowed by increasing temperature, the reaction must produce heat or the rate of reaction would be expected to increase with increasing temperature. 1

30 (*procedure for preparing a standard solution of cobalt II ions*)

Mole Co (II) ion required; $1.00\text{g}/58.9\text{ g mol}^{-1} = 0.0170\text{ mol}$

To make the required solution, dissolve 0.0170 mol (3.11g) of $\text{Co}(\text{NO}_3)_2$ in 100 mL of distilled water. 1

Dilute 10 mL of this solution in 1.00L of distilled water, then dilute 10mL of the resulting solution in 1.00L of distilled water to make a $1\mu\text{g L}^{-1}$ solution. 1

31a) Dissolved oxygen and biological oxygen demand are plotted on the same axes using separate line graphs that are labelled or identified using a key 2

Both axes correctly plotted 1

31b) 1 to 1.5 km 1

31c) DO refers to the level of dissolved oxygen in the water of a stream.

BOD refers to the demand for oxygen by all organisms in the water 1

At the discharge point the level of DO is quite high and the BOD is low as little organic material is present in the stream. DO decreases downstream from the effluent addition point; as BOD increases due to increase number and activity of microorganisms. 1

31 d) A sample of water is taken and the oxygen concentration is measured at it's sampled temperature by using titration, an oxygen probe or using a colorimeter. 1

The sample is placed in a sealed, airtight container and kept out of the light for 5 days. The oxygen concentration is again measured. BOD is the difference between the two measurements. 1

Shipwrecks, corrosion and salvage unit

33 a) i) salts are leached from terrestrial rocks or hydrothermal vents on the seafloor to remain in seawater. 1

a) ii) salt water acts an electrolyte 1
to aid ion migration between the anodic site of corrosion and the cathodic surface 1

b) i) acid passivates the steel by forming a stable coating of iron phosphate 1

ii) Phosphate barrier is more effective than other forms of coating such as grease or oil, as it adheres to the metals ,
passivating is less effective at preventing corrosion than methods such as anodic protection, phosphate passivating is more effective in terrestrial environments and when used with other forms of protection such as painting **1 for ea to 3**

c) made of more active metals than the metals being protected,
they give up electrons (are oxidised) to the oxidising agent more readily than the metal being protected,



The sacrificial anode is oxidised so that the cathode (steel ship) has any corrosion reversed.

1 ea for 4

d) *experiment - 3 marks, explanation of interpretation of results – 1 mark*

aluminium will provide anodic protection to the iron , if the aluminium is corroded, it will develop pits and a coating of white aluminium oxide.

method;

wrap aluminium strips around 3 identical nails

place the nails individually in three test tubes

place distilled water in one test tube with a wrapped nail

place an electrolyte solution in a second test tube with a wrapped nail,

place a sample of coolant in the third test tube with a wrapped nail

e) *factor affecting an electrolysis reaction – 1*

diagram or description of equipment , e.g. electrolytic cell, voltameter, etc. – 1

description of appropriate experiment to test identified factor – 1

- f) description and comparison of corrosive conditions of near shore and deep ocean - 2
description and comparison of rate, type or agent of corrosion of wood, steel and brass /
bronze -3
roles of organisms, oxygen, water and salt in corrosion and decay - 2

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