SHENTON
COLLEGE

Examination
Question/Answer Booklet

ATAR CHEMISTRY

Unit 1
Semester 1 2015

Name:

Teacher (circle): Dhue Lee Saggers-Gray Smith

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time for paper: two hours

Materials required/recommended for this paper

To *be provided by the supervisor*
This Question/Answer Booklet
Multiple-choice Answer Sheet
Chemistry Data Sheet

To *be provided by the candidate*
Standard items: pens, pencils, eraser, correction fluid/tape, ruler, and highlighters

Special items: non-programmable calculators satisfying the conditions set out by the SCSA for this course

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Section 1	Section 2	Section 3	Total	Percentage
/25	/60	/35	/120	%

Structure of this paper

Section	Number of questions	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	25	30	25	21
Section Two: Short answer	12	55	60	50
Section Three: Extended answer	4	35	35	29
		TOTAL	**120**	**100**

Instructions to candidates

1. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Sections Two and Three: Write your answers in this Question/Answer Booklet.

2. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

Section One: Multiple-choice (25 Marks)

This section has **25** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 30 minutes.

1. Which one of the following processes would result in the formation of a heterogeneous mixture?

   a) Dissolving sugar in distilled water.
   b) Pouring a jar of oxygen gas into a jar of nitrogen gas.
   c) Burning a hydrocarbon to create black smoke.
   d) Mixing sodium nitrate solution and salt water (NaCl).

2. Boron, aluminium, gallium (Ga) and indium (In) occur together in the same group in the Periodic Table because:

   a) Atoms of each of the elements contain the same number of electrons.
   b) They are good conductors of electricity.
   c) Neutral atoms of each of the elements have the same number of electrons in their outer shell.
   d) The masses of the atoms of these elements increase smoothly down the group.

3. In which one of the following sets do all the species have the electron configuration of a Noble Gas?

   a) N^{3-}, P^{3-}, Ar^{3+}
   b) H^{+}, Ca^{2+}, F^{-}
   c) S^{2-}, O^{2-}, Ag^{+}
   d) K^{+}, P^{3-}, Mg^{2+}

4. Consider the ion below.

   $$^{115}_{49}In^{3+}$$

   Which of the following lists the number of protons, neutrons and electrons for this ion correctly?

	Protons	Neutrons	Electrons
a)	115	49	49
b)	49	66	49
c)	49	66	52
d)	49	66	46

5. Which of the following species contains only ionic bonds?

a) $Mg(NO_3)_2(s)$
b) $H_2O(l)$
c) NaI(s)
d) $Cl_2(g)$

6. Which one of the following will **not** conduct electricity?

a) Solid potassium chloride
b) Solid mercury
c) Liquid sodium hydroxide
d) Liquid aluminium

7. Metallic bonds are due to:

a) the attraction of oppositely charged ions for each other.
b) pairs of electrons being shared equally between atoms.
c) pairs of electrons being shared unequally between atoms.
d) the attraction of positively charged ions for delocalised electrons.

8. A molecule of a non-cyclic alkane contains 7 carbon atoms. The number of hydrogen atoms in this molecule is:

a) 7
b) 14
c) 16
d) 28

9. Mass spectrometry is used to determine the isotopic composition of elements. It involves ionising a gaseous sample of the element, accelerating it and passing it through a magnetic field where it is deflected and then detected. The amount an ion will deflect in the magnetic field will depend on:

a) Only the mass of the ion
b) Only the charge of the ion
c) Both the charge and the mass of the ion
d) Neither the charge nor the mass of the ion

10. Which of the following is the correct equation for the complete combustion of hex-1-ene?

a) $2C_6H_{10} + 17\ O_2 \rightarrow 12\ CO_2 + 10\ H_2O$
b) $C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$
c) $2\ C_6H_{10} + 5\ O_2 \rightarrow 12\ C + 10\ H_2O$
d) $C_6H_{12} + 3\ O_2 \rightarrow 6\ C + 6\ H_2O$

11. Which of the following formulae represents a molecule that is saturated?

a) $CH_3CH_2CH_3$
b) $H_2CC(CH_3)_2$
c) $CH_2CHCH_2CH_3$
d) CH_3CCCH_3

12. Which of the following properties have an increasing trend across Period 3 of the Periodic Table?

I. Atomic number
II. Atomic radius
III. Electronegativity
IV. First ionization energy

a) III and IV
b) I, III and IV
c) II only
d) I, II, and III

13. Which of the following processes demonstrates a chemical change?

a) The condensing of water on a shower screen.
b) The burning of candle wax.
c) The evaporation of sweat from a sportsperson on a hot day.
d) The sublimation of dry ice (solid CO_2).

