



CATHOLIC SECONDARY SCHOOLS
ASSOCIATION OF NEW SOUTH WALES

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Centre Number

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Student Number

2005
TRIAL HIGHER SCHOOL CERTIFICATE
EXAMINATION

Chemistry

Afternoon Session
Friday 5 August 2005

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Use the Data Sheet and Periodic Table provided
- Use Multiple Choice Answer Sheet provided
- Write your Centre Number and Student Number and the top of this page and page 9

Total marks – 100

Section I Pages 3-20

75 marks

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt Questions 1-15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16-29
- Allow about 1 hour and 45 minutes for this part

Section II Pages 21-28

25 marks

- Attempt ONE question from Questions 30-34
- Allow about 45 minutes for this section

Disclaimer

Every effort has been made to prepare these 'Trial' Higher School Certificate Examinations in accordance with the Board of Studies documents, *Principles for Setting HSC Examinations in a Standards-Referenced Framework* (BOS Bulletin, Vol 8, No 9, Nov/Dec 1999), and *Principles for Developing Marking Guidelines Examinations in a Standards Referenced Framework* (BOS Bulletin, Vol 9, No 3, May 2000). No guarantee or warranty is made or implied that the 'Trial' Examination papers mirror in every respect the actual HSC Examination question paper in any or all courses to be examined. These papers do not constitute 'advice' nor can they be construed as authoritative interpretations of Board of Studies intentions. The CSSA accepts no liability for any reliance use or purpose related to these 'Trial' question papers. Advice on HSC examination issues is only to be obtained from the NSW Board of Studies.

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Section I
75 marks

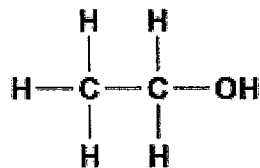
Part A – 15 marks

Attempt Questions 1-15

Allow about 30 minutes for this part

Use the Multiple Choice Answer Sheet provided

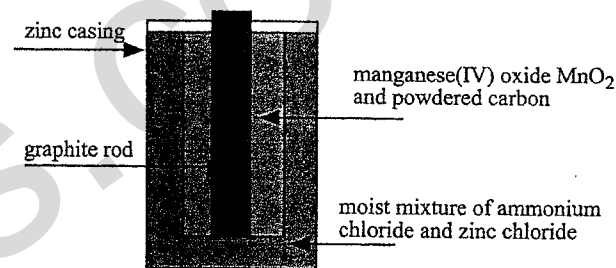
- 1 Identify the following compound.



- (A) Ethanoic acid
(B) Ethylene
(C) Ethanol
(D) Ethene
- 2 Which of the following is an alternative source of the compounds presently obtained from the petrochemical industry?
- (A) Biomass
(B) Haber process
(C) Photovoltaic cells
(D) Radioisotopes
- 3 Australians have recently become more aware of the 'hole' in the ozone layer above Antarctica. The reason that we should be concerned is that it will
- (A) allow oxygen to escape and we will have to wear oxygen equipment on Antarctic expeditions
(B) expose us to increased levels of ultra violet radiation
(C) cause an increase in ozone levels in the troposphere
(D) expose us to more CFCs

- 4 In an investigation to compare the pH of a strong acid and a weak acid, which pair of solutions would be most appropriate?
- (A) 1.0 molL⁻¹ citric acid and 1.0 molL⁻¹ acetic acid
(B) 0.10 molL⁻¹ acetic acid and 10 molL⁻¹ hydrochloric acid
(C) 0.30 molL⁻¹ citric acid and 0.10 molL⁻¹ hydrochloric acid
(D) 0.10 molL⁻¹ acetic acid and 0.10 molL⁻¹ hydrochloric acid

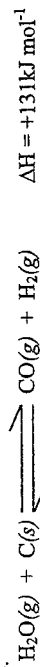
- 5 The diagram below shows a dry cell battery.



Which of the following statements is correct for this dry cell battery?

