



CHEMOLOGY EDUCATION SERVICES

Name: _____

2004 CHEMISTRY UNIT 1 TRIAL EXAM

Time allowed: 1 hour 30 minutes
QUESTION AND ANSWER BOOKLET
Structure of booklet

<u>Section</u>	<u>Number of questions</u>	<u>Number of questions to be answered</u>
A	20 multiple choice items	20 multiple choice items
B	9	9

Materials

Question and answer booklet of 10 pages.

Answer sheet for multiple choice items

An approved calculator may be used.

The Task

Pleasure ensure that you write your name on the multiple choice answer sheet and this answer booklet.

Answer **all** items from Section A, which should be answered on the sheet provided.

Answer **all** questions from Section B, which should be answered in this booklet in the spaces provided.

There is a total of 75 marks available.

All answers should be written in English.

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SECTION A**Specific instructions for Section A**

Question 1 consists of 20 multiple choice questions. Section A is worth approximately 30% of the marks available. You should spend about 30 minutes on this section.

Choose the response that is **correct** or **best answers the question**, and mark your choice on the multiple choice answer sheet provided.

No credit will be given for an item if two or more letters are marked for that item. Marks will not be deducted for incorrect answers and you should attempt every item.

Question 1

The last sub-atomic particle to be identified was the

- A. proton.
- B. neutron.
- C. electron
- D. nucleus.

Question 2

The mass number of an element is equal to

- A. the mass of protons in the nucleus.
- B. The number of protons in the nucleus of an atom.
- C. The number of neutrons in the nucleus of an atom.
- D. The number of protons and neutrons in the nucleus of an atom.

Question 3

The number of valence electrons in the element carbon is

- A. 1 B. 2 C. 3 D. 4

Question 4

An atom of $^{14}_7\text{N}$ is ionised to give N^{3-} . In this ion there are

- A. 7 protons and 7 electrons.
- B. 7 protons and 4 electrons
- C. 7 neutrons and 10 protons.
- D. 7 protons and 10 electrons.

Question 5

An element towards the top right hand side of the periodic table will tend to be

- A. metallic and have a high electronegativity.
- B. non-metallic and have a high electronegativity.
- C. metallic and have a low electronegativity.
- D. non-metallic and have a low electronegativity.

Question 6

Metals conduct electricity due to

- A. their outer electrons not being firmly bound to the atom.
- B. The movement of the positive metal ions.
- C. Vibrations of ions within the metal lattice.
- D. Metal atoms are not as firmly bonded to one another as non-metals.

Question 7

The electronic arrangement of four elements is listed below. Which one represents a **non-metal** atom which may form a negative charge?

- A. 2, 8, 1
- B. 2, 8, 2
- C. 2, 7
- D. 2, 8

Question 8

The elements Beryllium, Calcium and Strontium all form ions with a

- A. + 1 charge only.
- B. + 2 charge only.
- C. + 3 charge only.
- D. + 1 or + 2 charge.

Question 9

Atom **A** has three electrons in its outershell. It reacts vigorously with atom **B**, which has six electrons in its outershell. Which of the following is correct?

- A. **A** has a -3 charge while **B** has a +2 charge.
- B. The compound formed between A and B would probably have a low melting point.
- C. The formula of the compound formed would be A_2B_3 .
- D. No compound can form between atoms A and B.

Question 10

The brittleness of an ionic compound can directly be attributed to the

- A. Repulsions that occur when like charges align.
- B. Weakness of the bonds within the lattice.
- C. Strength of the bonds and their unwillingness to bend.
- D. Presence of positive and negative ions.

Question 11

Which one of the following exists as a covalent molecule?

- A. Al_2O_3
- B. NH_3
- C. $CuSO_4 \cdot H_2O$
- D. He

Question 12

Which one of the following would be a polar molecule that exhibits hydrogen bonding?

- A. HF B. CO₂ C. H₂ D. CH₄

Question 13

The addition of a small quantity of carbon to iron increases hardness. The best explanation for this is that

- A. the iron and carbon atoms pack into a more orderly arrangement which is difficult to distort.
- B. Together iron and carbon produce smaller but more closely packed crystals.
- C. The smaller carbon atoms fit between the iron atoms and stop layers from sliding past one another.
- D. The carbon atoms are arranged around the crystals, preventing them from being deformed.