14. The percentage by mass of oxygen in glucose, $C_6H_{12}O_6$, is

a) 8.89%
b) 96.0%
c) 53.3%
d) 40.0%

15. Which of the following are isomeric pairs?

(a) $CH_3CH_2CH_2CH_2CH_3$ and $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2CH_3$

(b) $CH_3CH=CHCH_3$ and $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_3$

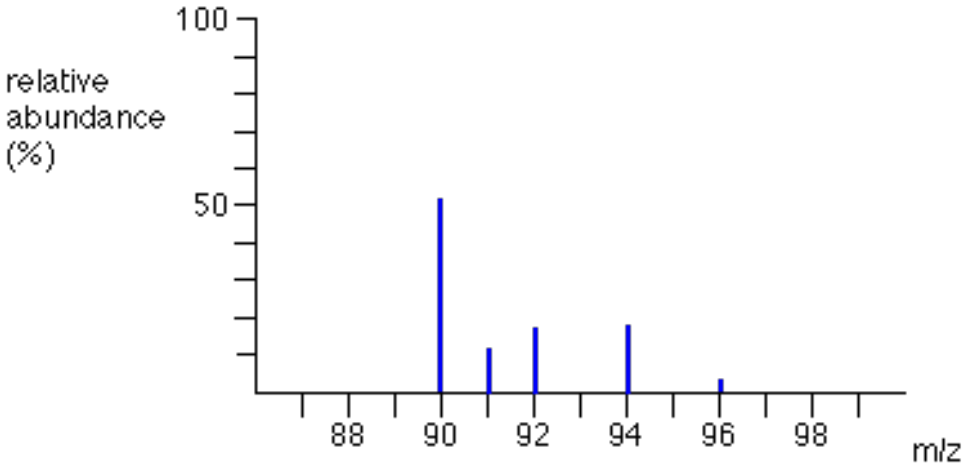
(c) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$ and $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_3$

(d) $CH_2=\underset{\displaystyle CH_2}{\overset{|}{C}}-CH_3$ and $CH_2=CHCH_2CH_3$

16. Which of the following separation techniques would be used to obtain pure water from sea water?

a) Filtration
b) Crystallisation
c) Gravity separation
d) Distillation

Use the mass spectrum of an unknown element below to answer questions 17 – 18



17. Which of the following statements are correct?

I There are 5 stable isotopes of the element
II The peak at 94 has two more protons than the peak at 92
III All peaks come from atoms with the same number of electrons
IV The peak at 91 comes from the least abundant isotope of the element

a) I, II, III and IV
b) I, III and IV
c) III only
d) I and III

18. The element that is most likely to show the mass spectrum above is

a) Zirconium
b) Molybdenum
c) Niobium
d) None of the above

19. Choose the correct option that lists the following compounds in order from highest to lowest electrical conductivity when in aqueous solution of equal concentrations.

CaI_2, $AgNO_3$, $C_{12}H_{22}O_{11}$, $AlCl_3$

a) high conductivity: $AgNO_3 > C_{12}H_{22}O_{11} > CaI_2 > AlCl_3$:low conductivity
b) high conductivity: $AlCl_3 > CaI_2 > AgNO_3 > C_{12}H_{22}O_{11}$:low conductivity
c) high conductivity: $CaI_2 > AgNO_3 > H_3PO_4 > C_{12}H_{22}O_{11}$:low conductivity
d) high conductivity: $AgNO_3 > AlCl_3 > CaI_2 > C_{12}H_{22}O_{11}$:low conductivity

20. Elements '***X***' and '***Y***' combine to form a covalent network compound. What are the likely electron configurations for the elements that comprise this compound?

	Element '*X*'	Element '*Y*'
a)	2, 8, 8, 1	2, 8, 7
b)	2, 8, 1	2, 8, 6
c)	2, 4	2, 8, 7
d)	2, 8, 4	2, 6

21. The low melting point of nitrogen gas can best be explained by its

a) Weak intermolecular forces
b) Weak intramolecular forces
c) Strong intermolecular forces
d) Strong intramolecular forces

22. How many **lone pairs** (non-bonding) of electrons would be found in a molecule of oxygen gas?

a) 1
b) 2
c) 3
d) 4

23. Which of the following would have the highest melting point in its elemental form?

a) Magnesium
b) Aluminium
c) Silicon
d) Phosphorus

24. Which one of the following species contains a different number of electrons from the others?

(a) N_2
(b) C_2H_2
(c) HCN
(d) O_2^{2-}

25. Oxygen can exist in different molecular forms, for example, Oxygen(O_2) ,ozone (O_3) and octaoxygen (O_8). These different forms are called

a) Isotopes
b) Allotropes
c) Azeotropes
d) Polyatomic ions

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Section Two: Short answer 50% (60 Marks)

This section has **12** questions. Answer **all** questions. Write your answers in the spaces provided.

