Baulkham Hills
2006

SECTION I
(75 marks)
PART A

15 multiple choice questions, worth 1 mark each.
Use the separate Answer Sheet.

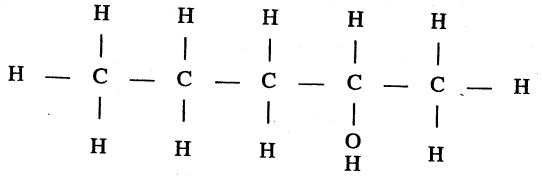
1 Ethene is a very reactive molecule. The reactivity of this molecule is due to:

(A) it being a hydrocarbon molecule.
(B) it being a two carbon organic molecule.
(C) the reactive C – H bonds present.
(D) the presence of a double covalent bond in the molecule.

2 Cellulose is a biopolymer. It is formed:

(A) by a process of addition polymerisation.
(B) as a long branched chain of monomer units.
(C) with the elimination of a water molecule as the pairs of monomers combine.
(D) with water acting as a catalyst.

3



The IUPAC name for the alkanol is:

(A) 3 – pentanol.
(B) 2 – pentanol.
(C) 2 – pentane – ol.
(D) 4 – pentane – ol.

4 The redox reaction for the cell $Mn/Mn^{2+}//Ag^{+}/Ag$ is:

(A) $Ag(s) + Mn(s) \longrightarrow Mn^{2+}(aq) + Ag^{+}(aq)$
(B) $2Ag^{+}(aq) + 2e^{-} \longrightarrow 2A(g)s$
(C) $Mn(s) + 2Ag^{+}(aq) \longrightarrow 2Ag(s) + Mn^{2}(aq)$
(D) $Mn^{2+}(aq) + e^{-} \longrightarrow Ag^{+}(aq)$

5 Argon –41 is a radioactive isotope. It has 18 protons and 23 nutrons in its nucleus. From the relative number of protons and neutrons in its nucleus it can be determined that argon –41 is most likely:

(A) an alpha emitter.
(B) a beta emitter.
(C) a gamma emitter.
(D) produces X–rays as it decays.

6 Which of the following does NOT apply to indicators?

(A) Are usually vegetable dyes
(B) Are used to determine the acidity or alkalinity of substances
(C) Change colour over their acidity/alkalinity range
(D) Are all acids

7 Concentrations of sulfur dioxide and oxides of nitrogen are increased in the atmosphere by a number of human activities. The main human activity that can release both these gases are:

(A) increased use of fertilisers.
(B) combustion of fossil fuels.
(C) industrial extraction of metals from their ores.
(D) the use of motor vehicles.

8 Which of the following activities would result in an increase of 2 pH units?

(A) Diluting 10mL of 0.1 mol L^{-1} HCI to 200 mL.
(B) Diluting 10mL of 0.1 mol L^{-1} NaOH to 200 mL.
(C) Diluting 10mL of 0.1 mol L^{-1} HCI to 1000 mL.
(D) Diluting 10mL of 0.1 mol L^{-1} NaOH to 1000 mL.

9 Which entry in the table below correctly identifies a Bronsted-Lowry acid-base pair?

	Acid	Base
(A)	H_2F_2	HF
(B)	H_2O	OH^-
(C)	HCO_3^-	H_2CO_3
(D)	CH_3COOH	CH_3OH

10 Which of the following is NOT a common use of esters?

(A) As a solvent.
(B) As a colouring agent.
(C) As a component in flavourings or essences.
(D) As a component in perfumes.

11 Incomplete combustion of hydrocarbons may result in the production of undesirable substances. Two such substances are:

(A) nitrogen oxides and sulfur dioxide.
(B) water and carbon dioxide.
(C) water and carbon.
(D) carbon monoxide and carbon.

12 Why would a catalyst be used in the following reaction?

$$N_2(g) + 3H_2(g) \equiv 2NH_{3(g)} \quad \triangle H = -92.4 kJ\ mol^{-1}$$

(A) To enable the reaction to produce more product.
(B) To enable the reaction to occur at a high pressure.
(C) To enable the reaction to occur at a high temperature.
(D) To enable equilibrium to be reached more quickly by lowering the reaction temperature.

13 The technique of atomic absorption spectroscopy is used to:

(A) measure dissolved oxygen levels in water.
(B) measure trace concentrations of metal ions.
(C) measure hardness of water.
(D) measure ozone concentration in the troposphere.

14 The constitutional formulae of four carbon-based compounds are given below:

$CH\,Cl_2\,CH_2F$	$CH_3\,CH_3$	$CClF_2\,CCl_2F$	$CCl_3\,CBrF_2$
W	X	Y	Z

These compounds belong to the classes of halons, CFCs, HCFCs and hydrocarbons. What is the classification of the compounds in the order shown (W, X, Y and Z)?

