



**Wanganui Park Secondary College
Victorian Certificate of Education
2011**

CHEMISTRY – Unit One

Assessment Task: Written Examination

Wednesday 15th June, 2011

Name: SOLUTIONS

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Total marks</i>
A	20	20	20
B	8	8	43

Total 63

Directions to students

Materials

Question and answer book of 12 pages, with a detachable data sheet.

Answer sheet for multiple-choice questions. You should have at least one pencil and an eraser.

An approved calculator may be used.

The Task

This paper consists of two sections, Section A and Section B.

Answer **all** questions from Section A. Section A is worth 20 marks.

Section A questions should be answered on the answer sheet provided for multiple-choice questions.

Answer **all** questions from Section B. Section B is worth 43 marks.

Section B questions should be answered in the spaces provided in this book.

There are a total of 63 marks available.

Working space is provided throughout this book.

All written responses should be in English.

At the end of the task

Place the answer sheet for multiple-choice questions inside the front cover of this book and hand them in.

SECTION A

Specific instructions for Section A

Section A consists of 20 multiple-choice questions. Section A is worth approximately 31 per cent of the marks available. You should spend approximately 26 minutes on this section.

Choose the response that is **correct** or **best answers** the question, and indicate your choice on the multiple-choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark; an incorrect answer is worth no marks. No mark will be given if more than one answer is completed for any questions. Marks will **not** be deducted for incorrect answers. You should attempt every question.

Question 1

Which one of the following atoms represents an isotope of ${}^{14}_7\text{N}$?

- A. ${}^{7}_{14}\text{N}$
- B. ${}^{14}_8\text{N}$
- C. ${}^{15}_7\text{N}$
- D. ${}^{15}_8\text{N}$

Question 2

As you move down the elements in Group 1 of the periodic table, the atomic size

- A. decreases and the electronegativity decreases.
- B. decreases and the electronegativity increases.
- C. **increases and the electronegativity decreases.**
- D. increases and the electronegativity increases.

Question 3

The molar mass of calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$ is

- A. 199
- B. 279
- C. **310**
- D. 430

Question 4

An element was found to consist of two isotopes. One of the isotopes has a relative isotopic mass of 30 with a relative abundance of 76%. The second isotope has a relative isotopic mass of 33 with a relative abundance of 24%. The relative atomic mass of the element is

- A. 31.5
- B. 1536
- C. 30.72**
- D. 9.9

Question 5

Determine the amount, in mol, in 60 g of urea, NH_2CONH_2

- A. 60
- B. 1**
- C. 6.02×10^{23}
- D. 1.0×10^{-22}

Question 6

The number of molecules in 1.5 mol of H_2 gas is

- A. 9.03×10^{23}
- B. 1.81×10^{24}**
- C. 1.5
- D. 3.0

Question 7

The element sodium has which of the following properties?

- A. malleability and relatively low electronegativity**
- B. malleability and relatively high electronegativity
- C. brittleness and relatively low electronegativity
- D. brittleness and relatively high electronegativity

Question 8

Which of the following substances is the best conductor of electricity?

- A. solid sodium chloride
- B. iron**
- C. pure water
- D. ethene gas

Question 9

The bonding within metallic solids may be described as

- A. ionic; formed between positively charged ions and negatively charged ions
- B. an electrostatic attraction between positively charged metal ions and delocalised electrons**
- C. dipole-dipole; between metallic molecules
- D. dispersion forces operating between metallic molecules.

The following information is referred to in Questions 10 and 11 below.

I	CH_2CHCl
II	C_8H_{18}
III	CH_3F
IV	CH_3OH

Question 10

The substance(s) that contain(s) molecules that are attracted to each other by hydrogen bonds is (are):

- A. III
- B. III and IV**
- C. II, III and IV
- D. IV

Question 11

The substance that relies on dispersion forces **alone** for attraction between its molecules is:

- A. I
- B. II**
- C. III
- D. IV

Question 12

A list that contains empirical formulas **only** is

- A. CO_2 , H_2O_2 , N_2O_4 , KNO_3
- B. NaCl , NO_2 , BH_3 , SF_4**
- C. MgO , C_6H_6 , PH_3 , LiCl
- D. P_2O_5 , Al_2O_3 , C_2H_4 , SiO_2

Question 13

The empirical formula of ethane, C_2H_6 , is

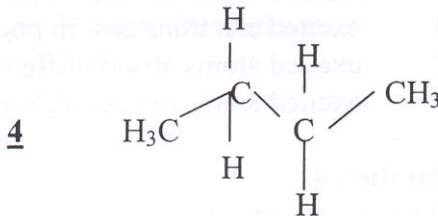
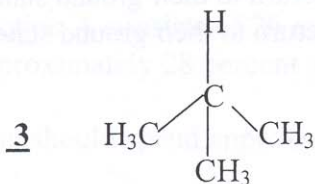
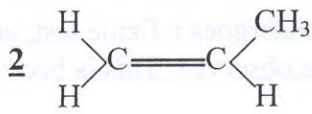
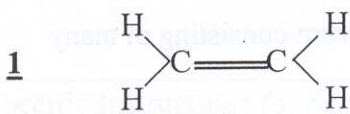
- A. CH
- B. CH_3**
- C. CH_2
- D. CH_4

Question 14

Which one of the following molecules is polar?

