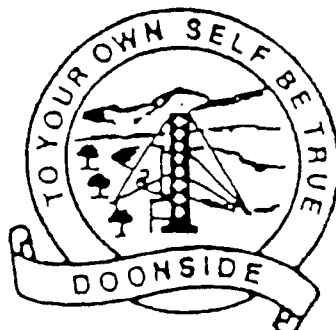


DOONSIDE TECHNOLOGY HIGH SCHOOL



+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

Allow about 30 minutes for this part

10

Part B

Total marks (60)

Attempt questions 16 – 28

Allow about 1 hour 45 minutes for this part

33 1/2

Section II - Pages 16 – 29

Total marks (25)

Attempt ONE question from Questions 29-33

Allow about 45 minutes for this section

17 1/2

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	

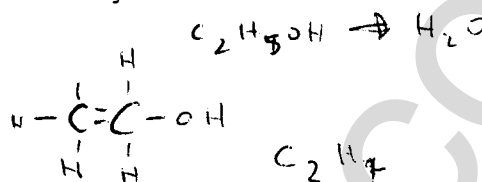
10

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

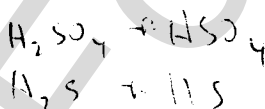


3. The pH of washing soda and an oven cleaner were measured with a pH meter. The washing soda had a pH of 11.0 and the oven cleaner had a pH of 13.0. Compared with washing soda the concentration of hydroxide ions in the oven cleaner is:

(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-}

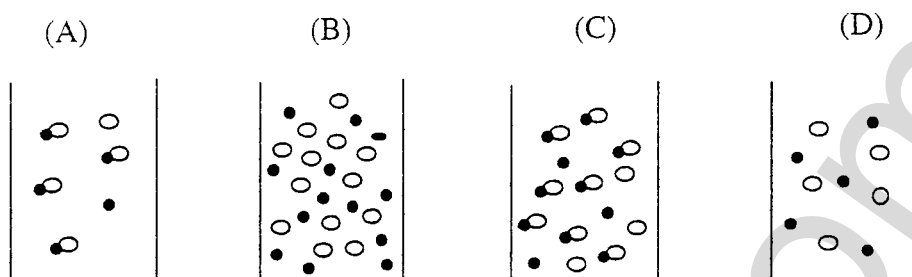


5. Biological Oxygen Demand is:

(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

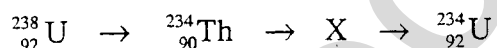
Which diagram represents a concentrated solution of a weak acid?



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.



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

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

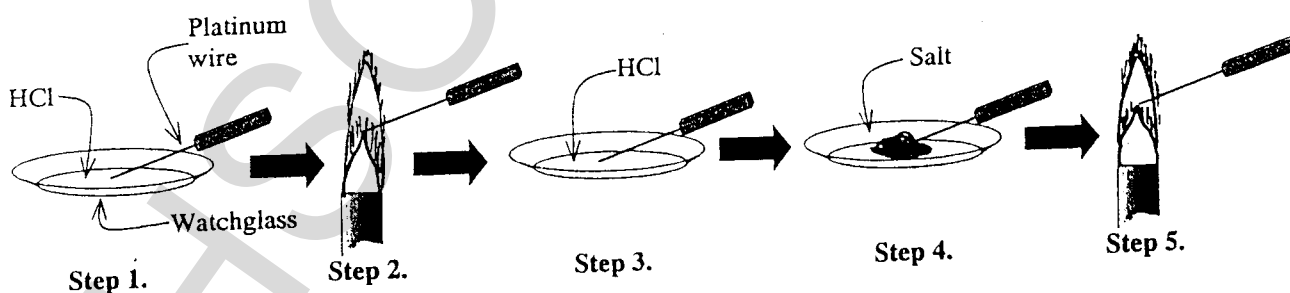
- (A) nitric acid HNO_3 $\frac{1}{6.2}$
 (B) sulfuric acid H_2SO_4 $\frac{1}{9.6}$
 (C) acetic acid (ethanoic acid) CH_3COOH $\frac{1}{5.7}$
 (D) hydrochloric acid HCl $\frac{1}{7.6}$