(A) CFC, halon, hydrocarbon, HCFC.
(B) halon, hydrocarbon, CFC, HCFC.
(C) HCFC, hydrocarbon, CFC halon.
(D) hydrocarbon, halon, CFC, HCFC.

15 Which quality of water is being tested by determining the percentage of light that is transmitted or scattered through a standard depth of the water?

(A) hardness
(B) turbidity
(C) dissolved oxygen
(D) acidity

END OF PART A

PART B
(60 marks)

QUESTION 16 (5 marks)

Marks

The production of ethylene from ethanol can be expressed as follows:

$$\text{ethanol} \xrightarrow{\text{catalyst X}} \text{ethene} + \text{compound Y}$$

(i) Identify compound Y. 1

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(ii) Identify catalyst X. 1

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(iii) One of the many uses of ethanol is an alternative car fuel. Discuss the advantages and disadvantages of its use. 3

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QUESTION 17 (4 marks)

One cell which has been investigated as an alternative to the lead-acid cell is the rechargeable sodium-sulfur cell, where the electrodes consist of molten sodium and sulfur.

(a) Construct an equation for the anode reaction in a sodium-sulfur cell. 1

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QUESTION 17 (Continued)

Marks

(b) Identify an advantage of the sodium-sulfur cell, when compared to the lead-acid cell. **1**

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(c) Assess **ONE** chemical safety issue to be considered with the use of a sodium-sulfur cell and recommend steps taken to observe this safety. **2**

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QUESTION 18 (5 marks)

A gauge to monitor the thickness of cardboard as it is produced in a paper mill consists of a source of beta rays and a detector. The detector registers changes in the intensity of radiation passing through the cardboard.

(a) Justify the use of beta radiation for this application. **2**

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(b) Identify a suitable instrument to serve as the detector for this gauge. **1**

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(c) Describe advantages of this type of gauge compared with a mechanical instrument such as callipers. **2**

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QUESTION 19 (4 marks)

Marks

Plant growth is affected by the audity and alkalinity of soils.

Table I shows the pH range of a number of indicators.

Table II shows soil pH values below which growth of the listed plants is restricted.

TABLE I

Indicator	Colour in solution of		Approximate pH range
	low pH	high pH	
Thymol Blue	red	yellow	1.2 – 2.8
Bromocresol green	yellow	blue	3.8 – 5.4
Methyl red	pink	yellow	4.4 – 6.2
Bromothymol blue	yellow	blue	6.0 – 7.6
Phenol red	yellow	red	6.8 – 8.4
Phenolphthalein	colourless	red	8.3 – 10.0
Alizarin yellow	yellow	lilac	10.1 –12.0

TABLE II

Crop	pH
potatoes	4.9
apples	5.0
cabbages	5.4
wheat	5.5
beans	6.0
lettuces	6.1

(a) Define the term 'acid-base indicator'. **1**

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QUESTION 19 (Continued)

Marks

(b) Describe and justify a procedure that you would carry out to explain how indicators could be used to check whether the pH of the soil in a particular area is suited for growing wheat. **3**

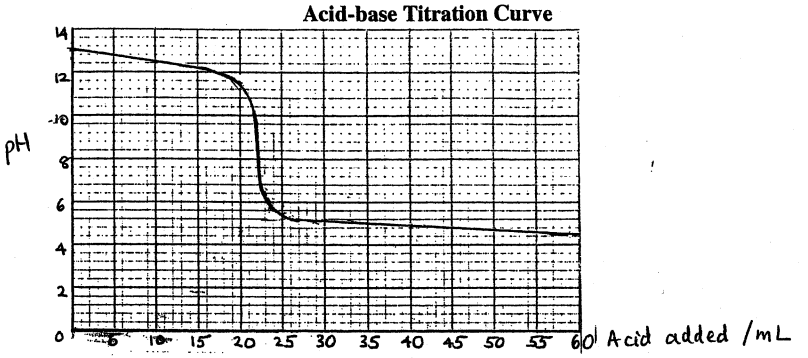
QUESTION 20 (6 marks)

(a) Use LeChatelier's Principle to relate the increase in the burning fossil fuels to possible increase in the acidity of the oceans. Include equations. **3**

QUESTION 21 (6 marks)

Marks

The graph below shows the pH during an acid-base titration. The base solution, with volume 25.00mL had an initial concentration of 0.100 mol L^{-1}.



(a) Describe one method which may be used to measure the pH of the solution during titration in the laboratory. Assess the accuracy of your method. **2**

(b) Identify a possible base, and an acid for this titration curve. **1**

(c) Using data from the graph, determine the concentration of the acid. (Assume that both the acid and base are monoprotic.) **2**

QUESTION 21 (Continued)

Marks

(d) Determine the pH of the acid used in this titration. **1**

QUESTION 22 (5 marks)

The table shows the boiling point for an alkanol, an alkanoic acid and an ester of the same molecular mass.

