DOONSIDE TECHNOLOGY HIGH SCHOOL

+1 +2
+1
+1

61%

2001
Higher School Certificate
Trial Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board approved calculators may be used
- Write using black or blue pen
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper
- Write your student number and/or name at the top of every page

Section I - Pages 3 – 16
Total marks (75)
This section has two parts, Part A and Part B

Part A
Total marks (15)
Attempt questions 1 – 15 10
Allow about 30 minutes for this part

Part B
Total marks (60)
Attempt questions 16 – 28 33½
Allow about 1 hour 45 minutes for this part

Section II - Pages 16 – 29 17½
Total marks (25)
Attempt ONE question from Questions 29-33
Allow about 45 minutes for this section

This paper MUST NOT be removed from the examination room

Section I

Total marks (75)

Part A

Total marks (15)
Attempt questions 1 – 15
Allow about 30 minutes for this part

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
1		X		
2		X		
3			X	
4		X		
5				X
6			X	
7	X	X		
8				X
9		X		
10			X	X
11	X	X		
12	X	X		
13			X	
14				X
15		X	X	

10

STUDENT NUMBER/NAME: .....

1. Microscopic membrane filters are used to:

   (A) electrolyse water
   (B) purify contaminated water
   (C) deionise water
   (D) remove heavy metals

2. What is the product formed from the dehydration of ethanol?

   (A) ethane
   (B) ethene
   (C) methane
   (D) ethanoic acid

3. The pH of washing soda and an oven cleaner were measured with a pH meter. The washing soda had a pH of 11.0 and the oven cleaner had a pH of 13.0. Compared with washing soda the concentration of hydroxide ions in the oven cleaner is:

   (A) 3 times greater
   (B) 3 times less
   (C) 100 times greater
   (D) 100 times less

4. The conjugate acid of HS^- is:

   (A) H_2SO_4
   (B) H_2S
   (C) S
   (D) S^{2-}

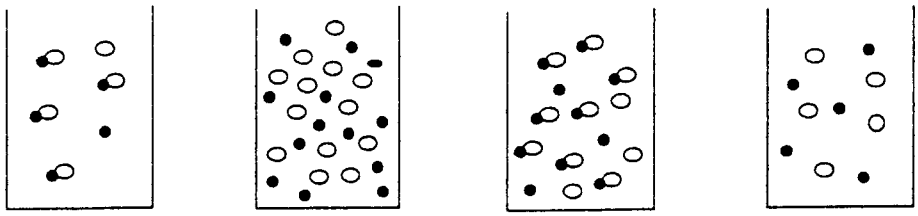
5. Biological Oxygen Demand is:

   (A) a measure of the number of aerobic organisms in a sample of water
   (B) a measure of organic wastes that can be broken down by organisms in a body of water
   (C) a measure of inorganic wastes that can be broken down by anaerobic organisms
   (D) the quantity of oxygen needed to respire organic wastes in a body of water

6. The following diagrams represent samples of 4 acids dissolved in water

Which diagram represents a concentrated solution of a weak acid?

(A) (B) (C) (D)



7. The process used industrially to convert some fractions from the refining of petroleum into useful products such as ethene is:

(A) catalytic cracking
(B) fractional distillation
(C) polymerisation
(D) dehydration

8. Some steps in the radioactive decay series for uranium-238 are shown in the following flow chart.

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th \rightarrow X \rightarrow {}^{234}_{92}U$$

The type of radioactive decay to produce X and the name of element X are

(A) alpha decay, protactinium
(B) gamma decay, actinium
(C) beta decay, neptunium
(D) beta decay, protactinium

9. One of the more important effects of high turbidity (>25 NTU) in a freshwater system is:

(A) all commercial species of fish die
(B) photosynthetic activity is suppressed
(C) marine mammals cannot see their food
(D) heavy metals are removed

STUDENT NUMBER/NAME: .....

10. Which one of the following solutions, each 0.1 mol L^{-1}, has the highest pH?

(A) nitric acid HNO_3 $1/62$
(B) sulfuric acid H_2SO_4 $1/2/98$
(C) acetic acid (ethanoic acid) CH_3COOH $1/57$
(D) hydrochloric acid HCl $1/36$

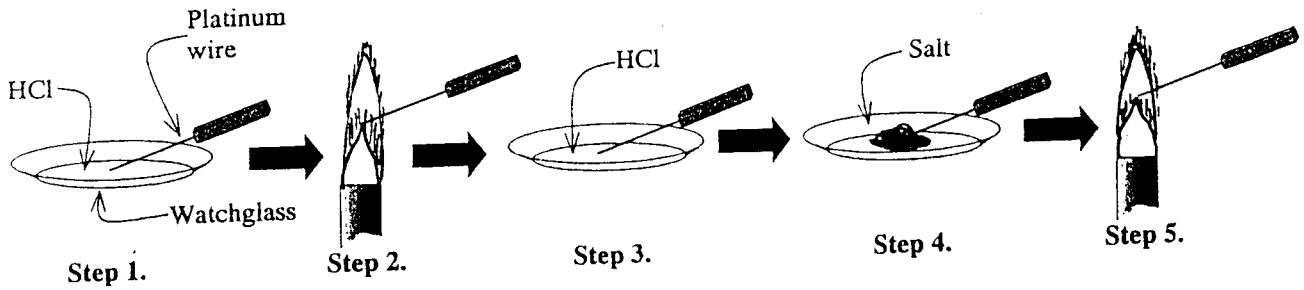
11. The table lists the boiling temperatures, in kelvins, of some alkanols and the corresponding alkanoic acids

Alkanols		Alkanoic Acids	
Substance	BP (K)	Substance	BP (K)
1-propanol	370	propanoic acid	414
1-butanol	390	butanoic acid	434
1-pentanol	411	pentanoic acid	459

The principal reason for the higher boiling temperatures of the alkanoic acids, compared with alkanols is:

(A) the greater dispersion forces between the molecules of the alkanoic acids
(B) ionic bonding that occurs in the alkanoic acids when they become ionised
(C) the stronger acidic properties of the alkanoic acids
(D) stronger hydrogen bonding between the alkanoic acid molecules

12. The diagram below shows the steps that a student could take to identify metal ions using a luminous flame.



What flame colour would Ca^{2+} ions produce, using this technique?