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

Alkanols		Alkanolic 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 alkanolic acids, compared with alkanols is:

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

Handwritten calculations for standard electrode potentials (E°):
 Mg: -2.36
 Zn: -0.76
 Ni: -0.24
 Mn: -1.18
 Ag: 0.80

14. The heat of combustion for four alkanols, in kJ mol⁻¹, is:

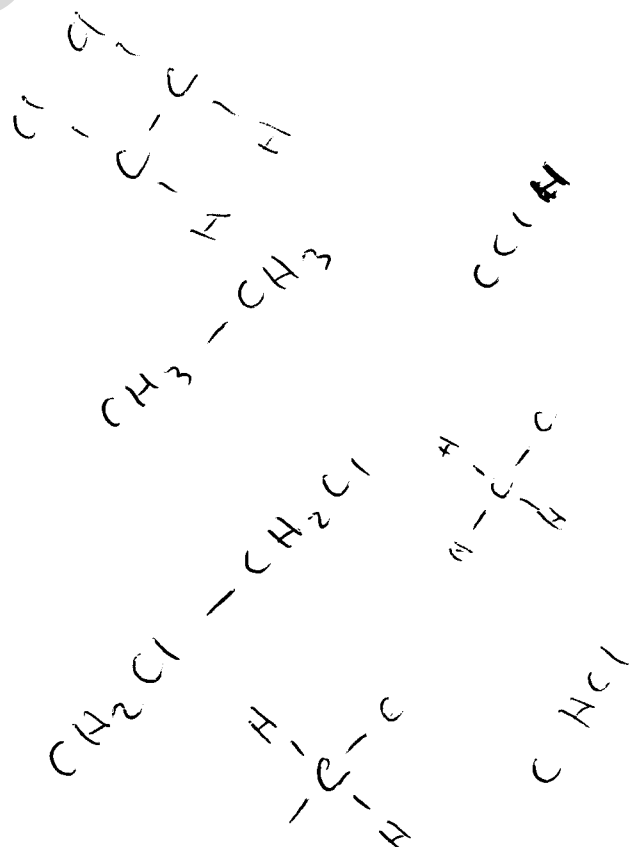
methanol : 715 $C_1H_4O = 32 = 22.34$
 ethanol : 1371 $C_2H_6O = 46 = 29.8$
 1-propanol : 2010 $C_3H_8O = 60 = 33.5$
 2-butanol : 2673 $C_4H_{10}O = 74 = 36.12$

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)

1

Marks

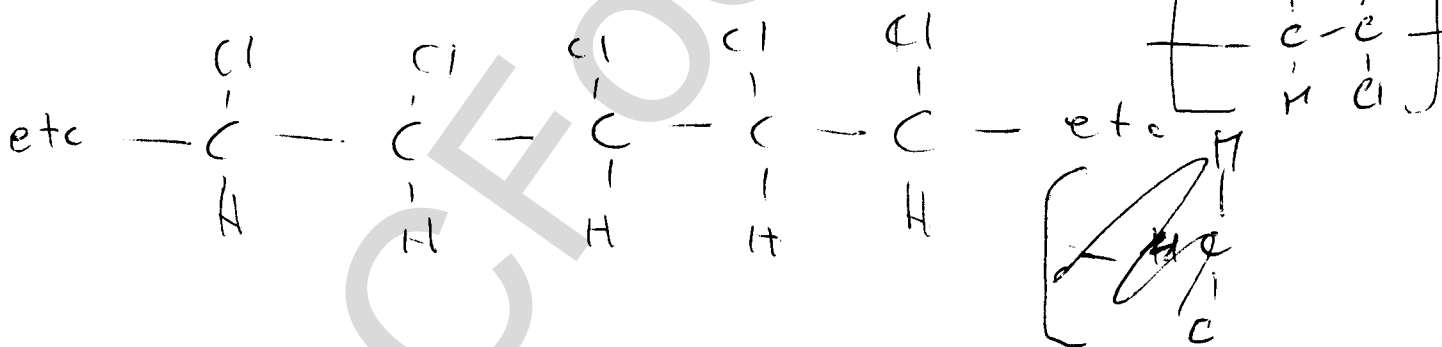
Vinyl chloride is a significant monomer used in the production of polymers.

