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STAV Publishing 2010

Student name

CHEMISTRY

Unit 1

Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

Structure of book

Section	Number of questions	Number of marks
A	20	20
B	9	67
	Total	**87**

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 14 pages, with a detachable data sheet in the centrefold and a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the data sheet from the centre of this book and the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and on the answer sheet for multiple-choice questions.
- All written responses should be in English.

At the end of the examination

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

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STAV Publishing

2010

CHEMISTRY

Unit 1 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

	ONE ANSWER PER LINE					ONE ANSWER PER LINE				
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	

SECTION A – Multiple-choice questions

Instructions for Section A

Answer all questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No mark will be given if more than one answer is completed for any question.

Question 1

Which of the following atoms has the greatest number of neutrons?

A. ^{58}Fe

B. ^{57}Co

C. ^{56}Mn

D. ^{56}Ni

Question 2

In the ground state, the electrons of a scandium (III) ion occupy

A. 2 shells

B. 3 shells

C. 4 shells

D. 5 shells

Question 3

A substance melts at high temperature, is insoluble in water, and does not conduct electricity in both the solid and liquid states. This substance is most likely to be

A. Al

B. O_2

C. CH_4

D. SiO_2

Question 4

How many lone pairs does the phosphorus atom have in its valence shell in a phosphine, PH_3 molecule?

A. 0

B. 1

C. 2

D. 3

Question 5

The neutron was discovered by

A. Francis Aston in the 19th century

B. James Chadwick in the 19th century

C. Francis Aston in the 20th century

D. James Chadwick in the 20th century

Question 6

Which of the following is **not** a property of an ionic compound?

A. conduction of electricity when molten

B. crystalline structure

C. high melting temperature

D. malleability

Question 7

A substance melts at 1640 ^{o}C and conducts electricity in both solid and liquid states. The solid structure of the substance is most likely to be

A. an ionic lattice

B. a covalent network lattice

C. a molecular lattice

D. a metallic lattice

Question 8

Which one of the following formulae represents a polar molecule?

A. CH_4

B. CCl_4

C. CO_2

D. CH_3Cl

Question 9

1,4 pentadiene contains

A. no tetrahedral carbon atoms

B. one tetrahedral carbon atom

C. two tetrahedral carbon atoms

D. four tetrahedral carbon atoms

Question 10

The correct IUPAC name of $CH_3CH(OH)CH_3$ would be

A. propyl hydroxide

B. 2-hydroxypropane

C. 2-propanol

D. methyl ethanol

Question 11

The number of hydrogen atoms present in butan-1-ol is

A. 8

B. 9

C. 10

D. 11

Question 12

The significant type(s) of chemical bonding present in an aqueous solution of ethanol are

A. covalent only

B. hydrogen bonding only

C. covalent and hydrogen bonding

D. dispersion forces

Question 13

Which one of the following substances is **not** able to form an addition polymer?

A. $CH_3(CH_2)_5CHCCl_2$

B. $C_2H_2Cl_2$

C. C_2H_3Cl

D. $CH_3CHClCH_2Cl$

Question 14

The number of different isomers represented by the formula C_4H_{10} is

A. 1

B. 2

C. 3

D. 4

The next two questions refer to the following information

A variety of whisky contains 40.0 % v/v alcohol

Question 15

The alcohol present in alcoholic drinks is

A. CH_3OH

B. CH_3CH_2OH

C. $CH_3CH_2CH_2OH$

D. both CH_3OH and CH_3CH_2OH

Question 16

If a serve of whisky contains 40 mL and a person drinks a double serve, the volume of alcohol consumed is

A. 16 mL

B. 24 mL

C. 32 mL

D. 48 mL

Question 17

The following list contains molecular formulae of three organic compounds.

I. $C_2H_4O_2$

II. C_2H_6O

III. $C_2H_6O_2$

The listed formulae that could represent a carboxylic (alkanoic) acid(s) is/ are

A. I only

B. III only

C. I and III only

D. I, II, and III

Question 18

There are 0.25 mol of **atoms** in

A. 7.0 g of N_2

B. 6.0 g of C

C. 8.0 g of S_8

D. 8.0 g of O_2

Question 19

It is known that 6.53 g of zinc reacts with 25.40 g of iodine (I_2) to form zinc iodide leaving no excess of zinc or iodine. It is correct to say

A. there are 127/25.4 mol of I atoms in 25.40 g of iodine

B. the formula of zinc iodide is ZnI

C. zinc and iodine react in a mole ratio of 6.53 : 25.40

D. the mass of zinc iodide formed in this experiment would be 31.93 g

Question 20

Which substance is expected to have the **lowest** boiling point?

