2007

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 a Periodic Table are provided
- Write your student number and/or name at the top of every page

Total marks - 100

Section I – Pages 2 – 15
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

Part B
Total marks (60)
Attempt Questions 16 – 23
Allow about 1 hour 45 minutes for this part

Section II – Pages 16 – 35
Total marks (25)
Attempt ONE question from Questions 24 – 28
Allow about 45 minutes for this section

This paper MUST NOT be removed from the examination room

STUDENT NUMBER/NAME: .....

STUDENT NUMBER/NAME: .....

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				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1. Which of the following cations exhibits an intense yellow flame when subjected to a flame test?

(A) Cr^{3+}
(B) Na^{+}
(C) Ba^{2+}
(D) Sr^{2+}

2. A compound is a colourless *liquid* that rapidly decolourises bromine water.

Which of the following is a possible formula for the compound?

(A) C_2H_4
(B) C_2H_5OH
(C) C_8H_{18}
(D) C_6H_{12}

3. A student measures the voltage between pairs of metal strips when placed in sodium sulfate solution.

Which metal gives the highest *positive* voltage in combination with copper?

(A) Silver
(B) Tin
(C) Zinc
(D) Magnesium

4. Butanoic acid and ethyl ethanoate have the same molecular formula, $C_4H_8O_2$.

Which of the following is the best chemical test to distinguish between these compounds?

(A) Dilute sodium carbonate
(B) Bromine water
(C) Solubility in water
(D) Smell

5. What is the systematic name for $CHCl = CCl_2$?

(A) 1,2 - dichloroethane
(B) 1,2,3 - trichlorethene
(C) 1,1,2 - trichloroethene
(D) 1,2 - dichloropropene

6. Which chemist first defined an acid as a substance which releases hydrogen ions in dilute solution?

(A) Lavoisier
(B) Davy
(C) Arrhenius
(D) Bronsted

7. When food passes from the mouth to the stomach the pH changes from 7 to 2.

What is the hydrogen ion concentration in the stomach compared with the mouth?

(A) 5 times less
(B) 5000 times less
(C) 50 times greater
(D) 100 000 times greater

8. Which reaction involves the formation of a coordinate covalent bond?

(A) $H^+ + OH^- \rightarrow H_20$
(B) $Mg(s) + 2H^+ \rightarrow Mg^2 + H_2(g)$
(C) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$
(D) $CH_4(g) + Br_2(g) \rightarrow CH_3Br(g) + HBr(g)$

9. Which compound results in a lower pH when dissolved in water?

(A) Sodium hydroxide
(B) Sulfur (IV) oxide
(C) Ammonia
(D) Potassium carbonate

10. Heavy metals such as mercury and lead are toxic in waterways, even at very low concentrations.

Which of the following is the most suitable method for analysing a water sample for these metals?

(A) Displacement by a more active metal
(B) Precipitation
(C) Flame test
(D) Atomic absorption spectroscopy

11. A paint solvent is a colourless liquid with a fruity odour and is insoluble in water.

To which group does the solvent most likely belong?

(A) Alkanoic acids
(B) Alkanols
(C) Esters
(D) Alkenes

12. One possible source of hydrogen for use as a fuel is through the 'reforming' of natural gas. The key reaction is:

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3H_2(g) \quad \Delta H = +172 \text{ kJ}$$

A catalyst is used for this reaction.
Which of the following is the most suitable set of conditions for this reaction?

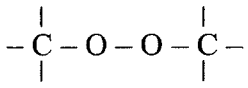
(A) Low pressure and low temperature
(B) Low pressure and high temperature
(C) High pressure and high temperature
(D) High pressure and low temperature

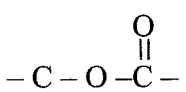
13. The first passenger-carrying balloons were made in the late 18th century using hydrogen from the reaction of iron with sulfuric acid.

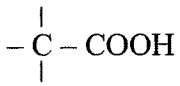
What is the mass of iron required to produce 10 kL of hydrogen at 25°C and 100kpa?