(A) red
(B) bright yellow
(C) green
(D) blue

13. A student constructed a galvanic cell using two different metals in electrolytes of the nitrate of the metals (1 mol L^{-1} solution). The combination of metals which would give the greatest potential difference is:

(A) magnesium and zinc
(B) zinc and nickel
(C) manganese and silver
(D) nickel and silver

14. The heat of combustion for four alkanols, in kJ mol^{-1}, is:

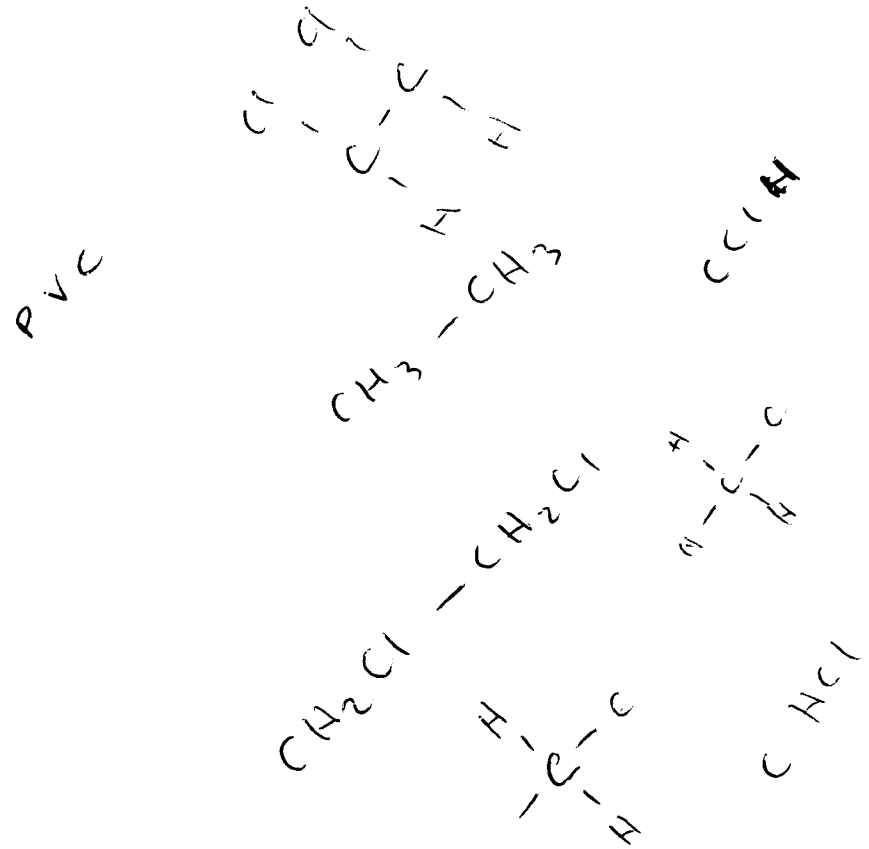
methanol	:	715
ethanol	:	1371
1-propanol	:	2010
2-butanol	:	2673

The alkanol (above) which produces the greatest amount of heat in kJ/g is:

(A) methanol
(B) ethanol
(C) 1-propanol
(D) 2-butanol

15. What is the pH of a solution with a hydroxide ion concentration of 7.2×10^{-9} mol L^{-1}?

(A) 4.86
(B) 5.86
(C) 8.14
(D) 9.14



Section I

Part B

Total marks (60)
Attempt questions 16 – 28
Allow about 1 hour 45 minutes for this part

Answer the questions in the spaces provided

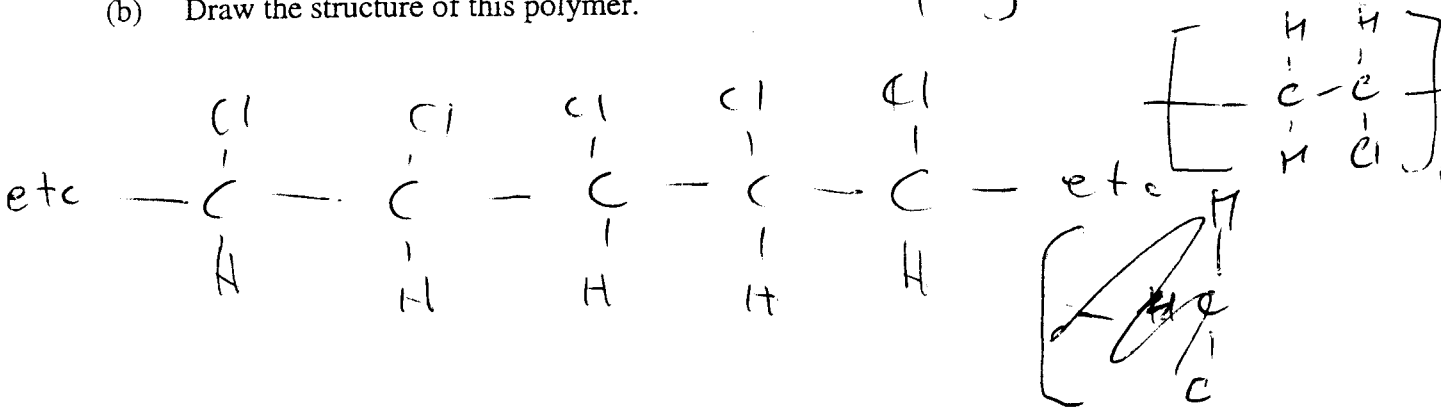
Question 16 (5 marks) **Marks**

Vinyl chloride is a significant monomer used in the production of polymers.

(a) Give the common AND systemic name for the polymer made from vinyl chloride. 2

PVC, polyvinyl chloride. ✓
~~Chloro hexane~~ (poly)chloroethene ~~Ethene~~
et
or polychloroethene

(b) Draw the structure of this polymer.



(c) State ONE use of this polymer and a property which makes it useful for this purpose. 2

~~Chain~~ Chain stiffening. Long molecule chains make products rigid and strong.

- electrical conduit.
- easily moulded or good insulator.

Question 17 (5 marks) **Marks**

Consider the following ions: CH_3COO^-, NH_4^+ and HPO_4^{2-}.

(a) Which of the ions above can act as an amphiprotic species? **1**

~~HPO_4^{2-}~~ NH_4^+ HPO_4^{2-} 0

(b) Write equations showing its behaviour in the acidic and basic environment. **2**

$HPO_4^{2-} + H^+ \rightarrow H_2PO_4^-$

$HPO_4^{2-} + OH^- \rightarrow PO_4^{3-} + H_2O$

$NH_4^+ + MgO \rightarrow NH_3OH$

$NH_4^+ + NaOH \rightarrow NH_3 + Na^+ + H_2O$

(c) Name a second chemical species which, together with this ion, can form a buffer solution in water. Briefly explain the buffering action in this example. **2**

PO_4^{3-} + $H_2PO_4^-$

addition H^+/OH^- doest alter PH greatly if both have roughly equal concentrations.