Suggested working time: 55 minutes.

Question 31 **(9 marks)**

Write equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'. You should draw the structural formula for any organic chemical. In each case describe in full what you would observe, including any colours and gases evolved (give the colour or describe as colourless).

a) Liquid bromine is added to a beaker containing cis-2-hexene (3 marks)

Equation _____

Observation

b) Ethane gas and chlorine gas are mixed and left under ultraviolet light for several hours. The reaction goes to completion (3 marks)

Equation _____

Observation:

c) A student incorrectly uses a safety flame to heat a beaker and the bottom of the beaker turns black with soot. Write an equation for the incomplete combustion of butane in the Bunsen burner. Assume that the black solid is the only carbon-based product formed. (3 marks)

Equation _____

Observation

Question 32

Calculate the relative atomic mass of a sample of silicon, given that a mass spectrometer shows that it consists of 92.2% of ^{28}Si, 4.70% of ^{29}Si and 3.10% of ^{30}Si.

(3 marks)

Question 33 **(8 marks)**

Draw electron dot diagrams to represent the following substances.

HCN
Al_2O_3
NI_3
SO_4^{2-}

Question 34 **(4 marks)**

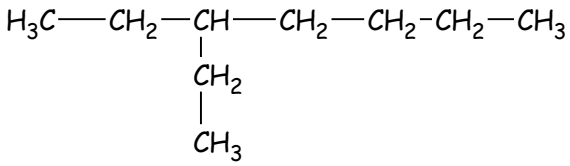
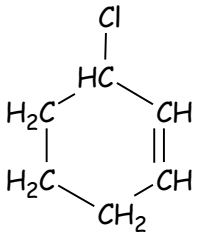
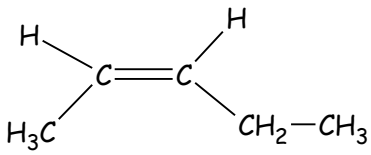
Using the information in the table below, identify the substances A, B, C and D from the following list:

aluminium
copper
copper(II) sulfate
octane
graphite
iodine
mercury
nickel(II) chloride
silicon dioxide
potassium chloride

	Electrical conductivity in the solid state	Electrical conductivity in the liquid state	Phase at 25°C	Colour at 25°C	Name of substance
A	nil	conducts	solid	white	
B	conducts	conducts	solid	silver	
C	nil	nil	liquid	colourless	
D	nil	nil	solid	white	

Question 35 **(3 marks)**

Complete the following table by writing the correct name for the structure.

I.U.P.A.C. NAME	STRUCTURAL FORMULA
a)	
b)	
c)	

Question 36 **(4 marks)**

Identify by **formula** each of the following

An element with a higher electronegativity than nitrogen	
An isomer of cyclopentane (draw the structural formula)	
The element in Period 2 with the smallest atomic radius	
An element with a lower first ionisation energy than sodium	

Question 37 **(4 marks)**

a) What are flame tests used for? (1 mark)

b) Explain how an atomic absorption spectrometer detects the presence of a particular element within a sample. (3 marks)

Question 38 **(5 marks)**

Draw and give I.U.P.A.C. names for all possible isomers with the formula C_4H_8

Question 39 **(8 marks)**

The table below shows the melting and boiling points for 3 unnamed hydrocarbons.

Hydrocarbon	Melting Point (°C)	Boiling Point (°C)
A	86	536
B	-140	-1
C	21	302

a) Which hydrocarbon would most likely be used for road surfacing (in bitumen)? Provide a reason and explanation for your answer. (3 marks)

b) Rank the hydrocarbons in order of *increasing* carbon chain length. (1 mark)

c) This mixture of hydrocarbons is found in crude oil. Name and describe the process that would separate the crude oil into its components. (4 marks)

Question 40 **(5 marks)**

a) Write the formulae for the following compounds: (2 marks)

A: Cobalt chloride hexahydrate

B: Magnesium phosphate

C: Dinitrogen tetroxide

D: Phosphorous pentafluoride

b) Which of the compounds above has the highest relative formula mass? Justify your answer by showing your working. (3 marks)

Question 40 **(4 marks)**

Using only substances listed below:

1-butene	2-butene	chloroethane
1,1-dichloroethane	1,2-dichloroethane	cyclopentane
propene	2,4-dimethylbutane	1,3-dimethylbutane

Complete the table by choosing one example that matches the descriptions, and draw the structure of that substance. (You cannot use a substance more than once)

Description	Name	Structure
A substance that can be produced by an addition reaction of chlorine gas with an alkene		
A substance that exhibits geometric (cis/trans) isomerism.		(show trans isomer)
A molecule that is an isomer of 2-methyl-1-butene. C_5H_{10}		
A molecule that has been incorrectly named in the above list. (give the corrected name)	**(**correct)	

Question 42 **(3 marks)**

Explain the trend seen in atomic radius as you move from left to right across a period.