Question 14

Fluoromethane, CH₃F would be classified as

- A. Polar and a tetrahedral shape.
- B. Polar and linear.
- C. Non-polar and a tetrahedral shape.
- D. Non-polar and linear.

Question 15

An alkane with 7 carbon atoms would have how many hydrogen atoms?

- A. 7 B. 14 C. 12 D. 16

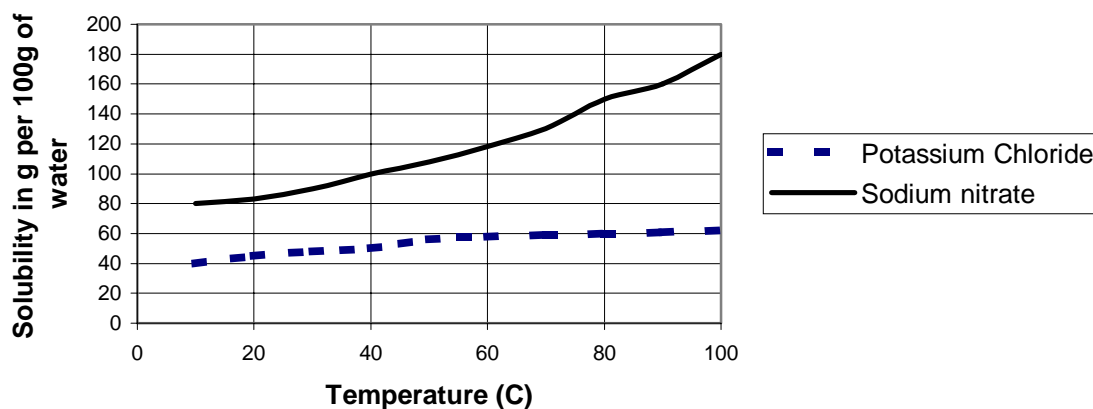
Question 16

Which one of the following is **unable** to form an addition polymer

- A. CH₂CHCl
- B. CH₂CH₂
- C. HOCHCHOH
- D. CH₂CHCH₃

Questions 17 and 18 refer to the following information

The graph below shows the solubility curve for two salts, sodium nitrate and potassium chloride.



Question 17

The temperature required to dissolve 120g of sodium nitrate in 100g of water is

- A. 60°C B. 80°C C. 100°C D. 40°C

Question 18

If 150g of sodium nitrate is dissolved in 100g of water at 80°C and then cooled to 20°C, the mass of sodium nitrate that will crystallise in the solution is

- A. 150g
B. 70g
C. 35g
D. 80g

Question 19

A surfactant lowers the surface tension of the liquid in which it is dissolved because

- A. it disrupts the attractive forces between molecules at the liquid surface.
B. it has a lower surface tension than the liquid and spread over the surface.
C. its molecules bury their polar tails in the liquid.
D. the non-polar heads of its molecules are strongly attracted to the liquid surface.

Question 20

The concentration of sodium chloride in sea water is 28.5g/L. The mass of salt remaining if 2.0L of the sea water were evaporated to dryness would be:

- A. 14.3g
B. 57.0g
C. 28.5g
D. 42.8g

END OF SECTION A

SECTION B**Specific Instructions for Section B**

Section B consists of 9 short answer questions (question 1 to 9). You must answer all of these questions. The section is worth 55 marks or approximately 70% of the total. You should spend approximately 60 minutes on this section. The marks allocated and suggested time, are at the end of each question.

Questions should be answered in the spaces provided in this booklet.

You should

* Show all working in your answers to numerical problems. No marks can be given unless accompanied by working.

* make sure all chemical equations are balanced and that formulas for individual substances include an indication of state. Eg $\text{H}_2(\text{g})$, $\text{NaCl}(\text{s})$.

Question 1

Complete the following table

Molecule	Valence Structure	Shape	Polar or Non-polar	Forces operating between molecules
PH_3				
CO_2				
CH_3F				

(12 marks)

Question 2

Use the information in the following table to answer the questions below:

Element	Atomic Number	Mass Number	Number of Electrons
A	11	23	10
B	12	24	12
C	11	24	11
D	17	35	18
E	35	80	36

- Which two elements are isotopes? _____
- Write the symbol of the element that is a cation. _____
- Which two elements would be in group 7 of the periodic table? _____
- Write the electron arrangement for element D. _____
- Write the formula for the compound that forms between element B and D. _____
- What type of bonding exists in the compound formed in (e). _____
- For element A, what is the number of protons _____ and neutrons _____.