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

PVC, polyvinyl chloride.
~~Chloro hexane (poly)chloro ethane~~

- (b) Draw the structure of this polymer.

or polychloroethene



- (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 conduct.
- easily moulded or good insulator.

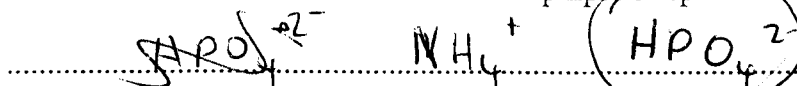
Question 17 (5 marks)

Marks

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

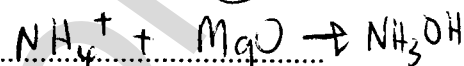
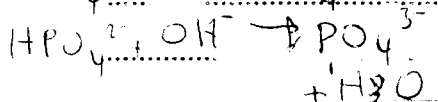
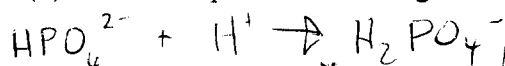
- (a) Which of the ions above can act as an amphoteric species?

1



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

2



- (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

$\text{PO}_4^{3-} + \text{H}_2\text{PO}_4^-$ forms NH_3OH
 addition H^+/OH^- an acid if given
 does not alter pH greatly a base if added
 if both have roughly equal concentrations.
 ~~$\rightarrow \text{NH}_3\text{Cl} + \text{H}_2\text{O}$
 $\rightarrow (\text{NH}_3\text{O})\text{Na}^+ + \text{H}_2\text{O}$~~

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 maintain 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 isn't as good in that it's harmful products (mercury poisoning)

Also mercury cell production releases mercury and compounds into environment.

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.

Adv
• Less CO formed • Renewable

As it's an organic chemical, it can be regenerated and not in a specific limited supply

Not as suitable for use or as easily obtained from environment in needed amounts.

Disadv. • lower energy density

• more expensive

• use of crops/soils to grow plants?

Question 20 (3 marks)

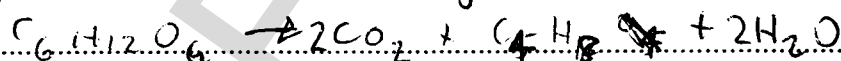
Marks

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.



- (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 ($\text{C}_6\text{H}_{12}\text{O}_6$).

Glucose $\text{C}_6\text{H}_{12}\text{O}_6 = 180 \text{ g/mol}$



1000g $\rightarrow$ 5.5 mole $\rightarrow$ 11.1 moles CO_2

$24.47 \text{ L} \times 11.1$

$= 271.8 \text{ L}$

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

$11.1 \times 44 = 488.8 \text{ g}$

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

~~BDO~~ Biochemical oxygen demand.
Need to know 'correct' value oxygen needed in water

- (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. O₂ conc. higher at surface

- (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

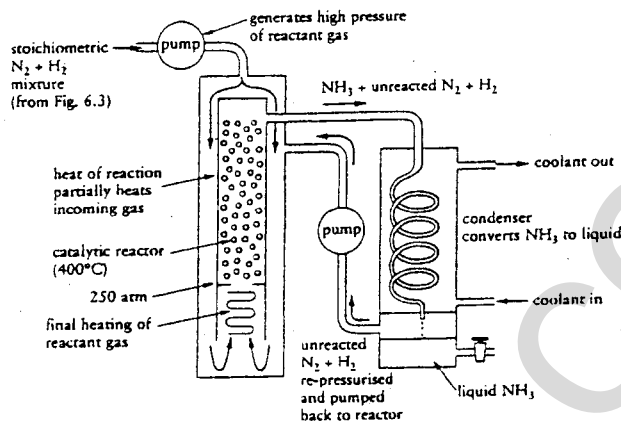
O₂ solubility in water decreases as temp increases.