A. CH_4

B. C_2H_4

C. $CHCl_3$

D. CH_3OCH_3

END OF SECTION A

SECTION B – Short answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures 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 chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; NaCl(s)

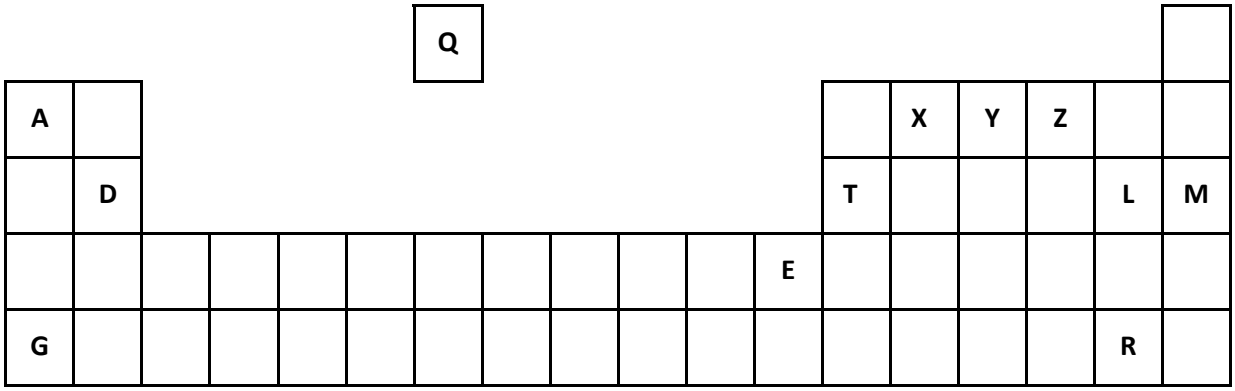
Question 1 Complete the following table.

Name of compound	Formula of compound
calcium nitride	
sodium sulfate	
	Cu_2CO_3
	$Al(NO_3)_3$
	$CH_2CHCH_2CH_3$
	CH_3OH
butanoic acid	semi-structural formula required
	$CH_3CH_2CHClCH_3$

Total 8 marks

Question 2

The diagram below represents the Periodic Table with a selection of elements represented by letters. Note: these letters are **not** the actual symbols of these elements.



a. Selecting only from the element symbols labelled on this Periodic Table, write the letter (A, D, E, G, L, M, Q, R, T, X, Y or Z) corresponding to the element that:

i. is a non-metal with five electrons in its outershell _____

ii. is in Group II _____

iii. is a transition element with three fully occupied shells _____

iv. has the lowest electronegativity _____

v. is in Period 2 and has a total of three electrons _____

vi. forms an ionic compound with chlorine where the ion of the element has a +3 charge _____

vii. forms molecules containing one atom of the element to four atoms of element Q _____

7 marks

b. Atoms of two elements react to form a compound. Give the chemical formula of the compound formed

i. using the elements A and L. _____

ii. using the elements Z and T. _____

2 marks

c. Give the electron shell arrangement for

i. an atom of element X _____

ii. the cation formed from element D _____

2 marks

Total 11 marks

Question 3

a. A student adds an iodine (I_2) crystal to each of two test tubes. One test tube contains 10 mL of water and the other 10 mL of hexane. Predict in which solvent the iodine will be most soluble. Explain your selection.

_____

_____

_____

_____

3 marks

b. Na_2S and H_2S have quite different physical properties.

i. State **two** physical properties of each substance.

_____

_____

_____

_____

ii. Clearly describe both the **structure** and **bonding** in each substance and account for the difference in their physical properties.

_____

_____

_____

_____

_____

_____

_____

_____

6 marks

Total 9 marks

Question 4

A group of students set out to determine experimentally the number of atoms in one mole of a metal. They take a small cube made of iron and weigh it. It was found to have a mass of 14.90 g.

By using displacement of water in a 25.0 mL measuring cylinder, the students were able to establish that the cube had a volume of 2.0 mL (cm^3).