(7 marks)

Question 3

Ammonia, NH_3 and nitrogen, N_2 are both two important nitrogen containing compounds essential for healthy plant growth. Plants can't absorb nitrogen directly from the air, it must be in a soluble compound of nitrogen, such as ammonia.

- Draw structures for ammonia and nitrogen in the space below showing all **bonding** and **non-bonding** pairs.

i) Nitrogen

ii) Ammonia

- Indicate on the diagrams above whether the molecules are polar or non-polar.

- c) Explain why ammonia is soluble in water. Whereas nitrogen is only sparingly soluble.

- d) Name the type of intermolecular bonding that would exist between ammonia molecules and between nitrogen molecules.

Ammonia _____

Nitrogen _____

(2+2+2+2 = 8 marks)

Question 4

- a) Two noble gases, helium and argon, have boiling points of $-269\text{ }^{\circ}\text{C}$ and $-186\text{ }^{\circ}\text{C}$ respectively. Explain the large difference in boiling points.

- b) Both Kr (boiling point $-152\text{ }^{\circ}\text{C}$) and HBr (boiling point $-67\text{ }^{\circ}\text{C}$) have the same number of electrons. Explain what factors could affect the intermolecular forces to cause the difference in boiling points between Kr and HBr.

Question 4 continued on next page

- c) HCl has more electrons than HF so we would expect it to have the higher boiling point. However, the boiling points of HCl and HF are $-83.7\text{ }^{\circ}\text{C}$ and $19.4\text{ }^{\circ}\text{C}$ respectively.

(2+2+2 = 6 marks)

Question 5

Complete the following table:

Name of Compound	Formula of Compound
Aluminium sulfate	
Methanol	Structural Formula Required
	C_7H_{16}
Ethanoic acid	Structural Formula Required
Copper sulfate pentahydrate	
	$\text{K}_2\text{Cr}_2\text{O}_7$
2-pentene	Structural Formula Required

(7 marks)

Question 6

Hydrocarbons form a very important group of compounds. They may be grouped into various families.

- a) i) Write the formula of the alkane with 4 carbon atoms.

_____ (1)

- ii) Draw two different structures with this formula in the space below and **name** them.

(4)

- iii) What is the name given to the structures above? _____ (1)

- b) Octane, C_8H_{18} , is the major hydrocarbon present in petrol. Write a balanced chemical equation for its combustion in air in the space below:

_____ (2)

- c) Octane can undergo the process of cracking, where it is heated in the presence of a catalyst, to yield a shorter chain alkane and ethene. Write a balanced equation for this reaction and **name** the shorter chained alkane produced.

_____ (2)

- d) Draw the structure of ethene below: (1)

- e) What type of polymerisation does ethene undergo? _____ (1)

(12 marks)

Question 7

Use the data page to help with this question.

A solution of potassium hydroxide is added to a solution of calcium nitrate.

- a) Write the formula of these two compounds

Potassium hydroxide _____ **Calcium nitrate** _____ (2)

- b) When these two compounds react a precipitate is formed. Write the **formula** and **name** of the compound formed below:

Formula _____ **Name** _____ (2)

- c) Write a balanced equation, including states, for this reaction.

_____ (2)

(6 marks)

Question 8

The label on a bottle of white wine states that it contains 12.5% (v/v) alcohol. The alcohol present in drinks is ethanol.

- a) Draw the structure of ethanol below: (1)

- b) Explain, with the aid of a diagram, why ethanol would be soluble in water. (3)

- c) If the wine bottle contains 750ml, determine the volume of ethanol in the bottle. (1)

(5 marks)

END OF EXAM

DATA PAGE

Table of some selected ions

+1	+2	+3
Silver Ag^+	Zinc Zn^{2+}	Iron (III) Fe^{3+}
Copper (I) Cu^+	Copper(II) Cu^{2+}	Chromium (III) Cr^{3+}
Ammonium NH_4^+	Iron (II) Fe^{2+}	
-1	-2	-3
Hydroxide OH^-	Carbonate CO_3^{2-}	Phosphate PO_4^{3-}
Nitrate NO_3^-	Sulfate SO_4^{2-}	
Nitrite NO_2^-	Sulfite SO_3^{2-}	
Ethanoate CH_3COO^-	Dichromate CrO_4^{2-}	
Permanganate MnO_4^-		
Hydrogen carbonate HCO_3^-		