1

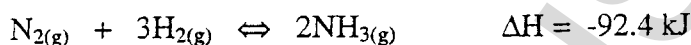
Question 22 (6 marks)

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.



- (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 to 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 equilibrium faster, but produce lower yield. 400°C produces about 40% yield in suitable time to be the most ideal setup. (2)

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

$\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ 4 moles $\rightarrow$ 2 moles
Le Chatelier's Principle says a system will decrease effect of disturbance made. Thus high pressure will force reaction forward.
Higher pressure means more collisions of atoms so will react faster. (2)

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. 2
- ~~Flammability~~ ~~Toxicity vapours~~ ~~Bromine exp. v. light.~~
 Refluxing apparatus - contains vertical condenser 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 temperatures ~~and~~ without losing products/reactants due to them escaping as gases. (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
 Absorbs some/most ~~all~~ 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
- $$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{H} \end{array} + \begin{array}{c} \text{O} \\ || \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array} \rightarrow \begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{O}-\text{O}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array} + \text{H}_2\text{O}$$

$$(\text{CH}_3\text{OH} + \text{C}_2\text{H}_3\text{COOH} \rightarrow \text{C}_2\text{H}_3\text{OOCCH}_3 + \text{H}_2\text{O}) \quad (2)$$

$$\text{CH}_3\text{COOCH}_3$$

p 326 conc chem

$$\text{CH}_3\text{OH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O}$$

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

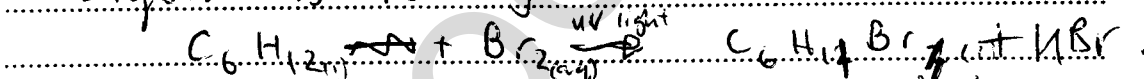
Toxicity

Exposure to UV

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

2

Liquid B is cyclohexane substitution reaction.



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

Question 25 (2 marks)

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. 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

A strip of zinc metal is placed in a 1.0 mol L⁻¹ solution of copper sulfate.

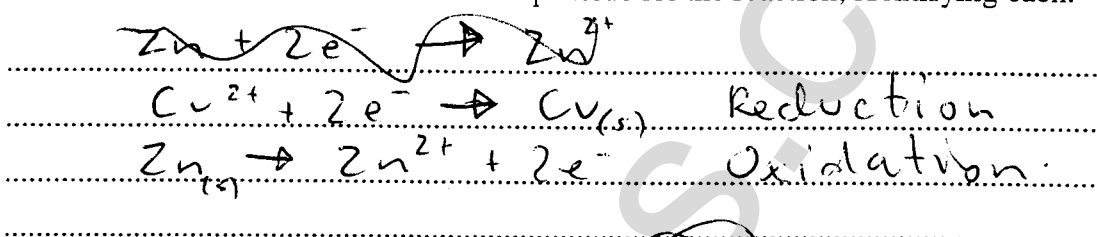
- (a) State TWO changes you would observe.

2

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

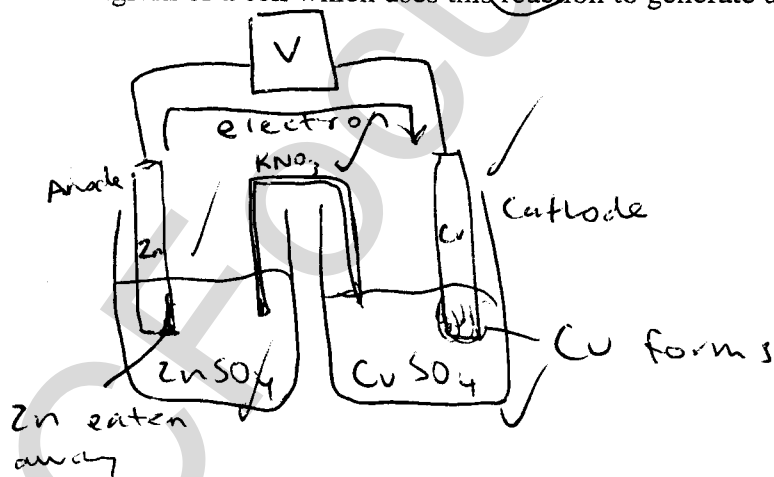
- (b) Write the oxidation and reduction half-equations for the reaction, identifying each.