- A. CCl_4
- B. CH_2Cl_2**
- C. SiH_4
- D. CO_2

Questions 15, 16, and 17 refer to the following organic compounds



Question 15

Which of the above can form polymers?

- A. All of them.
- B. 1 and 2 only**
- C. 3 and 4 only
- D. None of them.

Question 16

Which of the above are structural isomers?

- A. All of them.
- B. 1 and 2 only
- C. 3 and 4 only**
- D. None of them.

Question 17

Which of the compounds are members of the alkene homologous series?

- A. All of them.
- B. 1 and 2 only**
- C. 3 and 4 only
- D. None of them.

CHEMISTRY

Unit One: Unit Examination

DATA SHEET

Directions to students

Detach this data sheet during reading time.

This data sheet is provided for your reference.

The names and formulae of some common and positive and negative ions

Positive Ions (Cations)					
+1		+2		+3	
Lithium	Li ⁺	Magnesium	Mg ²⁺	Aluminium	Al ³⁺
Sodium	Na ⁺	Calcium	Ca ²⁺	Chromium	Cr ³⁺
Potassium	K ⁺	Barium	Ba ²⁺	Iron(III)	Fe ³⁺
Silver	Ag ⁺	Zinc	Zn ²⁺		
Copper(I)	Cu ⁺	Copper(II)	Cu ²⁺		
Ammonium	NH ₄ ⁺	Mercury(II)	Hg ²⁺		
		Iron(II)	Fe ²⁺		
		Nickel(II)	Ni ²⁺		
		Tin(II)	Sn ²⁺		
		Lead(II)	Pb ²⁺		

Negative Ions (Anions)					
-1		-2		-3	
Hydroxide	OH ⁻	Oxide	O ²⁻	Nitride	N ³⁻
Hydrogen carbonate	HCO ₃ ⁻	Sulfide	S ²⁻	Phosphate	PO ₄ ³⁻
Nitrate	NO ₃ ⁻	Sulfate	SO ₄ ²⁻		
Fluoride	F ⁻	Carbonate	CO ₃ ²⁻		
Chloride	Cl ⁻	Chromate	CrO ₄ ²⁻		
Bromide	Br ⁻	Dichromate	Cr ₂ O ₇ ²⁻		
Iodide	I ⁻				
acetate	CH ₃ COO ⁻				

Electronegativity values

1	2	13	14	15	16	17	18
H 2.20							He
Li 0.98	Be 1.57	B 2.04	C 2.55	N 3.04	O 3.44	F 3.98	Ne
Na 0.93	Mg 1.31	Al 1.61	Si 1.90	P 2.19	S 2.58	Cl 3.16	Ar
K 0.82	Ca 1.00	Ga 1.61	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr 2.9
Rb 0.82	Sr 0.95	In 1.78	Sn 1.96	Sb 2.05	Te 2.1	I 2.66	Xe 2.6
Cs 0.79	Ba 0.89	Tl 2.04	Pb 2.33	Bi 2.02	Po 2.0	At 2.2	Rn

Figure 5.28 The Pauling scale of electronegativities for main group elements

Source: *SJ Chemical Data*, 5th Edition, Aylward G and Findlay T, Wiley, 2002.

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 20.2
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 (255)	103 Lr (256)
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Data sheet formulae

The following information may be useful

$$n = \frac{m}{M}$$

where n = amount of substance in mol
 m = mass of substance in grams
 M = molar mass in g mol^{-1}

$$n = \frac{N}{N_A}$$

where N = number of particles
 N_A = number of particles in 1 mol (6.02×10^{23})

$$\text{RAM (Atomic Mass)} = \frac{\sum (\text{RIM}_1 \times \text{relative abundance} + \text{RIM}_2 \times \text{relative abundance} + \dots)}{100}$$

where RIM = relative isotopic mass

$$\% \text{ composition (element)} = \frac{\text{mass of element in compound} \times 100}{\text{mass of compound}}$$