Some solubility data

Level of Solubility	Ionic compounds containing	Exceptions
Generally soluble	Na^+ , K^+ , NH_4^+ , NO_3^- , CH_3COO^- all group 1 elements Cl^- , Br^- , I^- , SO_4^{2-}	None Ag^+ compounds Pb^{2+} , Ba^{2+} , Ag^+ , Ca^{2+}
Low solubility	CO_3^{2-} , PO_4^{3-} , S^{2-} OH^-	All group I and NH_4^+ All group I and NH_4^+ and Ba^{2+} , Sr^{2+}

Electronegativity Values

H 2.1						
Li 1.0	Be 1.6	B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.3	Al 1.6	Si 1.9	P 2.1	S 2.6	Cl 3.2

Physical constants

$$F = 96\,500 \text{ C mol}^{-1}$$

$$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$1 \text{ atm} = 101\,325 \text{ Pa} = 760 \text{ mmHg}$$

$$0^\circ\text{C} = 273 \text{ K}$$

$$\text{Molar volume at STP} = 22.4 \text{ L mol}^{-1}$$

$$\text{Avogadro constant} = 6.02 \times 10^{23} \text{ mol}^{-1}$$

Ideal gas equation

$$pV = nRT$$

The electrochemical series

	E° in volt
$\text{F}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{F}^-(\text{aq})$	+2.87
$\text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.77
$\text{Au}^+(\text{aq}) + \text{e}^- \rightarrow \text{Au}(\text{s})$	+1.68
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-(\text{aq})$	+1.36
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.23
$\text{Br}_2(\text{l}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{aq})$	+1.09
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.80
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+0.77
$\text{I}_2(\text{s}) + 2\text{e}^- \rightarrow 2\text{I}^-(\text{aq})$	+0.54
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightarrow 4\text{OH}^-(\text{aq})$	+0.40
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	+0.34
$\text{S}(\text{s}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2\text{S}(\text{g})$	+0.14
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.00
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb}(\text{s})$	-0.13
$\text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}(\text{s})$	-0.14
$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Ni}(\text{s})$	-0.23
$\text{Co}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Co}(\text{s})$	-0.28
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.44
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$	-0.76
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	-0.83
$\text{Mn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mn}(\text{s})$	-1.03
$\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s})$	-1.67
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$	-2.34
$\text{Na}^+(\text{aq}) + \text{e}^- \rightarrow \text{Na}(\text{s})$	-2.71
$\text{Ca}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Ca}(\text{s})$	-2.87
$\text{K}^+(\text{aq}) + \text{e}^- \rightarrow \text{K}(\text{s})$	-2.93
$\text{Li}^+(\text{aq}) + \text{e}^- \rightarrow \text{Li}(\text{s})$	-3.02

Periodic table of the elements

1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.1
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 44.9	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.9	27 Co 58.9	28 Ni 58.7	29 Cu 63.6	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.1	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 197.0	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)															

Lanthanides

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.3	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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Actinides

90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.1	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)
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CHEMOLOGY EDUCATION SERVICES

Name: _____

CHEMISTRY Unit 1 MULTIPLE CHOICE ANSWER SHEET

Colour the box after the letter corresponding to your answer.

1. A B C D

11. A B C D

2. A B C D

12. A B C D

3. A B C D

13. A B C D

4. A B C D

14. A B C D

5. A B C D

15. A B C D

6. A B C D

16. A B C D

7. A B C D

17. A B C D

8. A B C D

18. A B C D

9. A B C D

19. A B C D

10. A B C D

20. A B C D



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Suggested Solutions to Chemology Unit 1 Chemistry 2004 Trial Exam

Section A

1. B	2. D	3. D	4. D
5. B	6. A	7. C	8. B
9. C	10. A	11. B	12. A
13. C	14. A	15. D	16. C
17. A	18. B	19. A	20. B

Section B

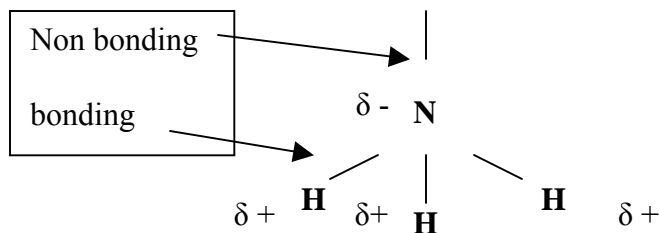
Question 1.