- (A) The manganese(IV) oxide is the electrolyte
(B) The graphite rod is the anode
(C) Graphite is reduced at the cathode
(D) Zinc is oxidised to zinc (II) at the anode
- 6 A student used a pH meter to measure the acidity of 100mL of 0.1 molL⁻¹ HCl. She found that the pH was 1. She then added 900mL of water and tested the pH again.
- The value for pH that she obtained for the new concentration was
- (A) 10
(B) 2
(C) 1
(D) 0.5

7 The hydrogen for the Haber process can be obtained from the reaction of steam on red-hot coke.



Use Le Chatelier's Principle to predict the conditions required for the efficient production of hydrogen.

- (A) High pressure and high temperature
- (B) High pressure and low temperature
- (C) Low pressure and high temperature
- (D) Moderate temperature, high pressure and a catalyst

8 Which pair of equations correctly describes the behaviour of the oxides of lithium and carbon when placed with water?

- (A) $\text{Li}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow 2 \text{LiOH}(aq)$
 $2 \text{CO}_2(g) + \text{H}_2\text{O}(l) \longrightarrow \text{HCO}_3^-(aq) + \text{HCO}_2^-(aq)$
- (B) $\text{Li}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow 2 \text{LiOH}(aq)$
 $\text{CO}_2(g) + \text{H}_2\text{O}(l) \longrightarrow \text{H}_2\text{CO}_3(aq)$
- (C) $2 \text{Li}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow \text{HLiO}_3(aq) + \text{HLiO}_2(aq)$
 $\text{C}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow 2 \text{COH}(aq)$
- (D) $\text{Li}_2\text{O}(s) + \text{H}_2\text{O}(l) \longrightarrow \text{HLiO}_3(aq) + 2 \text{HLiO}_2(aq)$
 $\text{CO}(s) + \text{H}_2\text{O}(l) \longrightarrow \text{C}(\text{OH})_2(aq)$

9 Which of the following isotopes is the most unstable?

- (A) ${}^1_1\text{H}$
- (B) ${}^{12}_6\text{C}$
- (C) ${}^{14}_7\text{N}$
- (D) ${}^{18}_8\text{O}$

10 A student tested 4 household substances using indicators. Which of the following results is recorded correctly?

	Substance	Colour with phenolphthalein	Colour with methyl orange
(A)	wine	pink	red
(B)	ammonia cleaner	pink	yellow
(C)	vinegar	red	blue
(D)	bicarbonate of soda	clear	blue

11 A student added a solution of barium nitrate to a solution of lawn fertilizer in order to determine the sulfate content of the fertilizer. The resulting solution was heated and stirred and then filtered. Barium nitrate was then added to the filtrate.

It is true to say that

- (A) the barium nitrate is added to the filtrate to determine whether sulfate ions were still present
- (B) the solution was heated and stirred to dissolve the fertilizer and the barium nitrate
- (C) barium nitrate was added to dissolve the fertilizer
- (D) the solution was filtered to remove any impurities in the fertilizer

12 Oysters provide a rich source of zinc, an essential trace element in our diet. The minimum recommended intake for an adult is 12mg per day.

If a sample of oysters was found by AAS to contain an average of 200ppm of zinc per oyster how many oysters would an adult have to eat to reach the minimum recommended daily intake?

- (A) 0.2
- (B) 1.7
- (C) 6
- (D) 12

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Centre Number

Chemistry
Section I (continued)

Part B – 60 marks
Attempt Questions 16-29
Allow about 1 hour and 45 minutes for this part

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Student Number

13 The following cathode reaction occurs in the vanadium redox cell.



The oxidation state of vanadium changes from

- (A) +5 to +4
- (B) +5 to +2
- (C) +2 to +1
- (D) +4 to +5

14 Two water samples from a waste water recycling plant were tested for their level of biochemical oxygen demand.

The following results were obtained.