Compound	Molecular mass	Boiling point, ^{0}C
1-pentanol	88	138
butanoic acid	88	164
melthyl propanoate	88	80

(a) Explain the difference in boiling points of the compounds shown in the table. **2**

(b) Identify the two compounds needed to make methyl propanoate. **1**

QUESTION 22 (Continued)

Marks

(c) When making methyl propanoate a catalyst was added to the reactants and the mixture was then refluxed. Name the catalyst used and outline why the mixture was refluxed. **2**

QUESTION 23 (5 marks)

(a) Outline the role of a chemist employed in a specific industry or enterprise. Identify the branch of chemistry and **ONE** chemical principle used by this chemist. **3**

QUESTION 23 (Continued)

(b) Discuss the need for collaboration between chemists as they collect and analyse data. **Marks 2**

QUESTION 24 (5 marks)

(a) In terms of water quality, what do the letters BOD stand for? **1**

(b) Why is it important to monitor BOD? **1**

c) Describe briefly how BOD is monitored? **2**

A 100mL sample of water from a dam was analysed by volumetric analysis. The average of three titrations was 3.90mL using 0.025 moles per litre sodium thiosulfate. Calculate the dissolved oxygen concentration in parts per million. **1**

QUESTION 25 (4 marks)

Cobalt is a trace element essential in the metabolism of many animals including sheep.

Soils must contain cobalt at concentrations of more than 0.05 ppm if the sheep grazing on that land are to remain healthy.

A chemist was assigned the task of analysing a farmer's soil to see if it was suitable for raising sheep. The chemist used Atomic Absorption Spectroscopy (AAS) as a means of measuring the concentration of cobalt in the soil.

Justify the procedure he should follow in order to prepare the soil and the equipment for analysis using AAS. **4**

QUESTION 26 (6 marks)

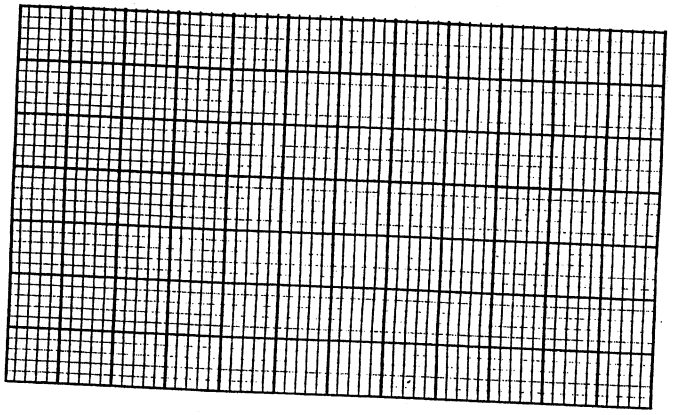
Marks

The percentages of ammonia in the equilibrium mixtures, formed during the synthesis of this compound from its constituent elements, are shown below for various conditions for the reaction:

$$N_2(g) + 3H_2(g) \equiv 2NH_3(g)$$

Temperature (°C)	Amount of ammonia (in percent) Pressure in Atmospheres		
	200	400	1000
200	90	97	99
400	39	69	80
600	8	24	32
700	4	12	16

(a) Plot a graph with the given data. **2**



(b) Describe **AND** explain the effects of pressure on the percentage yield of ammonia at equilibrium. **2**

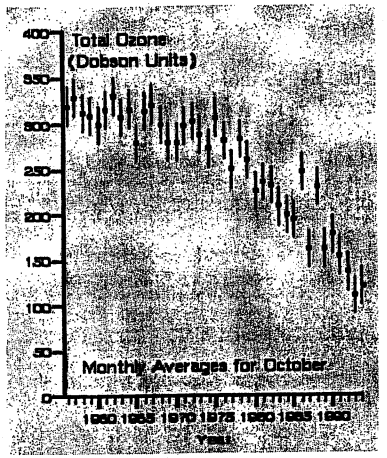
QUESTION 26 (Continued)

Marks

(c) Explain why ammonia is produced at temperatures of $400^0C - 500^0C$. **2**

QUESTION 27 (5 marks)

The graph below plots the ozone levels in the stratosphere measured at a station in Antarctica from 1957 to 1997.



(a) Construct an electron dot (Lewis diagram) structure for ozone. **1**

QUESTION 27 (Continued)

Marks

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

(c) Discuss, using relevant chemical equations, the effect of chlorofluorocarbons (CFC's) on ozone levels in the upper atmosphere. **3**

END OF PART B

STUDENT NUMBER: _____

QUESTION 20 (Continued)

Marks

(b) Define the term "buffer" in relation to acid-base systems and describe **ONE** example of buffer action in a natural system. Include equations. **3**