Molecule	Valence Structure	Shape	Polar or Non-polar	Forces operating between molecules
PH ₃	$\begin{array}{c} \text{P} \\ / \quad \quad \backslash \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	Pyramidal	polar	Dispersion and Dipole attraction
CO ₂	O = C = O	Linear	Non-polar	Dispersion
CH ₃ F	$\begin{array}{c} \text{F} \\ \\ \text{C} \\ / \quad \quad \backslash \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	Tetrahedral	Polar	Dispersion and Dipole attraction

1 for each box

Question 2.

- a) A and C b) A or A⁺ c) D & E d) 2,8,8 e) BD₂ f) Ionic g) 11 & 12
 7 x 1

Question 3a) $:\text{N} \equiv \text{N}:$ Non-polar

① ① marks for diagrams

① ① marks for polarity

polar

c) Ammonia is a polar molecule ① and forms hydrogen bonds ① with polar water molecules. Nitrogen is non-polar and will not readily mix with a polar solvent. ①

d) Ammonia - dispersion and hydrogen bonds ① award mark for just h/bonds
Nitrogen - dispersion ①**Question 4**

- a) Helium atoms have only two electrons while argon atoms have 18. ① Thus, dispersion forces are larger as the number of electrons increases and argon has the higher boiling point. ①
- b) HBr is polar and experiences dipole-dipole forces as well as dispersion ①, while Kr only experiences dispersion. ①
- c) HF has hydrogen bonding ① which is stronger than dipole-dipole attraction. ①

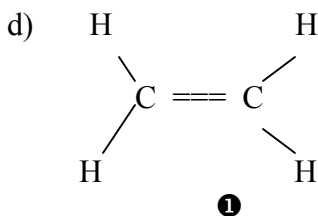
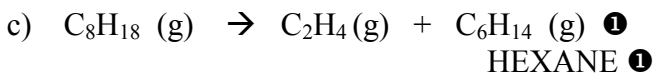
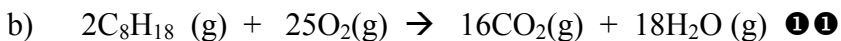
Question 5

Name of Compound	Formula of Compound
Aluminium sulfate	$\text{Al}_2(\text{SO}_4)_3$
Methanol	Semi Structural Formula Required CH_3OH
HEPTANE	C_7H_{16}
Ethanoic acid	Semi Structural Formula Required CH_3COOH
Copper sulfate pentahydrate	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
Potassium dichromate	$\text{K}_2\text{Cr}_2\text{O}_7$
2-pentene	Structural Formula Required $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$

① MARK EACH BOX = 7 MARKS

Question 6

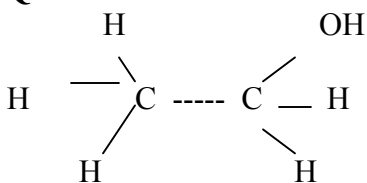
- a) i) C_4H_{10} 1 marks
 ii) $CH_3-CH_2-CH_2-CH_3$ 1 Butane 1
 $CH_3-CH(CH_3)-CH_3$ 1 2-methylpropane 1
 iii) Isomers 1



e) Addition 1

Question 7

- a) potassium hydroxide **KOH** Calcium nitrate **Ca(NO₃)₂** 1 1
 b) calcium hydroxide **Ca(OH)₂** 1 1
 c) $2KOH(aq) + Ca(NO_3)_2(aq) \rightarrow Ca(OH)_2(s) + 2KNO_3(aq)$ 1 1

Question 8

- a) 1
 b) ethanol is a polar molecule and would form hydrogen bonds with polar water molecules. Diagram to indicate correct orientation of polar OH groups. 1 1
 c) $12.5/100 \times 750 = 93.75\text{ml}$ 1