No of C atoms	Alkanes ($\text{C}_n\text{H}_{2n+2}$)		Alkenes (C_nH_{2n})	
1	methane	CH_4		
2	Ethane	C_2H_6	Ethene	C_2H_4
3	Propane	C_3H_8	Propene	C_3H_6
4	Butane	C_4H_{10}	Butene	C_4H_8
5	Pentane	C_5H_{12}	Pentene	C_5H_{10}
6	Hexane	C_6H_{14}	Hexene	C_6H_{12}
7	Heptane	C_7H_{16}	Heptene	C_7H_{14}
8	Octane	C_8H_{18}	Octene	C_8H_{16}
9	Nonane	C_9H_{20}	Nonene	C_9H_{18}
10	Decane	$\text{C}_{10}\text{H}_{22}$	Decene	$\text{C}_{10}\text{H}_{20}$

Specific instructions for Section B

Section B consists of eight short-answer questions. You should answer all of these questions. This section is worth approximately 69 per cent of the total. You should spend approximately 63 minutes on this section.

The marks allotted are shown at the end of each question.

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

To obtain full marks for your responses you should:

- Give simplified answers for all numerical questions; unsimplified answers will not be given full marks.
- Show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- Make sure all chemical equations are balanced and that the formulas for individual substances include an indication of state {for example, H₂(g); Na(s)}

Question 1

The element silver, Ag, occurs as two isotopes.

One isotope has a relative isotopic mass of 106.9 and a relative abundance of 51.8%.

The other isotope has a relative isotopic mass of 109.0 and a relative abundance of 48.2%.

Calculate the **relative atomic mass** of silver.

$$\begin{aligned}\text{RAM (Ag)} &= [(106.9 \times 51.8) + (109.0 \times 48.2)]/100 \\ &= 107.91\end{aligned}$$

(3 marks)

Question 2

The diagram below represents a **section** of the periodic table.

Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl

From the list of elements, give the **symbol** for the element in this section that represents:

- (a) the most electronegative element

F

- (b) the least electronegative element

Na

- (c) an **atom** that has an electron configuration of $2s^22s^22p^4$

O

- (d) a period 3 element that would be expected combine with oxygen to form a metallic oxide.

Any of Na, Mg or Al

- (e) an element that would reaction combine form a non-metallic oxide that a **linear** shaped molecule.

C

- (f) an element that is in Group 15 and period 2.

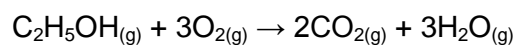
N

(1 + 1 + 1 + 1 + 1 + 1 = 6 marks)

Question 3

Ethanol, $\text{C}_2\text{H}_5\text{OH}$, is being used as a biofuel. When combusted (burnt) in air, (O_2) it produces carbon dioxide and water vapour.

The balanced chemical equation for this reaction is:



92 g of ethanol is burnt in excess air. (NOTE: This was a typo on the exam.)

- (a) Determine the molar mass of ethanol.

$$\begin{aligned} M(\text{C}_2\text{H}_5\text{OH}) &= [(2 \times 12) + (5 \times 1) + 16 + 1] \\ &= 46 \text{ g mol}^{-1} \end{aligned}$$

- (b) Calculate the amount, in mol, of ethanol.

$$\begin{aligned} n(\text{C}_2\text{H}_5\text{OH}) &= m/M \\ &= 92/46 \\ &= 2 \text{ mol} \end{aligned}$$

- (c) Determine the **number** of carbon **atoms** present in 92 g of ethanol.

$$\begin{aligned} N(\text{C}) &= n(\text{C}) \times N_A \\ &= 2n(\text{C}_2\text{H}_5\text{OH}) \times 6.0 \times 10^{23} \\ &= 2 \times 2 \times 6.0 \times 10^{23} \\ &= 2.4 \times 10^{24} \end{aligned}$$

- (d) What is the percentage by mass of **oxygen** in ethanol?

$$\begin{aligned} \% (\text{O}) &= 16/46 \times 100 \\ &= 34.78\% \end{aligned}$$

1 + 1 + 2 + 2 = 8 marks

Question 4

Determine the **percentage composition** by mass of silver, Ag, in silver nitrate, AgNO₃.

$$\begin{aligned}\% (\text{Ag}) &= 107.9/169.9 \times 100 \\ &= 63.51\%\end{aligned}$$

$$\begin{aligned}\text{NOTE: molar mass of AgNO}_3 &= 107.9 + 14 + (16 \times 3) \\ &= 169.9\end{aligned}$$

(2 marks)

Question 5

A liquid was found to contain 37.6% carbon by mass, 12.5% hydrogen by mass and 50% oxygen by mass. Determine the **empirical formula** of the liquid.