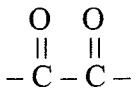
(A) 280 g
(B) 560 g
(C) 11 kg
(D) 22 kg

14. Identify the structural group that is present in all esters?

(A) 

(B) 

(C) 

(D) 

15. What is the purpose of using reflux in the production of an ester?

(A) To accelerate the reaction
(B) To increase the equilibrium yield of ester
(C) To remove the water by vaporisation
(D) All of the above

Section I (continued)

Part B
Total marks (60)
Attempt Questions 16 – 23
Allow about 1 hour 45 minutes for this part

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Question 16 (12 marks) **Marks**

Ethanol is described as a "water-like" compound but also has properties like those of hydrocarbons.

(a) Referring to ethanol's molecular structure, explain why it has similarities to both water and hydrocarbons. **3**

.....

.....

.....

.....

.....

.....

.....

.....

(b) Describe ONE "water-like" property of ethanol. **1**

.....

.....

.....

.....

Question 16 continues on the next page

Question 16 (continued) **Marks**

(c) Describe ONE "hydrocarbon-like" property of ethanol. **1**

.....

.....

.....

.....

(d) Construct chemical equations to demonstrate ONE renewable and ONE non-renewable method of ethanol production. **3**

.....

.....

.....

.....

.....

(e) The NSW Government intends to make 10% ethanol compulsory in all petrol.

Discuss the benefits and costs of using ethanol as a motor fuel. **4**

.....

.....

.....

.....

.....

.....

.....

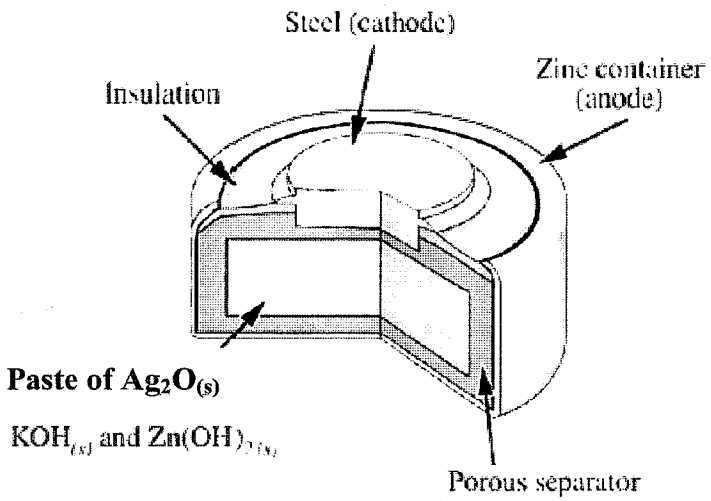
.....

.....

.....

Question 17 (8 marks) **Marks**

The diagram shows a silver oxide button cell, used in calculators, watches and hearing aids.



Half-Reactions

$$Zn(OH)_{2(s)} + 2e \rightarrow Zn_{(s)} + 2OH_{(aq)} \qquad E^\circ = -1.25\ V$$

$$Ag_2O_{(s)} + H_2O_{(l)} + 2e \rightarrow 2Ag_{(s)} + 2OH_{(aq)} \qquad E^\circ = +0.34\ V$$

(a) Construct the equation for the net cell reaction. **2**

.....

.....

(b) Calculate the voltage of the cell, stating the polarity of the steel cathode. **2**

.....

.....

(c) Explain the function of the porous barrier. **2**

.....

.....

.....

(d) Consider this cell when 90% of the silver oxide has reacted.

Predict the effect on the cell voltage, giving reasons for your answer. **2**

.....

.....

.....

.....

Question 18 (6 marks) **Marks**

Space probes require a power supply lasting many years. Often this is provided as heat from plutonium 238, an intensely radioactive alpha emitter.

(a) Identify the products of decay of Pu^{238}. **2**

.....

.....

.....

.....

(b) Describe TWO advantages of using an alpha-emitting source, rather than a beta or gamma emitter. **2**

.....

.....

.....

.....

(c) Assess the risks associated with this use of plutonium. **2**

.....

.....

.....

.....

.....

.....

.....

.....

STUDENT NUMBER/NAME: .....