Covers NH_3OH can acid if given a base, if acids

$NH_3Cl + H_2O$

$(NH_3O)Na^+ + H_2O$

Question 18 (3 marks)

During your chemistry course you compared and evaluated the use of a mercury cell to a dry cell or lead/acid battery.
Evaluate the use of a mercury cell in comparison to EITHER a dry cell OR a lead/acid battery. **3**

Mercury – Dry cell

- mercury cell can main-tain a constant voltage (about 1.6v) for longer than a dry cell. Mercury cell voltage is naturally higher (1.6v) than dry cell (1.25v)
- Mercury cell isnt as good in that its harmful products (mercury poisoning)
- Also mercury cell production releases mercury and compounds into environment

3

Question 19 (2 marks) **Marks**

Ethanol is an organic chemical with the potential to be used as an alternative fuel to fossil fuels. Discuss ONE advantage and ONE disadvantage of ethanol as an alternative to fossil fuels. 2

Adv
• Less CO formed • Renewable
As it's an organic chemical, it can be regenerated and not in specific limited supply
Not as suitable for use or as easily obtained from environment in needed amounts.
Disad: • Lower energy density
• more expensive
• use of crops/soils to grow plants?

1 1

Question 20 (3 marks) **Marks**

Carbon dioxide, as a by-product of fermentation, is cooled and compressed to form 'dry ice' for use as a refrigerant and as a cleaning agent.

$$CO_{2(g)} \rightarrow CO_{2(s)}$$

(a) Calculate the volume of carbon dioxide gas at 25°C and 101.3 kPa pressure which could be obtained by the fermentation of 1.0 kg of glucose ($C_6H_{12}O_6$). 2

Glucose $C_6H_{12}O_6$ = 180 g/mol

$C_6H_{12}O_6 \rightarrow 2CO_2 + C_2H_5OH + 2H_2O$

1000 g → 5.5 mole → 11.1 moles CO_2

24.47 L × 11.1

= 271.67 L

2

(b) What mass of solid carbon dioxide (dry ice) could be obtained? 1

11.1 × 44 = 488.8 g

1

Question 21 (4 marks)

In February the Richmond River in northern NSW experienced its most extensive fish kill recorded to date. NSW fisheries sampling data are shown in the table below.

Table 1: Water quality parameters recorded during the survey conducted along the lower Richmond River on 9 February (records taken at approx. 0.3 m depth)

Site	Dissolved O_2 (mg/L)	pH	Conductivity (ms/cm)	Turbidity (NTU)	Temp. (°C)
Dungarubba	0.07	6.4	0.010	24	26.3
Broadwater	0.06	6.4	0.090	25	25.9
Laws Pt	0.01	6.4	0.090	29	25.9
Goat Is.	0.40	6.2	0.114	25	25.4
Wardell	0.08	6.3	0.114	32	25.2
Pimlico	0.03	6.4	0.125	32	26.4

A Fisheries spokesperson suggested that the fish kill was caused by low oxygen levels in the water.

(a) Identify an additional item of information you need to assess the correctness of this statement. **1**

BOD ~~Biochemical~~ oxygen demand.
Need to know 'correct' value oxygen needed in wate

(b) Suggest a reason for the water being sampled at a depth of 0.3 m. **1**

Inaccurate results may be obtained at surface, floating particles, etc. same with bottom of water. O_2 conc. higher at surfac

1

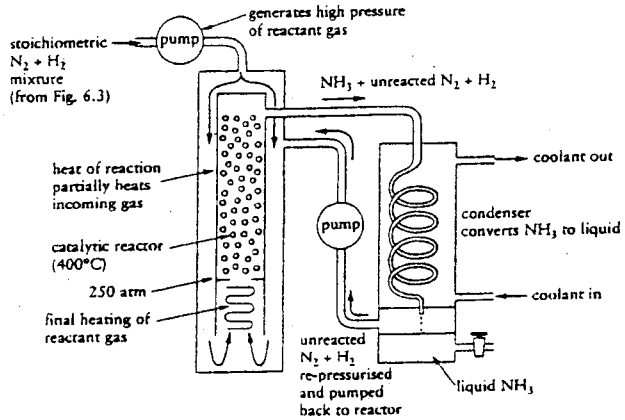
(c) Explain why a low level of dissolved oxygen might be linked to: (i) water turbidity (ii) water temperature. **2**

i) suspended particles in water may be consuming the ~~oxygen~~, such as biological breakdown of dead fish
ii) Temperature effects the equilibrium of the oxygen dissolving into the water at the surface
O_2 solubility in water decreases as temp increases.

1

Question 22 (6 marks) **Marks**

The Haber process for the production of ammonia could be shown diagrammatically as follows.



In this process nitrogen and hydrogen are fused using a catalyst. The equilibrium reaction can be expressed by the equation.

$$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)} \qquad \Delta H = -92.4 \text{ kJ}$$

(a) Identify a catalyst used in the Haber Process and explain its role in the reaction. 2

Fe_3O_4, surface reduced to Iron. It helps speed up the reaction, bringing it to equilibrium faster, but doesn't affect the position of equilibrium, just time taken to reach it. (2)

(b) According the Le Chatelier's Principle a lower temperature favours a higher yield of ammonia at equilibrium. Explain why the reacting gases are heated to 400°C to optimise ammonia production. 2

Lower temp such as 200°C will make a higher yield, but take forever to reach that yield. Higher temp, eg 800°C, will reach equil. faster, but produce lower yield. 400°C produces about 40% yield in suitable time to be most ideal set of. (2)

(c) Give TWO reasons for the use of high pressure to optimise the production of ammonia. 2

$N_2 + 3H_2 \rightarrow 2NH_3$ 4 moles → 2 moles

Le Chatelier's Principle says a system will decrease effect of disturbance made. Thus high pressu will force reaction forward.

Higher pressure means more collisions of atom so will react faster. (2)

STUDENT NUMBER/NAME: .....

Question 23 (7 marks) **Marks**

As part of a practical investigation into esters, a student read in a practical manual that the ester methyl ethanoate can be prepared by heating methanol and ethanoic acid together, under reflux, in a flask to which a few millilitres of concentrated sulfuric acid has been added.