They looked up the metallic radius of an iron atom which was found to be 124 pm.

(1 pm = 10^{-12} m = 10^{-10} cm)

a. Calculate the amount, in mol, of metal used to 3 significant figures.

_____

_____

1 mark

b. Calculate the volume, in cm^3, occupied by each metal atom in the sample using the formula

$V = \frac{4\pi r^3}{3}$ (1 pm = 10^{-12} m = 10^{-10} cm)

_____

_____

1 mark

c. Assume that the metal atoms are packed with no spaces in between. Use the volume of the metal sample, as measured by the displaced water, and the volume of each metal atom, to calculate the number of metal atoms in the sample.

_____

_____

1 mark

d. Calculate the number of metal atoms that would be present in one mole of the metal atoms based on the calculation in **c**. This is equal to Avogadro's number.

_____

_____

1 mark

e. In your calculation you assumed that the metal atoms are packed with no spaces between them. How does this assumption affect the result?

_____

_____

1 mark

f. Assume that the metal atoms actually occupy 65% of the volume of the metal. Recalculate the value for Avogadro's number.

_____

1 mark

g. Apart from the assumption in f, what is the largest source of error in this experiment?

_____

1 mark

h. If another metal was used instead of iron, would you expect the result to be different? Explain your answer.

_____

_____

1 mark

i. Write a concise conclusion for the experiment.

_____

_____

1 mark

Total 9 marks

Question 5

Aspirin is a drug used extensively for the relief of pain in humans. Chemical analysis of an aspirin tablet determined that it was composed of 57.5 % carbon, 37.8 % oxygen and the remainder hydrogen. Calculate the empirical formula of aspirin.

_____

_____

_____

_____

_____

_____

3 marks

Question 6

Magnesium is often used to alloy with another metal to improve its properties for a given application. When 2.00 g of such an alloy was treated with hydrochloric acid, HCl(aq), exactly 5.00×10^{-3} mol of hydrochloric acid was required to react with the magnesium.

a. The products of this reaction are hydrogen gas and magnesium chloride solution. Write the overall, balanced equation for the reaction of the magnesium with the acid.

_____

2 marks

b. Determine the amount, in mol, of magnesium that reacted.

_____

1 mark

c. Determine the mass, in g, of magnesium that reacted.

_____

1 mark

d. What percentage by mass of magnesium was present in the sample?

_____

1 mark

Total 5 marks

Question 7

a. Draw a structural formula (showing all lone electron pairs on the central atom) for each of the following molecules and state the shape of the molecule.

Molecule	Structural formula	Shape
N_2		
CCl_4		
SF_2		

6 marks

b. For the three molecules indicated, state whether they have high polarity, low polarity or are non-polar. Briefly justify your response.

N_2 _____

_____

CCl_4 _____

_____

SF_2 _____

_____

3 marks

Total 9 marks

Question 8

A freshly cut piece of potassium burns in a gas jar containing chlorine gas. A white smoke consisting of potassium chloride is formed and deposited in the gas jar.

a. Write a balanced equation for the reaction between solid potassium and chlorine gas.

_____

2 marks

b. Write the subshell electron configurations for potassium and chlorine atoms **after the reaction**.

_____

_____

2 marks

c. Explain why the melting point of the potassium chloride formed is much higher than that of solid chlorine.

_____

_____

_____

_____

2 marks

d. Write the subshell electron configuration of an excited potassium atom.

_____

1 mark

Total 7 marks

Question 9

The table provides formulae of some hydrocarbons.

Compound	Formula
A	CH_4
B	C_2H_2
C	C_2H_4
D	C_2H_6
E	C_3H_4
F	C_3H_6
G	C_3H_8
H	C_4H_6
I	C_4H_8
J	C_4H_{10}

a. **i.** List the letters of the members of this series that belong to the alkanes. _____

ii. Give the general formula of this series. _____

3 marks

b. **i.** Select a compound with **3 carbon atoms** and a double bond from the table. Indicate the letter corresponding to this compound in the box provided. ☐

ii. These compounds readily undergo polymerisation reactions. Write a chemical equation to illustrate the polymerisation reaction of your selected compound from part **i.**

_____

iii. Name the organic product of this reaction. _____

3 marks

Total 6 marks

END OF EXAMINATION