Question 19 (11 marks) **Marks**

A white crystalline solid dissolves easily in water to form a solution of pH 2.8. A chemist investigating the substance makes the following observations:

- The empirical formula is CHO;
- A few crystals rapidly decolourise bromine water;
- The pH curve for its neutralisation with sodium hydroxide shows that it is a diprotic acid;
- By titration using phenolphthalein as an indicator, a solution of 0.29 g of the compound in water is neutralised by 20.9 mL of standard 0.24 mol L^{-1} sodium hydroxide solution.

(a) Identify the structural unit in the molecule which reacts with bromine water. **1**

.....

.....

(b) Sketch the titration curve for a weak diprotic acid reacting with sodium hydroxide solution. **2**

(c) Justify the selection of phenolphthalein as an indicator in this instance. **2**

.....

.....

.....

.....

Question 19 continues on the next page

Question 19 (continued) **Marks**

(d) For the titration, explain why the volume of sodium hydroxide solution must be measured accurately, but not the volume of water used to dissolve the acid. **2**

.....

.....

.....

.....

(e) Determine the mole mass and molecular formula of the compound. **3**

.....

.....

.....

.....

.....

.....

(f) Propose a structural formula for the compound. **1**

.....

.....

.....

.....

End of Question 19

Question 20 (7 marks) **Marks**

It has been suggested that increasing levels of atmospheric carbon dioxide will result in increased acidity in the oceans as additional carbon dioxide dissolves in the surface layers.

(a) With the aid of an equation, demonstrate the effect of more carbon dioxide on the pH of oceans. **2**

.....

.....

.....

.....

.....

.....

(b) Outline problems that could arise from these oceanic changes. **3**

.....

.....

.....

.....

.....

.....

.....

.....

(c) Supporting your answer with an equation, describe ONE process which might offset these effects by removing carbon dioxide from the oceans. **2**

.....

.....

.....

.....

.....

.....

.....

.....

Question 21 (7 marks) **Marks**

In soils, phosphate ions exist in equilibrium as follows:

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

(a) Assess the importance of monitoring phosphate concentrations in soils and waterways. **3**

.....

.....

.....

.....

.....

.....

.....

.....

(b) Compare the nature of the phosphate ions in acid soil of pH 5.5 with that in alkaline soil of pH 7.5. **2**

.....

.....

.....

.....

.....

.....

(c) Demonstrate that EACH of these phosphate ions is amphiprotic. **2**

.....

.....

.....

.....

.....

Question 22 (6 marks) **Marks**

The product of ozone from oxygen is strongly endothermic with $\Delta H = 142$ kJ mol^{-1}.

(a) Draw a structural formula for the ozone molecule. **1**

.....

.....

(b) Compare the production of ozone in the upper and lower atmospheres. **3**

.....

.....

.....

.....

.....

.....

(c) Explain why ozone is both a pollutant and essential to our environment. **2**

.....

.....

.....

.....

Question 23 (3 marks)

Recently, biopolymer carry bags are often used in place of bags made from addition polymers such as polyethylene.
Discuss the benefits and problems associated with the use of biopolymer carry bags. **3**

.....

.....

.....

.....

.....

.....

End of Section I

STUDENT NUMBER/NAME: .....

Section II

Total marks (25)
Attempt ONE question from Questions 24 – 28
Allow about 45 minutes for this section

Answer the question on your own paper or writing booklet, if provided.

Show all relevant working in questions involving calculations.

Question 24 – Industrial Chemistry (25 marks) **Marks**

(a) Outline the production process for the manufacture of sulfuric acid, identifying reaction conditions which must be monitored. **7**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) The following 'water gas' reaction is used to produce hydrogen from carbon monoxide:

$$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g) \quad \Delta H = -42 \text{ kJ}$$

Equal volumes of carbon monoxide and steam are mixed and brought to equilibrium at 986°C. The equilibrium mixture is found to contain 22% by volume of hydrogen.

(i) Calculate the equilibrium constant at 986°C. **2**

.....

.....

.....

.....

Question 24 continues on the next page

Question 24 (continued) **Marks**

(ii) Identify methods to increase the equilibrium yield of hydrogen. **2**

.....

.....

.....

.....