2



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

2



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

1

$$0.76 \text{ V} + 0.34 \text{ V} = 1.1 \text{ V}$$

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 $0.0950 \text{ mol L}^{-1}$ 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

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

- (c) Calculate the concentration (in mol L^{-1}) of acetic acid (ethanoic acid) in the undiluted vinegar. CH_3COOH

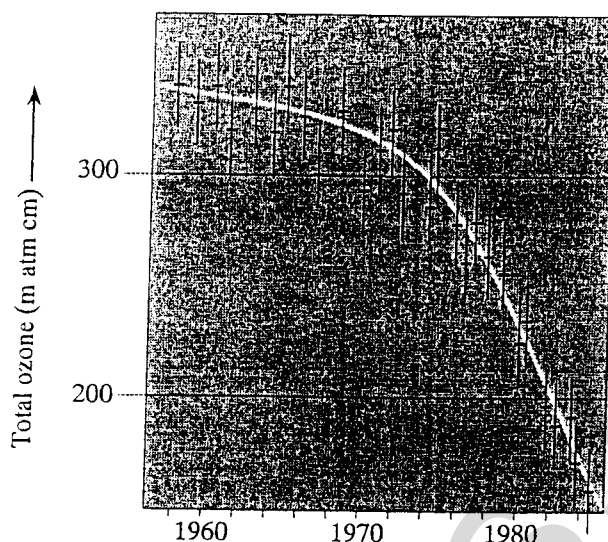
3

33.6 Discard first
Av tit measurement = 33.75 mL NaOH
moles = $0.095 \times 0.03375 = 0.0032$ 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.



(1/2)

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

(1/2)

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

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

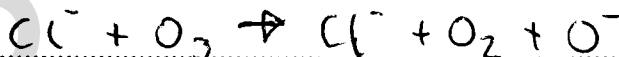
1

Ozone has been depleted in recent years

(1/2)

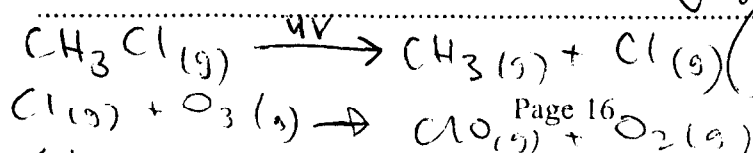
- (d) Discuss, using relevant chemical equations, the problems associated with the use of CFC's.

3



Chlorine breaks apart ozone into O_2 & O^- and then is free to break others down as its not used. $\text{O}^- + \text{O}^- \rightarrow \text{O}_2$ - oxygen ions from top equation. One molecule of a CFC can 'unlock' hundreds of ozone molecules, as its not consumed in the process.

(3)



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.

		Pages
Question 29	Industrial Chemistry	18-19
Question 30	Shipwrecks and Salvage	20-21
Question 31	Biochemistry of Movement	22-24
Question 32	Chemistry of Art	25-26
Question 33	Forensic Chemistry	27-29

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.

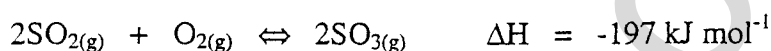
(i) Outline ONE use of sulfuric acid in industry.