(a) Describe the apparatus you would use to heat the reactants safely, under reflux, in a school laboratory. ~~• Flammability • Toxicity vapours • Bromine exp uv light.~~ 2

Refluxing apparatus - contains vertical condensing tube ~~surrounded~~ by a water 'sleeve' with cool water to ~~cool the~~ condense the gases formed back into liquid. Water goes in at bottom, out top. bunsen used to heat flask at bottom of condensing tube. Water Bath. to heat slowly. (1-)

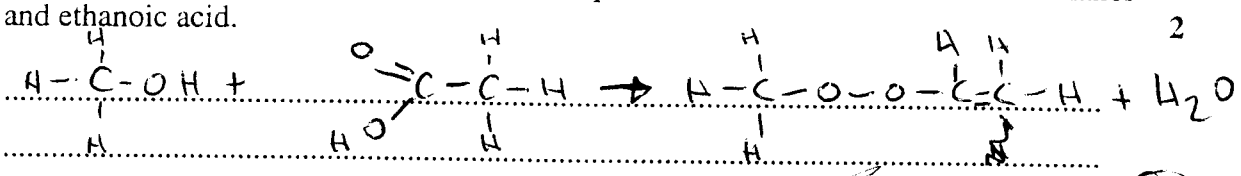
(b) State the purpose of heating under reflux. 1

Allows reaction to take place quicker due to higher temperature ~~and~~ without losing products/reactants due to them escaping as gas. (1)

(c) State TWO purposes for adding the concentrated sulfuric acid to the reaction mixture. 2

Acts as a catalyst to speed up the reaction ~~some/most~~ leave out
Absorbs water formed which stops reaction reversing. (2) Excellent.

(d) Using structural formulae, write a balanced equation for the reaction between methanol and ethanoic acid. 2



$CH_3OH + C_2H_3COOH \rightarrow C_2H_3OOCH_3 + H_2O$ (2)

CH_3COOCH_3

p32 conc chem

$CH_3OH + CH_3COOH \rightarrow CH_3COOCH_3 + H_2O$

Question 24 (4 marks) **Marks**

To identify unlabelled samples of cyclohexane and cyclohexene, both colourless liquids, a group of students added a few drops of each to bromine water, under normal room lighting and under ultraviolet light.
The table summarises their observations.

Substance	Room Light	UV light
Liquid A	decolourises	decolourises
Liquid B	no change	decolourises

(a) Identify TWO risk factors you would consider in performing risk analysis for this experiment. 2

wear suitable eye protection and clothing

Add the substance slowly.

Flammability / Exposure to UV
Toxicity

(b) Identify the liquid which is cyclohexane and, using a chemical equation, explain its reaction with bromine water. 2

substitution reaction

Liquid B is cyclohexane.

$C_6H_{12(l)} + Br_{2(aq)} \xrightarrow{UV\ light} C_6H_{11}Br_{(l)} + HBr$

The cyclohexane is broken apart into a normal hexane by bromine water. Its name is dibromo-hexane.

$C_6H_{12} + Br_2 \rightarrow C_6H_{11}Br + HBr$

Question 25 (2 marks)

E - trans
Z - cis

When ammonia solution is added to a blue solution of copper(II) sulfate, a deep blue solution of $Cu(NH_3)_4^{2+}$ ions is formed.

(a) In this reaction, the copper(II) ions are acting as a Lewis acid. Explain why. 1

They are an electron pair acceptor. accepts lone pair

The NH_3 is the electron pair donor (Lewis base

(b) Are the copper(II) ions also behaving as a Bronsted-Lowry acid, in this reaction? Explain your answer. 1

No, as they are not donating a proton. No hydrogen ions to donate as protons.

Question 26 (7 marks) **Marks**

Zn $Cu^{2+}SO_4^{=}$

A strip of zinc metal is placed in a 1.0 mol L^{-1} solution of copper sulfate.

(a) State TWO changes you would observe. **2**

the zinc would dissolve into the solution. (1)
Copper would form in the solution. (precipitate out)

(b) Write the oxidation and reduction half-equations for the reaction, identifying each. **2**

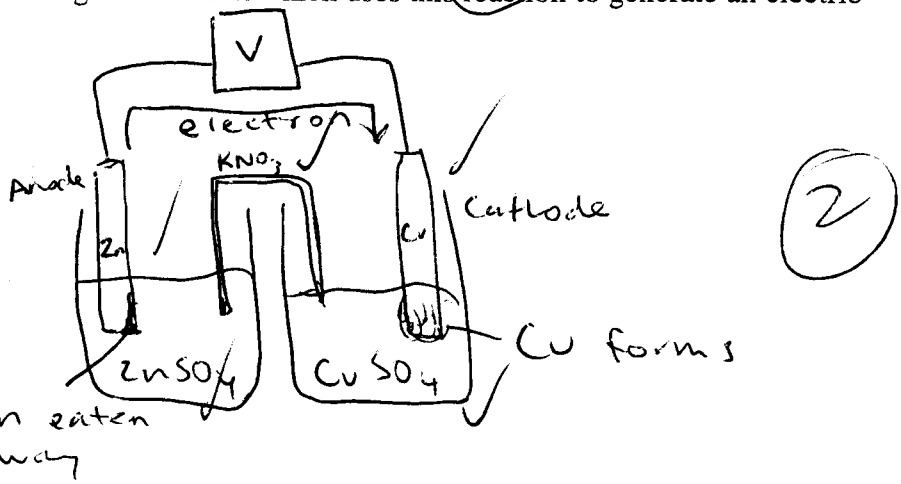
$Zn + 2e^- \rightarrow Zn^{2+}$

$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$ Reduction

$Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$ Oxidation.

(2)

(c) Draw a labelled diagram of a cell which uses this reaction to generate an electric current. **2**



(2)

(d) State the maximum voltage obtained from this cell. **1**

0.76 V + 0.34 V = 1.1 V

(1)

Question 27 (6 marks) **Marks**

A student determined the concentration of acetic acid (ethanoic acid) in some white vinegar by titrating a sample of the vinegar that had been diluted, accurately, by a factor of 5. A standardised 0.0950 mol L^{-1} sodium hydroxide solution was used for the titration. The student's results are shown below.

Volume of diluted vinegar = 25.0 mL	
Volume of standardised sodium hydroxide solution (mL) :	
1st titration	34.2
2nd titration	33.5
3rd titration	33.7
4th titration	33.6

(a) Name the vessel in which the vinegar solution could be diluted accurately. 1

~~pipette~~ Volumetric Flask X

(b) The following indicators were available for the student to use.