Water sample	BOD ($mg L^{-1}$)
1	2
2	16

Using these results, it would be true to conclude that

- (A) sample 2 has 8 times the level of dissolved oxygen of sample 1
- (B) sample 2 was taken in the final stage of treatment
- (C) sample 1 was taken at the beginning of the treatment
- (D) sample 1 has the least amount of biodegradable waste in it

15 When the lunar module of Apollo 11 landed on the moon, the fuel used was hydrazine (N_2H_4) and dinitrogen tetroxide (N_2O_4). When these were mixed a spontaneous reaction occurred.



What volume of gas would be expelled at 100kPa and 25°C, for each kilogram of hydrazine used?

- (A) 31 L
- (B) 109 L
- (C) 2707 L
- (D) 5414 L

Marks

Question 16 (4 marks)

Poly(vinyl chloride) is an addition polymer which has many everyday uses.

- (a) Draw the structural formula for the vinyl chloride monomer. **1**

- (b) Define the term *addition polymer*. **1**

- (c) Explain ONE use of this polymer in terms of its physical properties. **2**

Question 17 (2 marks)

The transuranic element Meitnerium was first detected in Germany in 1982. It existed for five-thousandths of a second. Describe how transuranic elements such as Meitnerium are produced.

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Marks

2

Question 19 (5 marks)

Assess the viability of the use of cellulose from biomass as a substitute for carbon chain structures obtained from petroleum.

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Marks

5

Question 18 (2 marks)

Describe the uses of ammonia that made Haber's discovery very important at that time in world history.

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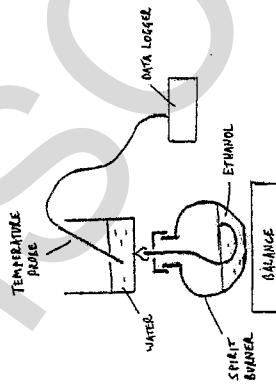
Marks

2

Question 20 (5 marks)

Marks

A quantity of ethanol was placed in a spirit burner, the wick lit and the energy produced used to heat 100g of water in a beaker. The change in mass of the spirit burner was measured by placing the burner on an electronic balance. The temperature was measured using a probe attached to a data logger. A diagram of the apparatus is shown.



The results are tabulated below.

Time (mins)	Mass of Burner + Alcohol (g)	Temperature (°C)
0	228.3	24
1	227.8	30
2	227.4	37
3	226.9	44
4	226.5	51
5	226.2	58

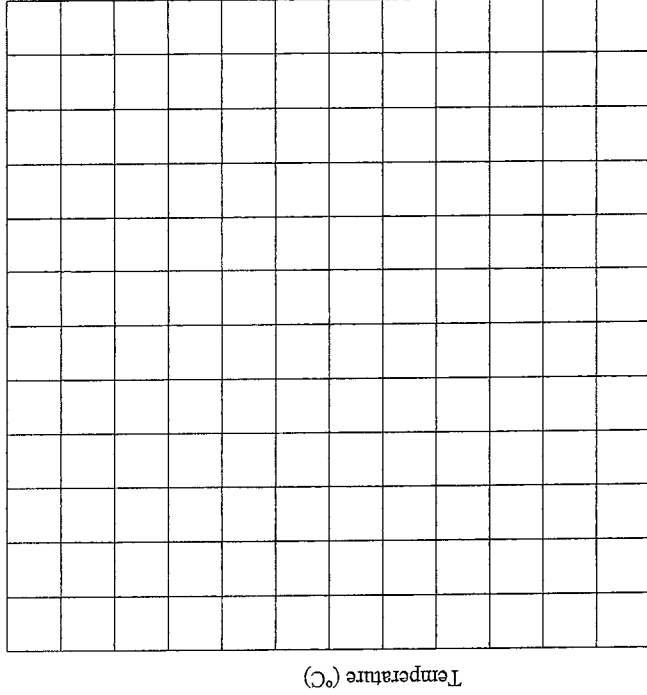
Question 20 continues on page 13

Question 20 (continued)

Marks

(a) Draw a graph of temperature v time. Use an appropriate scale.