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:

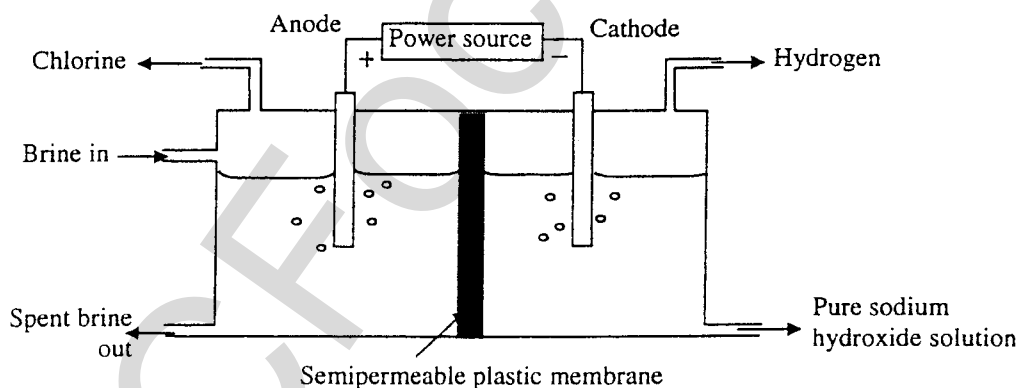


Outline the effects of reaction conditions on the equilibrium yield and rate of production of sulfur trioxide.

4



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

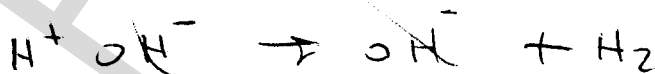


(i) Describe the chemical processes involved in the production of sodium hydroxide by this method. Use chemical equations to illustrate your answer. Outline the use of the semipermeable plastic membrane.

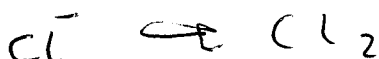
5

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

2



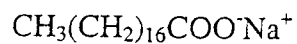
Question 29 – Industrial Chemistry continued on the next page



Question 29 – Industrial Chemistry (continued)

Marks

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



- (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:
- $$\text{Ni}_{(s)} \mid \text{Ni}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}_{(s)}$$
- (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)