(c) Compare the chemistry of saponification with esterification and justify the different conditions in which these reactions are carried out. **5**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

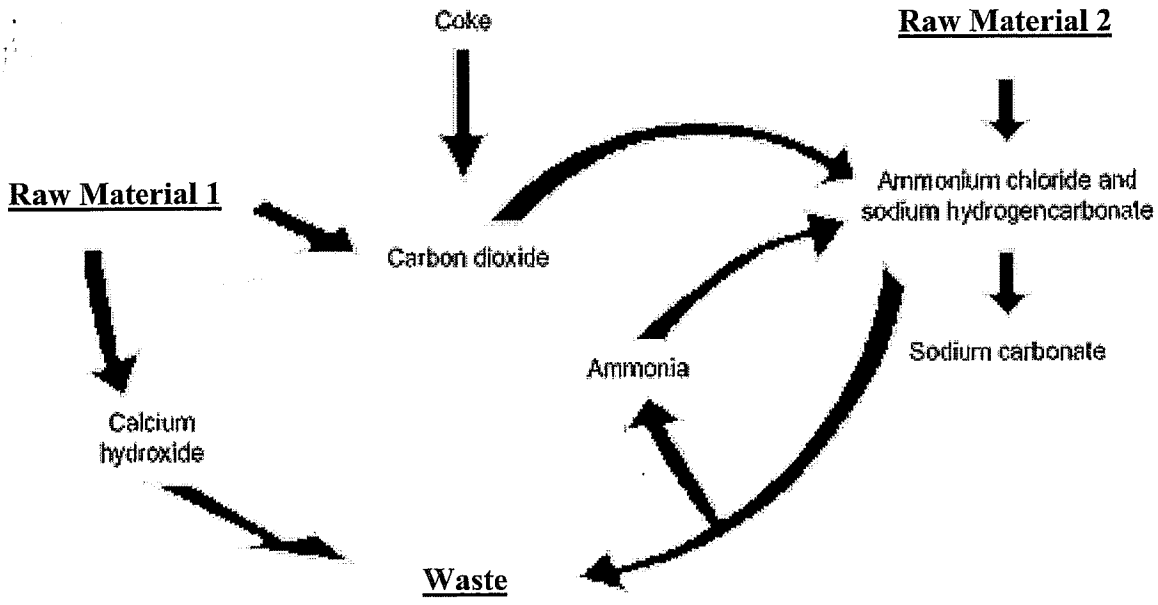
.....

.....

Question 24 continues on the next page

Question 24 (continued) **Marks**

(d) Study the flow chart of the Solvay Process shown below.



(i) Identify the raw materials 1 & 2 and the natural resources from which they are produced. **3**

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Construct an equation for the equilibrium in which sodium hydrogen carbonate is formed, and outline the conditions employed to maximise the yield. **3**

.....

.....

.....

.....

.....

.....

Question 24 (continued) **Marks**

(iii) Identify the main component of the waste discharge and discuss its importance in deciding on a suitable location for this industry. **3**

.....

.....

.....

.....

.....

.....

End of Question 24

STUDENT NUMBER/NAME: .....

Question 25 – Shipwrecks, Corrosion and Conservation (25 marks) **Marks**

(a) The ocean is a strong electrolyte solution, meaning that it readily conducts an electric current due to the movement of ions.

Identify and describe the origins of the minerals in the world's oceans. **4**

.....

.....

.....

.....

.....

.....

.....

.....

(b) The following information was contained in an electrochemist's notebook:

$$Sn(s) / Sn^{2+}(aq) // Mn^{2+}(aq) / Mn(s)$$

(i) Predict, using a list of standard potentials, which metal will corrode. **1**

.....

(ii) Write the net ionic equation for the above electrochemical cell and calculate the expected voltage of the cell under standard conditions. **2**

.....

.....

.....

.....

Question 25 continues on the next page

Question 25 (continued) **Marks**

(c) Steel is an alloy of various metals and non-metals. The properties of steel depend on the elements used and the percentage of each element in the steel.

(i) Contrast the composition and properties of THREE types of steel. **3**

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) The most common and economically destructive form of corrosion is the rusting of iron and steel.