2



Time (s)

(b) Calculate the molar heat of combustion of ethanol using these data.

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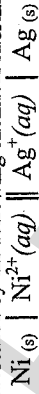
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End of Question 20

Question 21 (5 marks)

Marks

A student constructed an electrochemical cell using nickel, nickel nitrate, silver and silver nitrate. This can be represented by the following chemical shorthand:



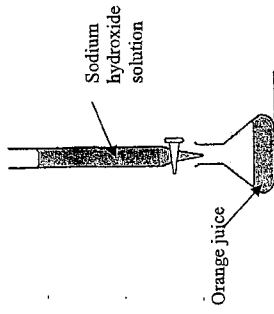
- (a) Draw a diagram of this electrochemical cell and label the following parts: **3**

1. anode and cathode
2. the direction of electron flow.

Question 22 (3 marks)

Marks

To find the citric acid content of some orange juice, a student used the following equipment.



- (a) Identify the piece of equipment that holds the sodium hydroxide solution. **1**

- (b) Outline the procedure required to rinse this piece of equipment before use. **1**

- (c) Identify a potential source of error in this experiment. **1**

Question 23 (3 marks)

Marks

- (a) Identify a practising Australian scientist you have studied during this Chemistry course. **1**

- (b) Describe his/her work. **2**

Question 24 (4 marks)

Marks

4

Two identical bottles of soda water (carbonated water), one at room temperature (25°C) and one just out of the refrigerator, had their pH determined using a probe and data logger. The results are tabulated below.

Soda Water	pH	Temperature (°C)
Bottle A	5.21	25
Bottle B	4.63	4

Account for the difference in pH in terms of Le Chatelier's principle.

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Question 25 (4 marks)

Marks

4

The presence of pairs of chemicals eg $\text{CO}_3^{2-} / \text{HCO}_3^-$, or $\text{H}_2\text{PO}_4^- / \text{HPO}_4^{2-}$, in the blood is essential to the proper functioning of the body. Describe the action of these chemical pairs using equations.

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Question 26 (7 marks)

Marks

A 500mL bottle of concentrated sulfuric acid (18 mol L^{-1}) was dropped in a laboratory accident. Solid sodium hydrogen carbonate (NaHCO_3) was used to neutralize the spilled acid.

(a) Justify the choice of the solid sodium hydrogen carbonate to clean up the spill. Include relevant equation(s).

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(b) Calculate the minimum mass of sodium hydrogen carbonate needed to neutralise the spilled acid completely.

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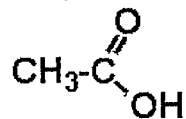
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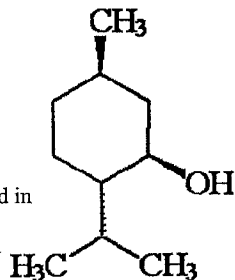
Question 27 (3 marks)

Marks

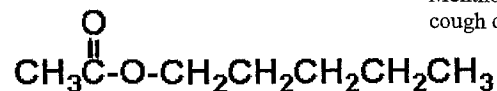
Many organic compounds, other than esters, are responsible for the distinctive aromas or flavours of foods. The following molecules are 'active' ingredients in various foods. Only ONE of these is an ester.



Acetic acid - found in salad dressing



Menthol - found in cough drops



Pentyl ethanoate - found in lollies

(a) Identify the ester. 1

(b) Outline how this ester could be produced in a school laboratory. 2

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Question 28 (6 marks)

Marks

(a) Identify your local catchment area. 1

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(b) Outline a chemical test that is carried out to test for a possible named contaminant in a water sample from your local catchment area. 2

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(c) Describe the methods used to purify and sanitise the drinking water supplied from your catchment area. 3

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Question 29 (7 marks)

Marks

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Evaluate the effectiveness of the steps taken to alleviate the problems associated with the use of CFCs.