Indicator	Colour Change	pH range
methyl orange	red-yellow	3.1 – 4.4
bromocresol green	yellow-blue	3.8 – 5.4
bromothymol blue	yellow-blue	6.2 – 7.6
phenolphthalein	colourless-red	8.3 – 10.0

Weak acid & strong base

Which of these indicators would be best for this titration? Explain why. 2

Bromthymol blue, as the equivalence point in this titration is at pH 7. (Acid/base neutralisation) X

phenolphthalein

(c) Calculate the concentration (in mol L^{-1}) of acetic acid (ethanoic acid) in the undiluted vinegar. CH_3OOH 33.6 Discard, first 3

Av of tit measurement = 33.75 mL NaOH

moles = 0.095 x 0.03375 = 0.0032 moles

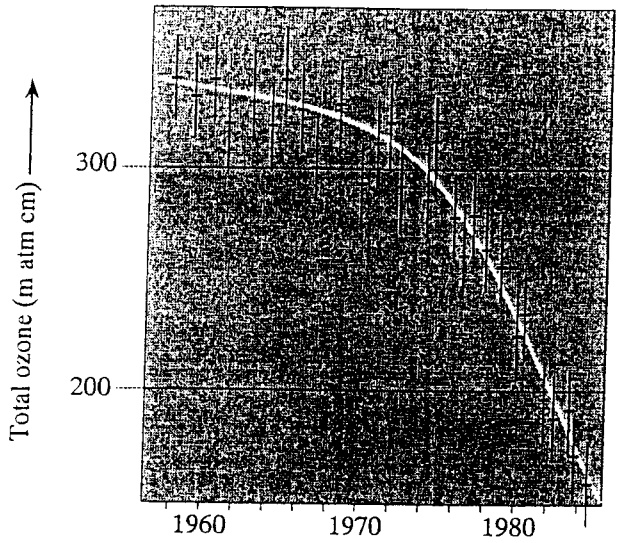
Undiluted vinegar = 5 mL

molarity = $\frac{\text{moles}}{\text{volume}} = \frac{0.0032}{0.005}$

= 0.64 mol L^{-1} 3

Question 28 (6 marks) Marks

The graph below plots the ozone levels measured in Antarctica from 1957 to 1985.



(a) Draw an electron dot structure for ozone. 1

1/2

(b) Identify the origins of CFC's in the atmosphere. 1

1/2

~~emissions from factories~~, used in refrigerants, propellents, cleaning solvents, blowing agents for making plastics

(c) Analyse the graph above and describe the changes observed. 1

Ozone has been depleted in recent ~~a~~ years 1/2

(d) Discuss, using relevant chemical equations, the problems associated with the use of CFC's. 3

$Cl^{\cdot} + O_3 \rightarrow ClO^{\cdot} + O_2 + O^{\cdot}$

chlorine breaks apart ozone into O_2 & $O^{\cdot}$ and then is free to break others down as its not used process

$O^{\cdot} + O^{\cdot} \rightarrow O_2$ - oxygen ions from top equation for O_2. One molecule of a CFC can 'unlock' hundreds of ozone molecules, as its not consumed in the process. V. good 3

$CH_3Cl_{(g)} \xrightarrow{UV} CH_{3(g)} + Cl_{(g)}$

$Cl_{(g)} + O_{3(g)} \rightarrow ClO_{(g)} + O_{2(g)}$

STUDENT NUMBER/NAME: .....

Section II

Total marks (25)

Attempt ONE question from Questions 29 – 33
Allow about 45 minutes for this part

Answer the question in a separate writing booklet. Extra writing booklets are available.

Question 29 – Industrial Chemistry (25 marks) **Marks**

(a) Sulfuric acid is used so extensively by industry that the quantity of sulfuric acid manufactured by a nation provides an indicator of the country's industrial activity.

(i) Outline ONE use of sulfuric acid in industry. 1

(ii) Sulfur dioxide used to produce sulfuric acid is mainly obtained from the combustion of elemental sulfur obtained from natural deposits.
Describe the processes used to extract sulfur from underground mineral deposits, identifying the physical properties of sulfur which allow its extraction. 4

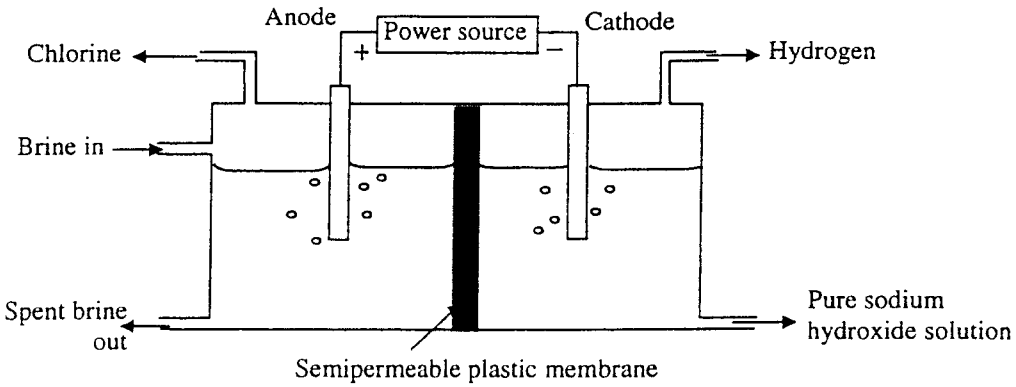
(iii) One stage in the production of sulfuric acid involves the conversion of sulfur dioxide to sulfur trioxide according to the following equation:

$$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)} \qquad \Delta H = -197 \text{ kJ mol}^{-1}$$

Outline the effects of reaction conditions on the equilibrium yield and rate of production of sulfur trioxide. 4

$NaCl^- + H_2O \rightarrow NaOH + H_2 + Cl_2$

(b) The diagram below shows the membrane process used to extract sodium hydroxide from brine (sodium chloride).