Describe the conditions under which rusting occurs and explain the process of rusting. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

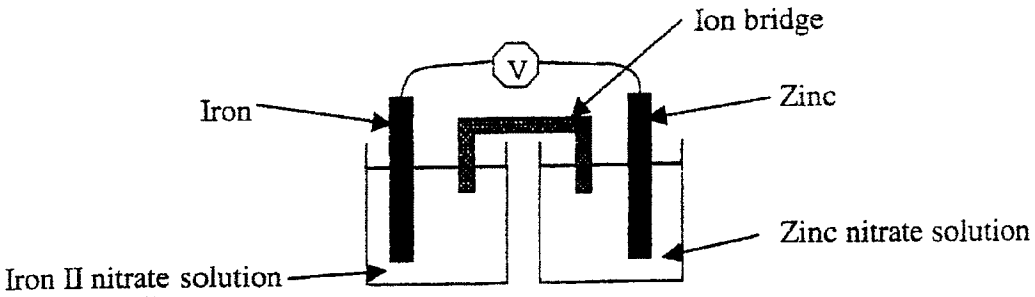
.....

.....

Question 25 continues on the next page

Question 25 (continued) **Marks**

(d) (i) Observe the electrochemical cell shown below.



Identify which is the anode and justify your choice. **2**

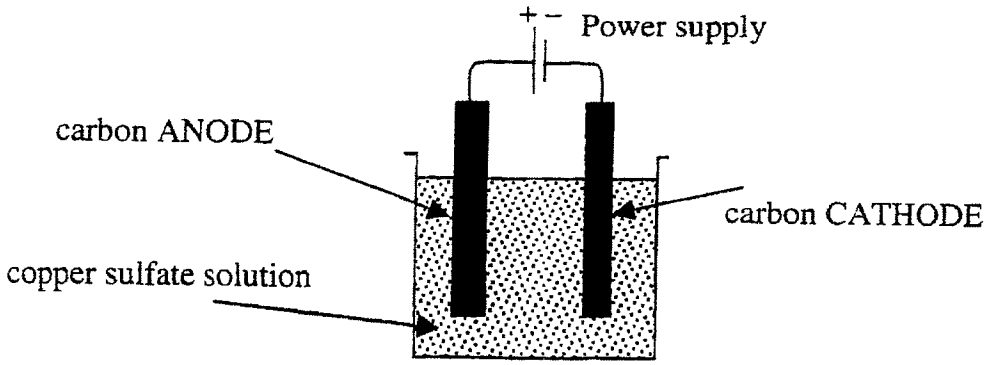
.....

.....

.....

.....

(ii) Observe the electrolytic cell shown below.



Outline TWO observations, ONE at the ANODE and ONE at the CATHODE, that you would see as electrolysis occurred over a period of time. **2**

.....

.....

.....

.....

Question 25 continues on the next page

Question 25 (continued) **Marks**

(e) Many scientists have contributed to our current theories on electrochemistry; none more so than Galvani, Volta, Davy and Faraday.

Outline and analyse the impact of these FOUR scientists on our understanding of electron transfer reactions. **7**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

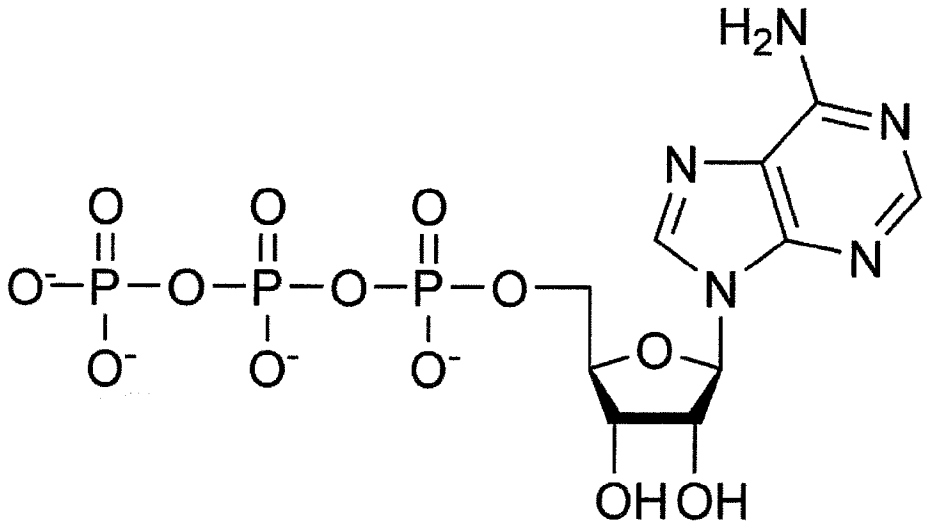
.....