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Section Three: Extended answer 29% (35 Marks)
This section contains **four (4)** questions. You must answer all questions. Write your answers in the spaces provided.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression. Lists or dot points are unlikely to gain full marks.

Final answers to calculations should be expressed to the appropriate number of significant figures.

Suggested working time: 35 minutes.

Question 43 (6 marks)

Lithium, sodium and potassium react vigorously with water to form a metal hydroxide and hydrogen gas. Some observations for their reactions are below:

Lithium: When added to water the lithium floated. It fizzed steadily and became smaller until it eventually disappeared

Sodium: When added to water it fizzed rapidly on the surface of the water and the gas produced burnt with an orange flame before the sodium disappeared.

Potassium: When added to water it moved very quickly on the surface of the water. The gas ignited instantly, setting the metal on fire and creating sparks and a lilac flame. There was a small explosion at the end of the reaction.

Explain the observations of the metal reactions above using your knowledge of first ionisation energy. Be sure to fully explain the trend seen and how it relates to the reactivity of the metals.

Question 44 **(13 marks)**

Magnesium chloride is an environmentally friendly compound with many applications in the areas of medicine, food production and dust control. However, magnesium metal and chlorine gas have markedly different applications and properties.

With the aid of the data displayed below, explain the differences in the properties of the three species.

	$MgCl_{2(s)}$	$Mg_{(s)}$	$Cl_{2(g)}$
Melting point	714°C	650°C	-101°C
Boiling point	1412°C	1107°C	-35°C
Electrical conductivity in solid state	Non – conductor	Conductor	Non – conductor

(a) Using your knowledge of their structure, give a detailed explanation for the observed differences in melting and boiling points of the three substances. (9 marks)

(b) $MgCl_{2(s)}$ is brittle compared to $Mg_{(s)}$ metal, which is malleable. Account for the brittle nature of $MgCl_{2(s)}$ and malleability of $Mg_{(s)}$. (4 marks)

Question 45 **(8 marks)**

Angelica has an accident in her garage and knocks over containers of salt, iron filings and sand. Give a detailed description of the method she could use to separate the three components out again. You must include what is being separated in each step of the method and the physical property used to separate them.

Question 46 **(8 marks)**

The plant *Indigofera tinctoria* contains an organic blue dye, indigo. The dye is extracted from the leaves. It has been used throughout the world as a natural colouring agent. Today synthetic indigo is produced, to dye cotton yarn, which is mainly for the production of denim cloth for blue jeans.

Indigo only contains the elements carbon, nitrogen, hydrogen and oxygen. When 2.05 g of indigo was completely combusted, it produced 5.50 g of carbon dioxide and 0.703 g of water. It was also found that the percentage composition, by mass, of nitrogen in indigo is 10.7%.

a) Calculate the mass percentage of carbon in carbon dioxide, use this number to determine the mass of carbon in indigo. (2 marks)

b) Calculate the mass percentage of hydrogen in water, use this number to determine the mass of hydrogen in indigo. (2 marks)

c) Calculate the mass of oxygen and nitrogen in indigo. (2 marks)

d) Determine the percentage composition of carbon, nitrogen, oxygen and hydrogen in indigo. (2 marks)

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END OF EXAM

SHENTON
COLLEGE

Examination
Multiple Choice Answer Sheet

ATAR CHEMISTRY

Unit 1

Semester 1 2015

Name: _____

Teacher (circle): **Dhue** **Lee** **Saggers-Gray** **Smith**

For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer

1.	a	b	c	d
2.	a	b	c	d
3.	a	b	c	d
4.	a	b	c	d
5.	a	b	c	d
6.	a	b	c	d
7.	a	b	c	d
8.	a	b	c	d
9.	a	b	c	d
10.	a	b	c	d
11.	a	b	c	d
12.	a	b	c	d
13.	a	b	c	d

14.	a	b	c	d
15.	a	b	c	d
16.	a	b	c	d
17.	a	b	c	d
18.	a	b	c	d
19.	a	b	c	d
20.	a	b	c	d
21.	a	b	c	d
22.	a	b	c	d
23.	a	b	c	d
24.	a	b	c	d
25.	a	b	c	d

/25