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Chemistry
Section II

25 marks

Attempt ONE question from Questions 30-34

Allow about 45 minutes for this section

Answer the question in a SEPARATE writing booklet.

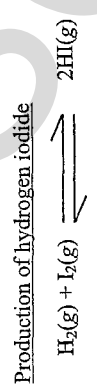
Show all relevant working in questions involving calculations.

	Page
Question 30 Industrial Chemistry	22-23
Question 31 Shipwrecks, Corrosion and Conservation	24
Question 32 The Biochemistry of Movement	25
Question 33 The Chemistry of Art	26
Question 34 Forensic Chemistry	27-28

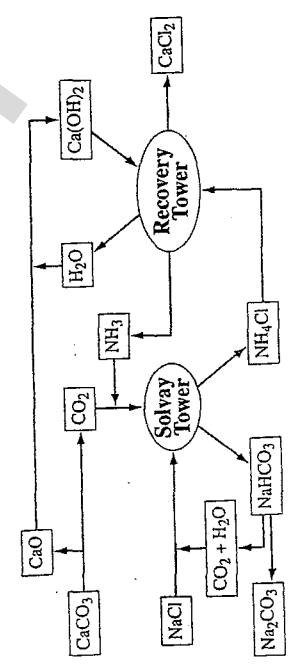
- (d) As part of your study of this Option you performed a first-hand investigation to carry out saponification and test the product. 3
- (i) Describe the procedure you used for this investigation. 3
- (ii) Justify your method of data collection. 3
- (e) Assess the impact on the environment of the developments in technology available to manufacture sodium hydroxide. 7

End of Question 30

- (a) Pressure, volume, concentration and temperature all have an effect on an equilibrium reaction. 1
- (i) Which of these factors will alter the equilibrium constant? 1
- (ii) Compare the effect of an increase in pressure on the following equilibria. 2



- (b) The Solvay Process is illustrated below. 1



- (i) Identify the major product of the Solvay Process. 1
- (ii) Choose ONE of the chemical changes that occur in this process and explain the chemistry involved. 3
- (c) Analyse the processes required to manufacture sulfuric acid from Earth materials. 5

Question 30 continues on page 23

Question 31 – Shipwrecks, Corrosion and Conservation (25 marks)

