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:

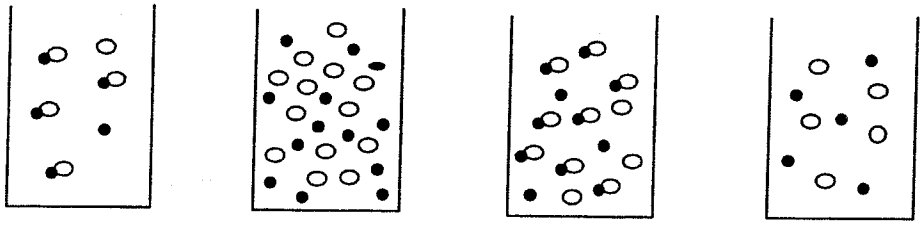
   (A) a measure of the number of aerobic organisms in a sample of water
   (B) a measure of organic wastes that can be broken down by organisms in a body of water
   (C) a measure of inorganic wastes that can be broken down by anaerobic organisms
   (D) the quantity of oxygen needed to respire organic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

STUDENT NUMBER/NAME: .....

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

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

(A) nitric acid
(B) sulfuric acid
(C) acetic acid (ethanoic acid)
(D) hydrochloric acid

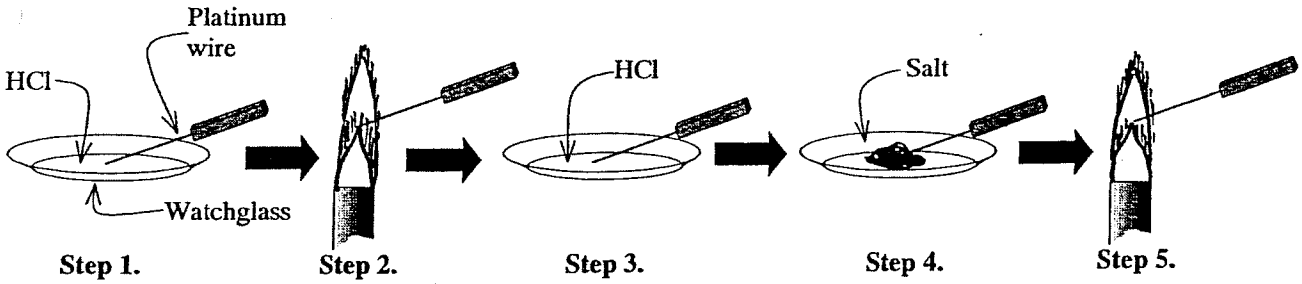
11. The table lists the boiling temperatures, in kelvins, of some alkanols and the corresponding alkanoic acids

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

STUDENT NUMBER/NAME: .....

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**

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(b) Draw the structure of this polymer. **1**

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

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STUDENT NUMBER/NAME: .....

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**

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

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(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**

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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.

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STUDENT NUMBER/NAME: .....

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**

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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**

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

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STUDENT NUMBER/NAME: .....

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**

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

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

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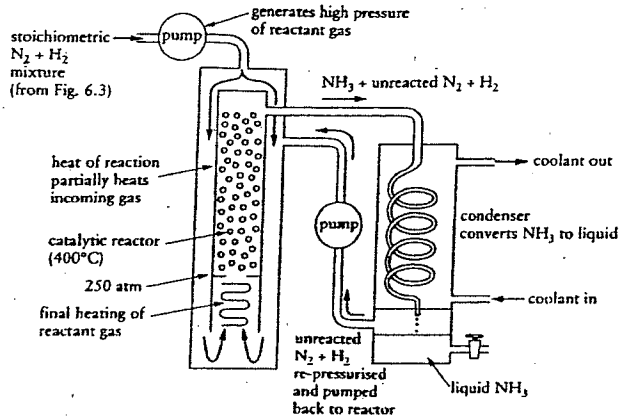
Question 22 (6 marks)

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**

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(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**

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

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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. **2**

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

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

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

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STUDENT NUMBER/NAME: .....

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**

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

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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**

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

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STUDENT NUMBER/NAME: .....

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**

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

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(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**

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STUDENT NUMBER/NAME: .....

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**

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(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

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

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(c) Calculate the concentration (in mol L^{-1}) of acetic acid (ethanoic acid) in the undiluted vinegar. **3**

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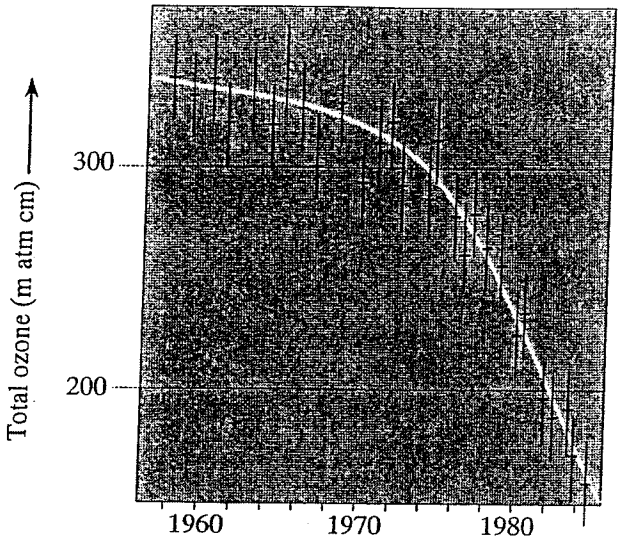
STUDENT NUMBER/NAME: ... ...

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**

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

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

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

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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

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