

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	10	74
	Total	94

- 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 16 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.

STAV Publishing

2016

CHEMISTRY

Unit 1 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	
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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 species has the least number of neutrons?

- A. ${}^{244}_{96}\text{Cm}^{3+}$
- B. ${}^{249}_{97}\text{Bk}^{3+}$
- C. ${}^{252}_{98}\text{Cf}^{3+}$
- D. ${}^{253}_{99}\text{Es}^{3+}$

Question 2

Which one of the following regarding electron orbitals is correct?

- A. they all have the same shape
- B. they were first suggested by Niels Bohr
- C. the third shell contains 4 orbitals
- D. each orbital can hold a maximum of two electrons

Question 3

Electron 'shells' in a sodium atom are:

- A. arranged randomly.
- B. evenly spaced.
- C. closer together nearer the nucleus.
- D. farther apart nearer the nucleus.

Question 4

Chromium metal is used in stainless steel. The number of electrons in the 3d subshell of a chromium atom is:

- A. 1
- B. 2
- C. 5
- D. 6

Question 5

In the Periodic Table, the block that contains the smallest number of elements is:

- A. s block
- B. p block
- C. d block
- D. f block

Question 6

The electronic configuration of an iron (II) ion is:

- A. $1s^2 2s^2 2p^6 3s^2 3p^4$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
- C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6$

Question 7

Which one of the following elements burns to form a gaseous oxide?

- A. calcium
- B. magnesium
- C. sodium
- D. sulfur

Question 8

When going down Group 1, which **one** of the following occurs?

- A. the elements become less reactive
- B. the attraction between the nucleus and valence electron increases.
- C. the first ionisation energy decreases
- D. the atomic radius decreases

Question 9

The table below shows a student's record of the reaction (✓) or lack of reaction (x) of five metals with hydrochloric acid under different conditions.

Metal foil	Very dilute acid	Very dilute acid	Fairly dilute acid	Fairly dilute acid	Concentrated acid	Concentrated acid
	Cold	Warm	Cold	Warm	Cold	Warm
P	✓	✓	✓	✓	✓	✓
Q	x	x	x	x	✓	✓
R	x	x	✓	✓	✓	✓
S	x	x	x	x	x	x
T	x	x	x	✓	✓	✓

The order of the metals in the reactivity series, putting the most reactive first is

- A. P T R Q S
- B. P R T Q S
- C. P T Q R S
- D. R P Q T S

The following information refers to the next two questions.

1.20 g of tin is added to some concentrated nitric acid to form a brown pungent gas and a white solid. When this white solid is heated strongly, it loses mass but remains white. The final product, which is an oxide of tin, has a mass of 1.52 g

Question 10

Which **one** of the following procedures is **not** necessary in order to carry out the experiment safely and successfully?

- A. The white solid should be heated until there is no further change in mass.
- B. The white solid should be heated until it changes colour.
- C. The reaction between tin and nitric acid should be carried out near a fume extractor.
- D. All the tin must be allowed to react with the concentrated nitric acid before the white solid is heated.

Question 11

The result of this experiment shows that the formula of the oxide of tin is:

- A. Sn_2O
- B. SnO
- C. SnO_2
- D. SnO_3

Question 12

The following is a list of formulae of various substances NH_3 , CaCl_2 , SCl_2 , HCl , KCl , SiC

Which of the following is **correct**? The list contains:

- A. one ionic substance
- B. one molecular substance
- C. more than two ionic substances
- D. more than two molecular substances

Question 13

Which of the following metals is the most reactive in water?

- A. Mg
- B. Ca
- C. Na
- D. K

Question 14

Which of the following molecular substances is **non-polar**?

- A. H₂S
- B. PCl₃
- C. C₂H₆
- D. HBr

Question 15

The amount, in mol, of H **atoms** in 5.0 g of hydrogen **gas** is closest to:

- A. 0.8
- B. 1.0
- C. 2.5
- D. 5.0

Question 16

In 2.0 mol of NH₃ **molecules**, there are approximately:

- A. 6.0×10^{23} atoms
- B. 1.2×10^{24} atoms
- C. 2.4×10^{24} atoms
- D. 4.8×10^{24} atoms

Question 17

The number of hydrogen **atoms** present in 2.0 g of CH₄ is:

- A. 7.5×10^{22}
- B. 3.0×10^{23}
- C. 1.2×10^{24}
- D. 4.8×10^{24}

Question 18

Which one of the following compounds has the highest percentage by mass of hydrogen?