(i) Describe the chemical processes involved in the production of sodium hydroxide by this method. Use chemical equations to illustrate your answer. Outline the use of the semipermeable plastic membrane. 5

(ii) Outline reasons why membrane cells have been developed to replace diaphragm cells and mercury cells to produce sodium hydroxide. 2

$H^+ OH^- \rightarrow OH^- + H_2$

Question 29 – Industrial Chemistry continued on the next page

$Cl^- \rightarrow Cl_2$

$Mg \rightarrow Mg^{2+} 0$

Marks

(c) The formula below shows the structure of the soap, sodium stearate.

$$CH_3(CH_2)_{16}COO^-Na^+$$

(i) Name the TWO reactants required to be mixed and heated for this soap to form. **2**

(ii) In relation to the structure of the soap molecule, account for the cleaning action of soap. **4**

(iii) Sodium stearate is considered an anionic detergent. Describe how cationic detergents are chemically different and state ONE use for them. **3**

End of Question 29

an positive

Question 30 – Shipwrecks and Salvage (25 marks) **Marks**

(a) The ship RMS Titanic sank on its first voyage across the Atlantic Ocean in 1912. In 1985, deep-sea researcher, Bob Ballard was able to use deep-sea submersibles to locate, explore and photograph the wreck lying on the ocean floor in 3810 metres of water.

(i) The environmental conditions at the wreck of the RMS Titanic have been described as "extremely cold, totally dark with tremendous pressures due to the depth of the water".
Predict how these conditions would affect the rate of corrosion of this shipwreck's steel hull. **2**

(ii) Explain the different rate of corrosion for a submerged ship such as the Titanic with that of a ship such as the Cherry Venture (located on the coast of Fraser Island, Queensland) which is fully exposed at low tide. **2**

(iii) Explain how bacterial activity contributes to corrosion at great depth. **2**

(iv) A piece of leather clothing was removed from a 600-year-old wreck in the Mediterranean Sea by divers. It was in "reasonable condition" at the time of removal from the wreck but as the water evaporated from it at the surface, it underwent progressive deterioration. Using your knowledge of artefact preservation, account for this deterioration as evaporation occurred. **2**

(b) Often when describing a galvanic cell a useful shorthand notation is used. This question refers to the galvanic cell:

$$Ni_{(s)} \mid Ni^{2+} \parallel Ag^{+} \mid Ag_{(s)}$$

(i) Identify the anode and cathode, and write the equation for the reaction. **2**

(ii) An external voltage can be used to reverse the cell reaction, making an electrolytic cell. State Faraday's First Law as it applies to this cell. **1**

(iii) Calculate the minimum voltage which must be applied to electrolyse this cell, under standard conditions. **1**

(iv) Describe THREE factors that affect the rate of this electrolysis reaction. **3**

Question 30 – Shipwrecks and Salvage continued on the next page

STUDENT NUMBER/NAME: .....

Question 30 – Shipwrecks and Salvage (continued)

Marks

(c) In 1622, a galleon called Atocha was destroyed on a reef following a hurricane. Part of the cargo was silver and gold in wooden chests. In 1985 part of the valuable cargo was salvaged. The silver coins recovered were encrusted with limestone ($CaCO_3$). After removing the limestone, the silver coins were black on the surface.

(i) Explain how the silver coins became corroded and encrusted. **2**

(ii) Discuss TWO procedures that could be used to restore the silver to almost the condition it was in when the Atocha sailed in 1622. **2**

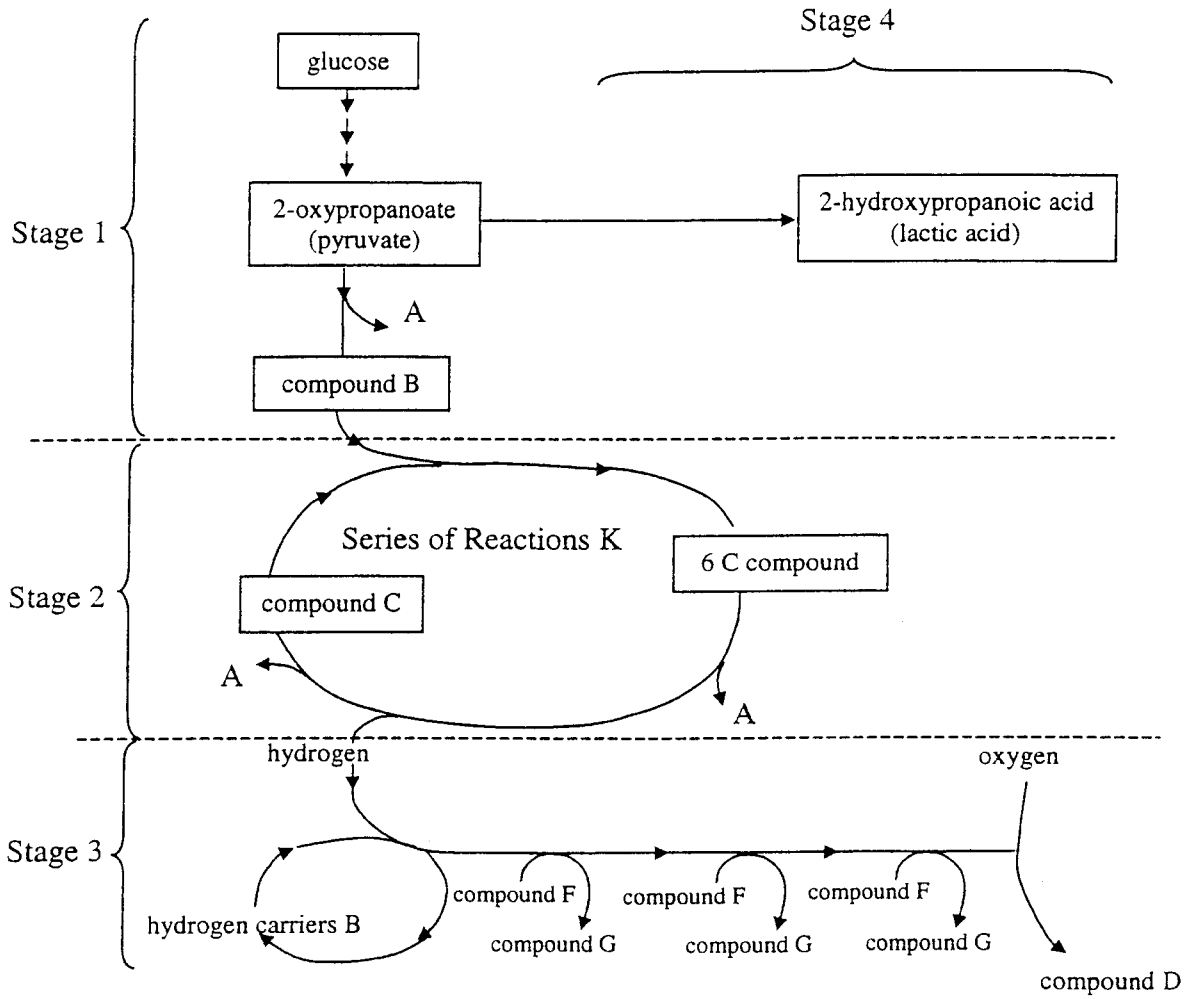
(d) Steel is the main structural material for bridges, cars and buildings. The controlling of its corrosion is extremely important. Describe the conditions under which rusting occurs and explain the process of rusting, using diagrams and chemical equations. **4**

(e) Underground iron pipes are often protected from corrosion through cathodic protection. Describe how the process of cathodic production works for the iron pipe. **2**

End of Question 30

Question 31 – The Biochemistry of Movement (25 marks) **Marks**

(a) The diagram below represents an outline of the four stages in respiration in muscle cells.