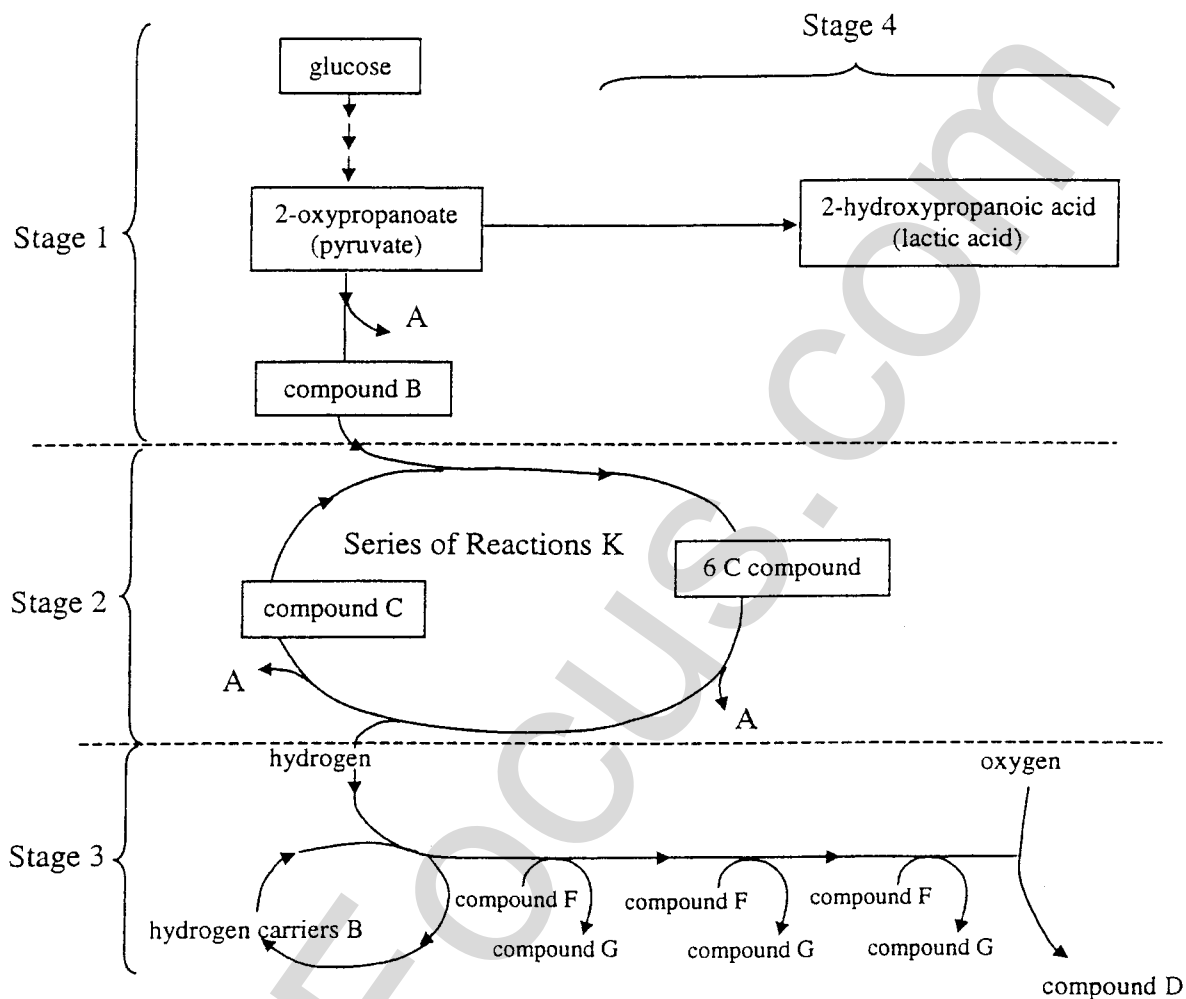
Marks

- (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 protection 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.



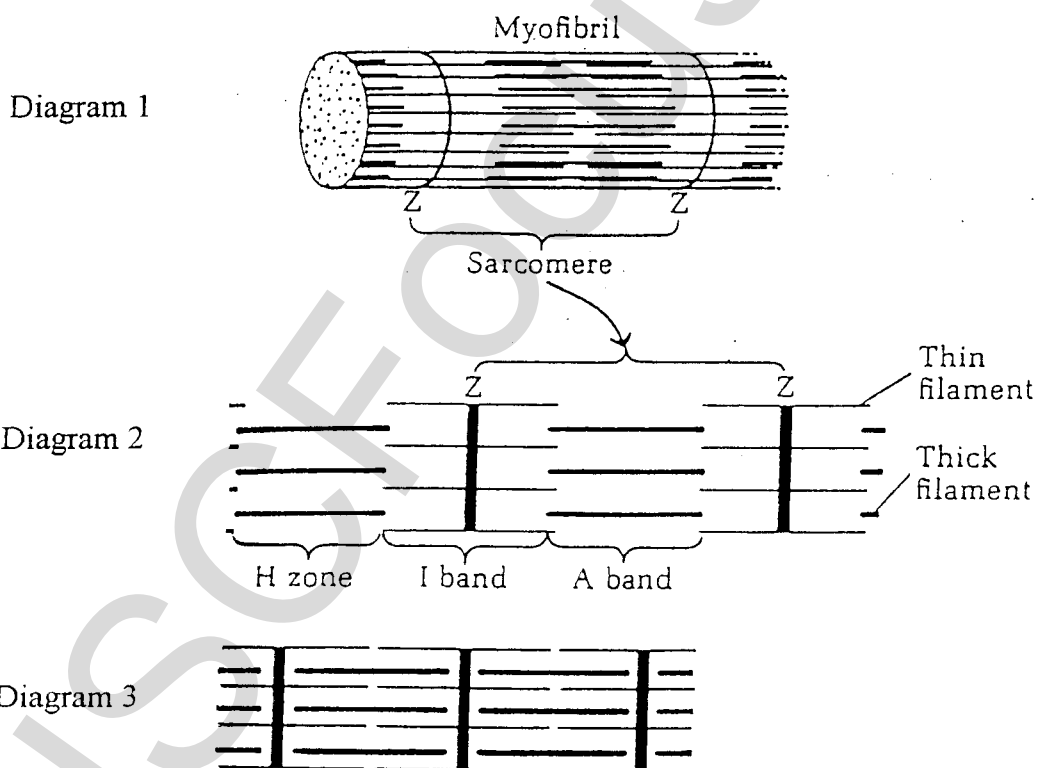
- | | |
|--|---|
| (i) Identify which Stages occur during aerobic respiration. | 1 |
| (ii) State the name for Stage I | 1 |
| (iii) State the name of compound B | 1 |
| (iv) What is the name given to the series of reactions K in Stage 2? | 1 |
| (v) State the exact location within the cell where the 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.