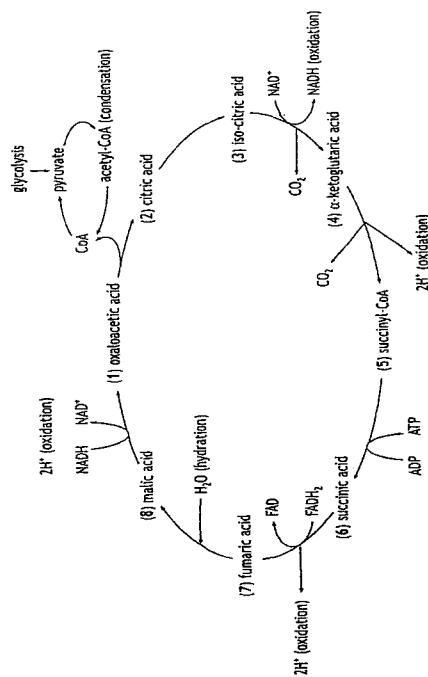
Marks

- (a) Luigi Galvani demonstrated “animal electricity” by making the muscles twitch in a dead frog. Alessandro Volta proposed a different theory about the origins of this electricity. **1**
- (i) Identify another scientist who contributed toward our understanding of electrochemistry. **1**
- (ii) Compare the theories of Galvani and Volta. **2**
- (b) (i) Identify ONE condition at great ocean depths which led to the prediction that shipwrecks would corrode slowly. **1**
- (ii) Explain how this condition led to the prediction of a slow rate of corrosion. Support your answer with balanced chemical equations. **3**
- (c) With reference to the factors that affect an electrolysis reaction, analyse how an understanding of electrolysis has led to the development of efficient processes that can be applied in the conservation and restoration of marine artefacts. **5**
- (d) You were required to perform a first-hand investigation to compare and describe the rate of corrosion of materials in different salt concentrations. **2**
- (i) Outline the procedure for your investigation. **4**
- (ii) Justify the procedure. **4**
- (e) Assess the impact of new materials and the development of corrosion protection systems on the construction of marine going vessels, with a particular emphasis on the 20th Century. **7**

Question 32 – The Biochemistry of Movement (25 marks)

Marks

- (a) (i) Identify the main use of ATP in the body. **1**
- (ii) Compare the structure of ATP and ADP. **2**
- (b) (i) Identify the name of the process shown below. **1**

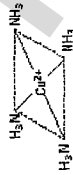


- (ii) Explain the importance of this process. Use an equation to support your answer. **3**
- (c) Analyse the effects of changes in pH and temperature on enzyme activity. **5**
- (d) As part of your study of this Option you performed a first-hand investigation to compare the structures of glycogen and glucose. **1**
- (i) Draw the structure of glucose. **3**
- (ii) Outline the procedure you used for this investigation. **2**
- (iii) Justify the choice of materials. **7**
- (e) Assess the impact of discoveries in biochemistry on the understanding of the changes that occur in the muscles of a sprinter. **7**

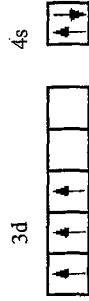
Question 33 – The Chemistry of Art (25 marks)

Marks

- (a) Ammonia (NH_3) is an example of a molecule that acts as a ligand.
- (i) Identify another molecule that can act as a ligand. **1**
- (ii) Describe the colour change when the following complex is formed from a Cu^{2+} solution and excess ammonia. **1**



- (iii) Write a chemical reaction showing the formation of this complex. **1**
- (b) (i) Identify the name of the element with the following electronic configuration. **1**



- (ii) Account for TWO different oxidation states of this element. **3**
- (c) Analyse the reasons for the position of Manganese in the periodic table in terms of its electron arrangement, ionisation energy and electronegativity. **5**
- (d) As part of your study of this Option you performed a first-hand investigation to observe the colour changes of a transition metal in its different oxidation states. **3**

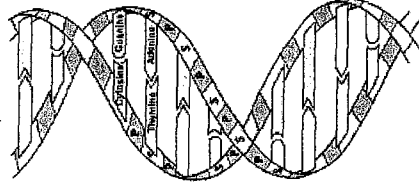
- (i) Outline the procedure you used for this investigation. **3**
- (ii) Justify the chemicals used. **3**
- (e) Assess the impact of technology in analysing the range of pigments used by artists throughout history. **7**

Question 34 – Forensic Chemistry (25 marks)

Marks

- (a) Carbohydrates such as cellulose, starch and glycogen can be used to distinguish between plant and animal materials
- (i) Identify the general formula for a carbohydrate. **1**
- (ii) Compare the use of carbohydrates by plants and animals. **2**

- (b) A section of a DNA molecule is shown below.



- (i) Identify the three main components of DNA. **1**
- (ii) Explain how DNA is analysed to identify relationships between people. **3**
- (c) With reference to a first hand investigation you have carried out, analyse the factors that allow a chemist to use emission spectroscopy to identify an element. **5**

Question 34 continues on page 28

Question 34 (continued)

Marks

- (d) As part of your study of this Option you performed a first-hand investigation to separate a mixture of organic materials.
- (i) Outline the procedure you used for this investigation. 3
- (ii) Justify your choice of solvent(s). 3
- (e) Assess the impact of developments in a range of technologies on the ability of chemists to resolve forensic investigations. 7

End of paper