.....

End of Question 25

STUDENT NUMBER/NAME: .....

Question 26 – The Biochemistry of Movement (25 marks) **Marks**



(a) Identify the chemical above. **1**

.....

(b) (i) Identify the anaerobic process of metabolism whereby carbohydrates are broken down to produce energy. **1**

.....

(ii) Identify the main chemical that is broken down in this process. **1**

.....

(iii) Identify the part of the cell where this process takes place. **1**

.....

(iv) Identify the end product of this metabolic process. **1**

.....

(v) Identify the net yield of ATP from this metabolic process. **1**

.....

Question 26 continues on the next page

Question 26 (continued) **Marks**

(c) Account for the process of protein denaturation. **3**

.....

.....

.....

.....

.....

.....

(d) Outline the decomposition of fatty acids. **2**

.....

.....

.....

.....

(e) Construct an equation that summarises the regeneration of ATP. **2**

.....

.....

.....

.....

(f) Describe the role of oxygen in respiration. **3**

.....

.....

.....

.....

.....

.....

Question 26 continues on the next page

Question 26 (continued) **Marks**

(g) Describe the formation of peptide bonds. **3**

.....

.....

.....

.....

.....

.....

(h) Define the term *oxidative phosphorylation*. **3**

.....

.....

.....

.....

.....

.....

(i) Outline why ATP is consumed in the process of muscle contraction. **3**

.....

.....

.....

.....

.....

.....

End of Question 26

Question 27 – Chemistry of Art (25 marks) **Marks**

(a) Account for the range of colours found in Aboriginal artwork in Australia, referring to the minerals available as pigments, including their chemical composition. **6**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Queen Elizabeth I is thought to have started an upper class fashion in facial make-up. She used white lead (lead carbonate), applied as a paste to the skin, to make her face paler.

Explain why lead carbonate has the required properties of a pigment, and identify ONE problem in its use. **2**

.....

.....

.....

.....

.....

Question 27 continues on the next page

Question 27 (continued) **Marks**

(c) Compare the electronic configurations of calcium and chromium, using subshell notation, and account for the range of oxidation states shown by EACH of these elements. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Refer to the diagram of the emission spectrum of gaseous sodium below to answer the following questions.

(i) Account for the observed flame test for sodium ions. **2**

.....

.....

.....

.....

.....

(ii) Contrast this spectrum with an absorption spectrum for gaseous sodium. **1**

.....

.....

Question 27 continues on the next page

Question 27(d) (continued) **Marks**

(iii) Outline the explanation developed by Bohr to explain the emission spectra of elements. **4**

.....

.....

.....

.....

.....

.....

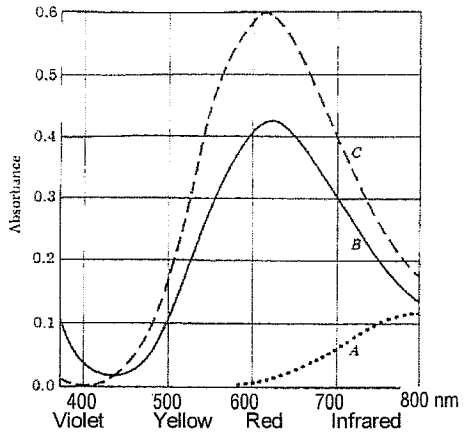
.....

.....

.....

.....

(e) Refer to the diagram of the absorption spectra of 10^{-2} mol L^{-1} aqueous copper sulfate (line A) and the same solution after the addition of 10^{-1} mol L^{-1} ammonia (line C).



(i) Using a diagram demonstrate the complex nature of the aqueous copper ion. **2**

Question 27 continues on the next page

Question 27 (continued) **Marks**

(ii) Describe the observed colour change when ammonia is added to the copper sulfate solution. **1**

.....