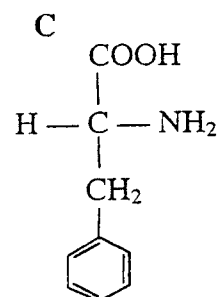
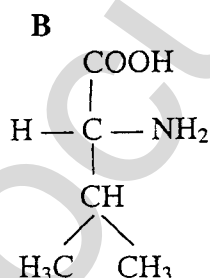
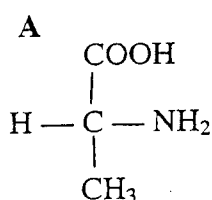


- (i) State the structural difference between the thick and the thin filaments. 1
- (ii) Which process does Diagram 3 shows in relation to Diagram 2? Explain how ATP is consumed in this process. 2

Question 31 – Biochemistry of Movement (continued)

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 triacylglycerols (TAGs) by lipase.
- (i) What are the products in the hydrolysis of triacylglycerol? 1
- (ii) Describe how these products enter the cycle of respiration. 2
- (e) Three amino acids are shown below.



- (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

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.

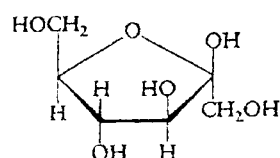
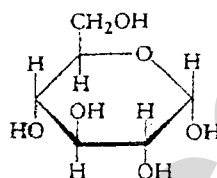
BC	
5000	Malachite for green eye shadow
3500	Powdered antimony used as grey eye shadow
500	Vermillion used as red war paint
200	Lead compounds used to whiten faces

- (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

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)

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

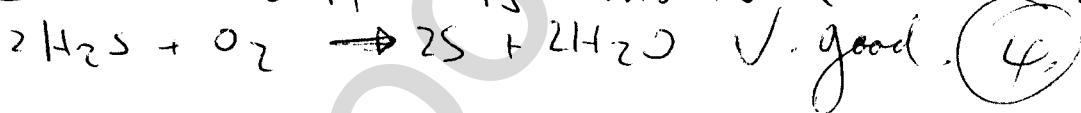
(29)

- a) i) used as a catalyst in many industrial processes. (1) pg 316-317
- ii) An ore, such as ZnS is mined from the earth.



Superheated water at $160^\circ C$ (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 $113^\circ C$. This is the ~~sub~~ drawn up in tube and extracted.

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



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 O_2 as it is cheaper.

(2)

Chemistry Trial.

(29) b)

i) The method used to obtain NaOH is the hydrolysis of $\text{NaCl}_{(aq)}$ (brine) solution.

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

Reaction:

$2\text{Cl}^- \rightarrow \text{Cl}_{2(g)} + 2\text{e}^-$ (Reduction)
Chlorine ions in NaCl are reduced to form chlorine gas.

$\text{H}^+ + \text{e}^- \rightarrow \text{H}_{2(g)}$ (Oxidation)
Hydrogen in water is oxidised to form hydrogen gas.

Overall reaction is



(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.

20 chem trial

(27) c)

forms the ester
1) stearic acid + Glycerol $\times$ and sodium hydroxide $\rightarrow$ Soap + Glycerol $\checkmark$
(1)

ii) the structure can be represented such as tail hydrophobic Na-philic.

 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 (3) and helps pull the dirt off.

iii) Cationic detergents have heads that are ~~negatively~~ positively charged eg:
 with negative

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