(i) Identify which Stages occur during aerobic respiration. **1**

(ii) State the name for Stage I **1**

(iii) State the name of compound B **1**

(iv) What is the name given to the series of reactions K in Stage 2? **1**

(v) State the exact location within the cell where the series of reactions K occurs. **1**

(vi) Stage 2 is regarded as oxidative decarboxylation. What is the meaning of decarboxylation? **1**

Question 31 – Biochemistry of Movement continued on next page

Question 31 – Biochemistry of Movement (continued) **Marks**

(vii) Write an equation to show how the oxidised form of hydrogen carrier B changes to the reduced form. **1**

(viii) Identify compound D. **1**

(ix) State the name of Stage 3. **1**

(x) Name the exact location within the cell where phosphorylation of compound F occurs. **1**

(xi) When does the cell carry out Stage 4? **1**

(b) The diagram below shows muscle fibre contains many myofibrils. Myofibrils are divided into sarcomeres by dark partitions, the Z lines. Each sarcomere is made up of regularly spaced thick and thin filaments.

Diagram 1

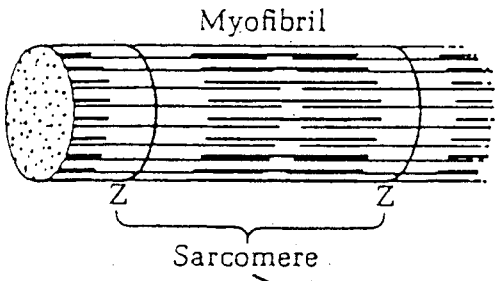


Diagram 2

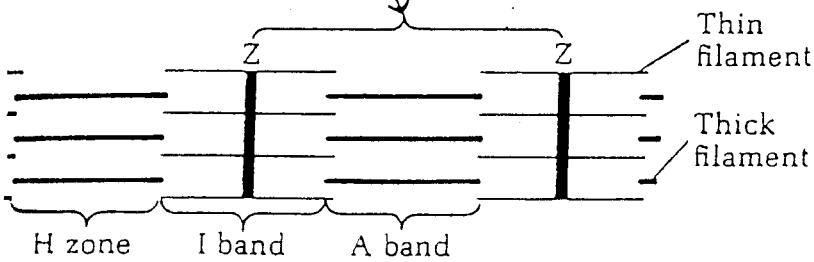
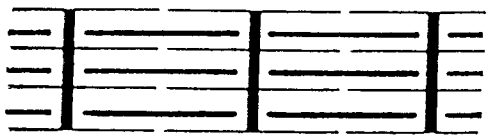


Diagram 3



(i) State the structural difference between the thick and the thin filaments. **1**

(ii) Which process does Diagram 3 shows in relation to Diagram 2? Explain how ATP is consumed in this process. **2**

Question 31 – Biochemistry of Movement continued on next page

Question 31 – Biochemistry of Movement (continued) **Marks**

(c) Type 1 muscle cells contract relatively slowly.
Type 2 muscle cells contract relatively rapidly.

(i) Give any TWO structural differences between type 1 and type 2 muscle cells. **2**

(ii) Which type of muscle cells carry out mostly anaerobic respiration? **1**

(iii) State one functional difference between type 1 and type 2 muscle cells. **1**

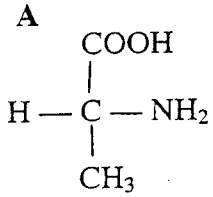
(d) The initial event in the utilisation of fat as an energy source is the hydrolysis of triacylglyerols (TAGs) by lipase.

(i) What are the products in the hydrolysis of triacylglyercol? **1**

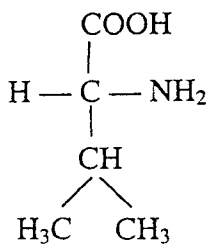
(ii) Describe how these products enter the cycle of respiration. **2**

(e) Three amino acids are shown below.

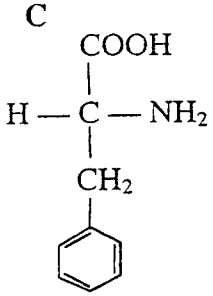
A



B



C



(i) Show how the three amino acids link together in the sequence "ABC" **1**

(ii) What is this type of reaction called? **1**

(iii) What is the other product of the reaction? **1**

(iv) What is the name of the chemical bond between the amino acid residues. **1**

End of Question 31

STUDENT NUMBER/NAME: .....

Question 32 – Chemistry of Art (25 marks) **Marks**

(a) From earliest times people have used colour to decorate their surroundings. Readily available minerals were used by Aboriginal people to prepare pigments used in traditional art.

(i) Name and describe the chemical composition of TWO minerals used by Aboriginal people to prepare pigments. 2

(ii) Other than colour, describe how ONE physical property that the pigments used by Aboriginal people needed to possess so that they would be effective as decorative paint. 2

(b) The discovery of new mineral deposits has made a range of new pigments available for the production of modern paint.

(i) Describe the general composition of modern paint. In your answer describe the function of each component. 3

(ii) Name ONE mineral used to make pigment for modern paint. Describe its composition and state the colour of the pigment that is produced from the mineral. 3

(c) During your course you performed a first hand investigation to determine the flame colour of a range of metallic ions.

(i) Name ONE metallic ion used in your investigation and state its colour. 1

(ii) Explain why some elements are able to produce coloured flames. 2

(iii) Describe how another method could be used to determine the identity of a metallic ion in a sample. 2

Question 32 – Chemistry of Art continued on next page

Question 32 – Chemistry of Art (continued) **Marks**

(d) The ten elements following calcium in the Periodic Table make up the first transition series of elements.