.....

.....

(iii) Explain why ammonia is a suitable ligand to form a complex ion with the copper ion. **1**

.....

.....

.....

(iv) Account for the variety of colours observed for complex ions of transition metals such as copper. **2**

.....

.....

.....

.....

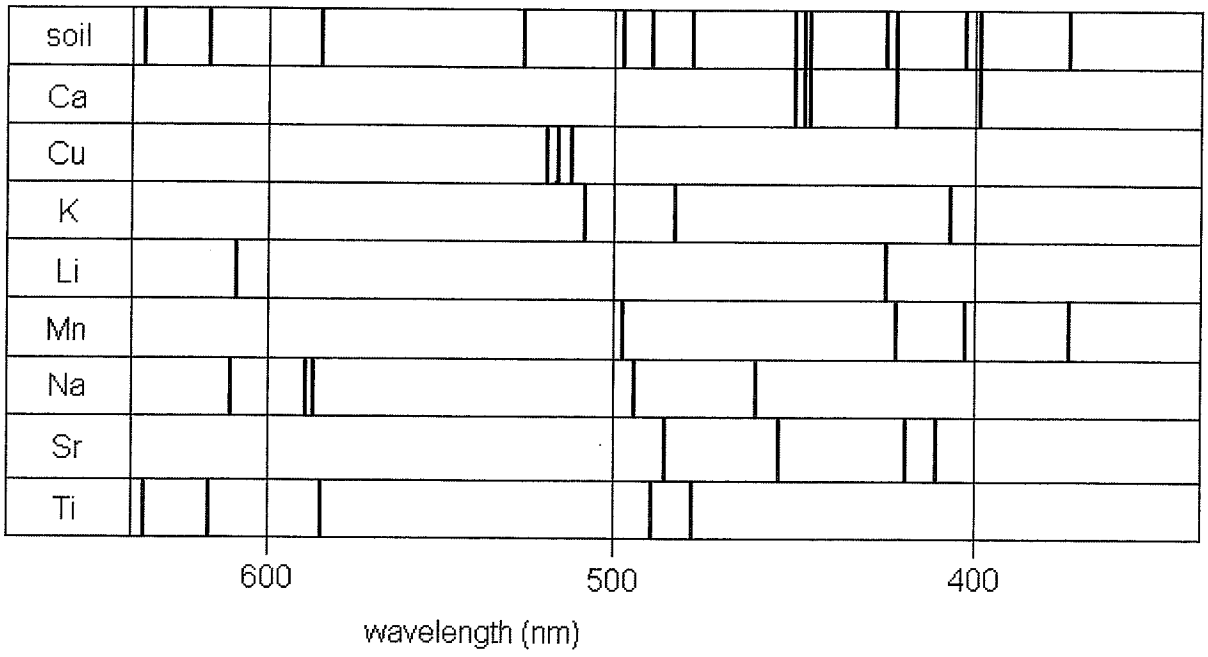
.....

End of Question 27

STUDENT NUMBER/NAME: .....

Question 28 – Forensic Chemistry (25 marks) **Marks**

(a) A soil sample was subjected to spectroscopic analysis. The emission spectrum of this sample is shown below, along with the emission lines of certain elements.



(i) Identify the elements present in the soil sample. **1**

.....

.....

.....

(ii) Explain why EACH element has a unique set of spectral lines. **3**

.....

.....

.....

.....

.....

.....

.....

.....

Question 28 continues on the next page

Question 28 (continued) **Marks**

(b) Glucose is an example of an organic compound that can be classified as a carbohydrate, a reducing sugar or a monosaccharide.

(i) State why glucose is classified as a carbohydrate. **2**

.....

.....

.....

.....

(ii) Describe the chemical difference between a reducing and a non-reducing sugar. **2**

.....

.....

.....

.....

(iii) Describe a test that can be used to distinguish between organic and inorganic compounds.

Include an outline of a risk assessment for carrying out this test. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 28 continues on the next page

Question 28 (continued) **Marks**

(c) Assess the usefulness of DNA analysis for investigating crime and discuss the importance of accuracy in solving crimes. **7**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

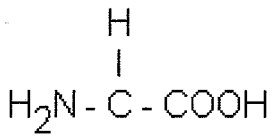
.....