$$n(\text{C}) : n(\text{H}) : n(\text{O})$$

$$37.6/12 : 12.5/1 : 50/16$$

$$3.133 : 12.5 : 3.125$$

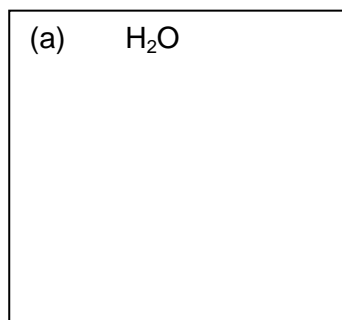
$$1 : 4 : 1$$

So, empirical formula is CH₄O

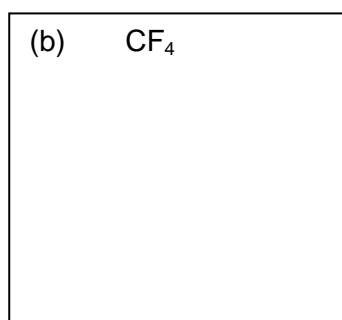
(4 marks)

Question 6

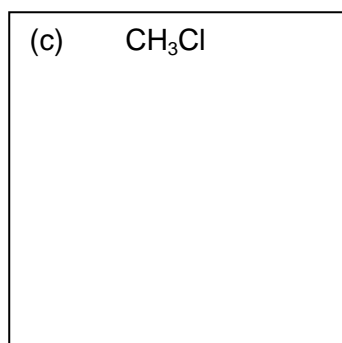
For each of the following substances, **draw** the structure the respective molecules in the boxes and **state** in each case whether the molecule is (significantly) polar or non-polar.



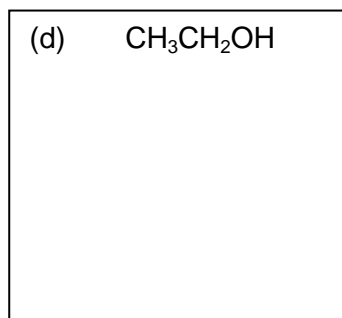
Shape will be bent (or V-shaped). The molecule is polar.



**The structure will be tetrahedral in shape.
The molecule is non-polar**



**The shape will be 'tetrahedral'.
The molecule is polar.**



**The shape is based on a tetrahedral arrangement around the carbon atoms.
The molecule is polar.**

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

Question 7

- (a) Draw two possible structural formulas for compounds with the molecular formula $C_3H_6Cl_2$.

There are four possible isomers:

1, 1 – dichloropropane

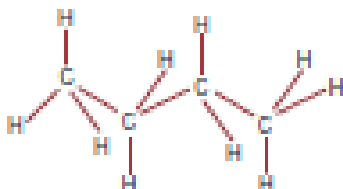
1, 2 – dichloropropane

2, 2 – dichloropropane

1, 3 - dichloropropane

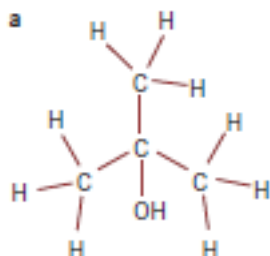
- (b) Give the systematic names for the following compounds.

(i)



Name: **butane**

(ii)



Name: **methyl propan-2-ol**

- (c) The boiling points for three hydrocarbon compounds are shown in the table below.

Compound	Boiling temperature (°C)
Methane CH_4	- 162
Octane C_8H_{18}	126
Dodecane $C_{12}H_{26}$	216

- (i) What is the main type of bonding interaction **between** the molecules of each of these three hydrocarbons?

Dispersion forces

- (ii) State the reason for the difference in the boiling points of these three hydrocarbons.

The strength of the dispersion forces increase with increasing molecular size, hence more energy is needed to separate (boil) the larger molecules than the smaller molecules.

(2 + 1 + 1 + 1 + 1 = 6 marks)

Question 8

The molecular formula $C_4H_{10}O$ has several possible structural isomers.

- (a) Give a definition of the term **isomers**.

Structural isomers have the same molecular formula but different structural formulas.

- (b) (i) In the two boxes below, write the semi-structural formula for **two** "straight" chain hydrocarbon compounds with the molecular formula $C_4H_{10}O$.

Name:	Name:

- (ii) Give a specific name for each of the molecules you have indicated in (i).

There are four isomers with this molecular formula. They are:

Butan-1-ol

Butan-2-ol

Methyl propan-1-ol

Methyl propan-2-ol

- (c) In which homologous series do the molecules referred to in (b) above, belong?

Alkanols (would accept alkanes)

(1 + 4 + 1 = 6 marks)

END OF EXAMINATION