(i) Choose ONE metal from the first transition series of elements that can exist in more than one oxidation state and write its ground state electronic configuration in terms of sub shells. **2**

With reference to the element you have chosen in (i) above, answer the following questions:

(ii) Explain why this element can exist in more than one oxidation state. **1**

(iii) Write a balanced half equation which shows how this element can change its oxidation state. Monatomic ions of the element or polyatomic ions containing the element may be used. Show the colour and oxidation number changes that occur. **3**

(iv) Other than colour describe ONE physical property of this element. **1**

(e) Some early uses of cosmetics are given in the table below.

BC	
5000	Malachite for green eye shadow
3500	Powdered antimony used as grey eye shadow
500	Vermillion used as red war paint
200	Lead compounds used to whiten faces

(i) Vermillion is mercury(II) sulfide. Write a chemical formula for this compound. **1**

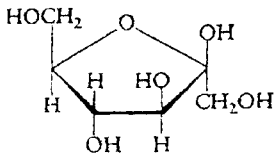
(ii) Assess the potential health risk associated with the use of one of these compounds. **2**

End of Question 32

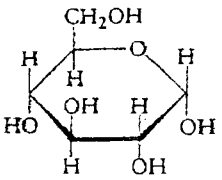
STUDENT NUMBER/NAME: .....

Question 33 – Forensic Chemistry (25 marks) **Marks**

(a) Glucose and fructose are both carbohydrates. Glucose is found in fruit juices and in the blood and tissues of animals, while fructose which is also found in many fruit juices is considered to be the sweetest sugar known. The structural formulae of these two carbohydrates are represented below.



fructose



glucose

(i) Write the molecular formula for fructose and use it to explain why fructose is classified as a carbohydrate. **2**

(ii) Sucrose, a sugar obtained from sugar cane, is a disaccharide composed of fructose and glucose. Write a chemical equation, using molecular formulae only, to represent the formation of sucrose. **1**

(iii) Sucrose is a non-reducing sugar while fructose and glucose are both reducing sugars. Describe a chemical test that could be used to distinguish between sucrose and glucose and describe the chemical difference between these two sugars that allows this distinction. **2**

(b) A forensic scientist is often analysing very small samples of material. The results of these analyses may be used as evidence in a court of law so accuracy is critical. Outline TWO precautions that may be necessary to ensure accuracy and prevent contamination of samples for analysis. **2**

(c) (i) The structure of deoxyribonucleic acid (DNA) contains hydrogen bonds between adenine and thymine and between guanine and cytosine bases.
Outline the structure and composition of DNA, including an explanation of the role of these hydrogen bonds. **3**

(ii) The DNA molecular chain contains "coding" sequences (the genes) and "non-coding" sequences (between the genes).
DNA analysis is a powerful tool for identifying whether two different samples came from the same person, related people or different persons. It can also be used to identify the parents of an individual.
Explain why analysis of DNA allows identification of individuals and relationships between people. **3**

Question 33 – Forensic Chemistry continued on next page

Question 33 – Forensic Chemistry (continued) **Marks**

(d) Fats belong to a very broad category of biomolecules called "lipids". Fats are the main constituents of the storage fat cells in animals and plants, and are one of the important food reserves of the organism. Discuss the differences in fats produced and stored in organisms and explain how this may be used as an identifying feature by a forensic chemist. 3

(e) Advances in technology have provided forensic chemists with a range of methods that can be useful in the analysis of very small samples of material, such as mass spectrometry and atomic emission spectroscopy.

(i) Outline how a mass spectrometer works, indicating how this technology can be used by a forensic chemist. 3

(ii) All elements have an identifiable emission spectrum and this can be used to identify trace elements. Explain why excited atoms in the gas phase emit only certain wavelengths of light and account for the fact that each element produces its own signature line emission spectrum. 2

Question 33 – Forensic Chemistry continued on next page

Chemistry

29

a) i) used as a catalyst in many industrial processes. (0) pg 316-317

ii) An ore, such as ZnS is mined from the earth.

$$ZnS + H_2O \rightarrow ZnO + H_2S$$

Superheated water at 160°C (that is water kept under pressure at above boiling pt temp to keep it as a liquid) heats the ore, which has a BP of 118°C. this is the ~~sved~~ drawn up in tube and extracted.

H_2S is then reduced to S. Sulfur globules are easily seperated from the water as sulfur is insoluble in water.

$2H_2S + O_2 \rightarrow 2S + 2H_2O$ ✓ good. (4)

iii) High pressure will increase the yield.

However reaction rate/yield is mainly depends on the temperature.

At high temperature the reaction occurs quicker.

But at a lower temperature, the equilibrium lies further to the right, as a lower temperature favours the exothermic reaction (or opposes the backwards endothermic reaction)

* Catalyst -
* Use ~~X~~'s O_2 as it is cheaper (2)

Chemistry Trial.

(29) b)

i) The method used to obtain NaOH is the hydrolysis of $NaCl_{(aq)}$ (brine) solution)

The power source forces the reaction in the opposite way to which it would normally occur. ~~H is more electronegative~~ Chlorine is much more electronegative that Hydrogen, thus reaction would normally occur in opposite direction.

Reaction:

$2Cl^- \rightarrow Cl_{2(g)} + 2e^-$ (Reduction)

Chlorine ions in NaCl are reduced to form chlorine gas.

$H^+ + e \rightarrow H_{2(g)}$ (oxidation)

Hydrogen in water is oxidised to form hydrogen gas.

Overall reaction is

$$NaCl_{(aq)} + H_2O \xrightarrow{\text{electrolysis}} NaOH + H_2 + Cl_2$$

(5)

The Na^+ ions are allowed to travel through the membrane to form NaOH on the other side.

ii) Membrane cells are more efficient and accurate in what they allow to pass through.

Diaphragm cells - asbestos (1½)

mercury cells are more efficient in power needed to allow the reaction to take place. However mercury and compounds are dangerous so must be disposed of correctly.

2u chem trial

24) c)

i) 3x stearic acid + Glycerol → forms the ester (fat/oil) + NaOH → Soap + Glycerol and sodium hydroxide ✓ (1)

ii) the structure can be represented such as Talk hydrophobic non-polar

with a large tail. The tail embeds itself in dirt (non polar) and the large head allows dirt to be 'pulled' off when the molecule is removed. The Na^+ head is charged, and the water attracts this 'polar' charge and helps pull the dirt off. (3)

iii) Cationic detergents have heads that are ~~positively~~ polar eg: ~~positively charged~~

with negative charges in the head. they can also be used in soaps and detergents to aid cleaning. (1)