.....

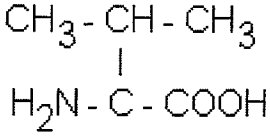
Question 28 continues on the next page

Question 28 (continued) **Marks**

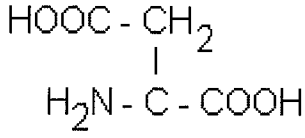
(d) The structure and isoelectric point for three different amino acids are given below.



glycine - 6.0



valine - 6.0



aspartic acid - 3.0

(i) Identify the major functional groups present in all amino acids. **1**

.....

.....

.....

.....

(ii) Justify the use of electrophoresis instead of gas chromatography for identifying the presence of glycine, valine and aspartic acid in a mixture of amino acids. **5**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of paper

Chemistry

DATA SHEET

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

Some useful formulae

$$\text{pH} = -\log_{10}[\text{H}^+] \qquad \Delta H = -mC\Delta T$$

Some standard potentials

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	–2.94 V
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	$Ba(s)$	–2.91 V
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	$Ca(s)$	–2.87 V
$Na^+ + e^-$	$\rightleftharpoons$	$Na(s)$	–2.71 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	$Mg(s)$	–2.36 V
$Al^{3+} + 3e^-$	$\rightleftharpoons$	$Al(s)$	–1.68 V
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	$Mn(s)$	–1.18 V
$H_2O + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g) + OH^-$	–0.83 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	$Zn(s)$	–0.76 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	$Fe(s)$	–0.44 V
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	$Ni(s)$	–0.24 V
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	$Sn(s)$	–0.14 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	$Pb(s)$	–0.13 V
$H^+ + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	$Cu(s)$	0.34 V
$\frac{1}{2}O_2(g) + H_2O + 2e^-$	$\rightleftharpoons$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\rightleftharpoons$	$Cu(s)$	0.52 V
$\frac{1}{2}I_2(s) + e^-$	$\rightleftharpoons$	I^-	0.54 V
$\frac{1}{2}I_2(aq) + e^-$	$\rightleftharpoons$	I^-	0.62 V
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\rightleftharpoons$	$Ag(s)$	0.80 V
$\frac{1}{2}Br_2(l) + e^-$	$\rightleftharpoons$	Br^-	1.08 V
$\frac{1}{2}Br_2(aq) + e^-$	$\rightleftharpoons$	Br^-	1.10 V
$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O	1.23 V
$\frac{1}{2}Cl_2(g) + e^-$	$\rightleftharpoons$	Cl^-	1.36 V
$\frac{1}{2}Cr_2O_7^{2-} + 7H^+ + 3e^-$	$\rightleftharpoons$	$Cr^{3+} + \frac{7}{2}H_2O$	1.36 V
$\frac{1}{2}Cl_2(aq) + e^-$	$\rightleftharpoons$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2}F_2(g) + e^-$	$\rightleftharpoons$	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

PERIODIC TABLE OF THE ELEMENTS

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanides	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223.0] Francium	88 Ra [226.0] Radium	89–103 Actinides	104 Rf [261.1] Rutherfordium	105 Db [262.1] Dubnium	106 Sg [266.1] Seaborgium	107 Bh [264.1] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

KEY

Atomic Number — 79 — Symbol of element

Atomic Weight — 197.0 — Name of element

Gold

Lanthanides

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [144.9] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium

Actinides

89 Ac [227.0] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237.0] Neptunium	94 Pu [244.1] Plutonium	95 Am [243.1] Americium	96 Cm [247.1] Curium	97 Bk [247.1] Berkelium	98 Cf [251.1] Californium	99 Es [252.1] Einsteinium	100 Fm [257.1] Fermium	101 Md [258.1] Mendelevium	102 No [259.1] Nobelium	103 Lr [262.1] Lawrencium

Where the atomic weight is not known, the relative atomic mass of the most common radioactive isotope is shown in brackets.
The atomic weights of Np and Tc are given for the isotopes ^{237}Np and ^{99}Tc.