- A. H₂O
- B. NH₃
- C. PH₃
- D. SiH₄

Question 19

All alkenes:

- A. are allotropes of ethene
- B. have only single covalent bonds
- C. have one or more C/C double covalent bonds
- D. have no more than one double covalent bond

Question 20

The number of different structural isomers represented by the formula C₆H₁₄ is:

- A. 4
- B. 5
- C. 6
- D. 7

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, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$

Question 1

- a. Convert 1.5 mm to nm.

_____ 1 mark

- b. A picometre (pm) is 0.001 of a nanometre. The radius of an oxygen atom is quoted as 97 pm. Write this radius in metres.

_____ 1 mark

- c. If the radius of a proton is about 1.4×10^{-13} cm and the radius of a hydrogen atom is 5.3×10^{-9} cm, what fraction of the volume ($\frac{4}{3} \pi r^3$) of the atom is the nucleus for the ^1H atom?

3 marks

Total 5 marks

Question 2

A sample of the element rubidium has two naturally occurring isotopes as shown in the Table below.

Identity of isotope	Relative isotopic mass
Rubidium-85	84.95
Rubidium-87	86.94

- a. Name the instrument used to determine relative isotopic mass.

_____ 1 mark

- b. What does the term **relative** in relative atomic mass refer to?

_____ 1 mark

- c. Calculate the percentage of rubidium-87 in the above sample to 3 significant figures.

_____ 4 marks

- d. Write the full isotopic symbol (nuclide representation) for a Rubidium-87 nucleus.

_____ 1 mark

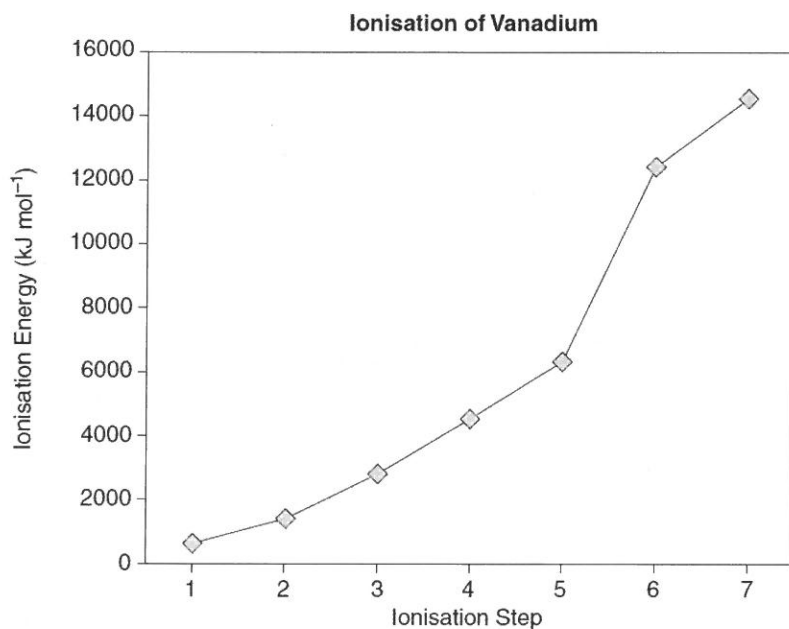
- e. In a mass spectrum of elemental rubidium, what would be the relative abundance ratio of rubidium 85 / rubidium 87?

_____ 1 mark

Total 8 marks

Question 3

Some of the ionisation energies of a sample of the element vanadium, V, are shown in the graph below.



- a. Define the term 'ionisation energy'.

1 mark

- b. Write the electron subshell configuration for vanadium.

1 mark

- c. Explain the relationship between ionisation energy and the arrangement of electrons in the vanadium atom as shown by the graph.

2 marks

Total 4 marks

Question 4

When high energy radiation is passed through a sample of sodium vapour, sodium atoms in an excited state are produced. As a consequence the sample then emits yellow light. If this light is passed through a diffraction grating, an emission spectrum is produced consisting of two discrete yellow lines at about 590 nm on a black background.

- a. What is meant by an 'excited state'?

1 mark

- b. Write a subshell electron configuration for a sodium atom to indicate an excited state.

1 mark

- c. Explain how the lines in the emission spectrum are produced.

4 marks

Total 6 marks

Question 5

Potassium permanganate is an ionic compound. It contains 24.7% potassium, 34.7% manganese and 40.5% oxygen by mass.

- a. Calculate the empirical formula of potassium permanganate. Show all working.

3 marks

- b. Given that the empirical formula is actually the formula of the substance, determine the molar mass.

1 mark

- c. Write the formula of each of the ions that make up the substance.

2 marks

Total 6 marks

Question 6

- a. Complete the table below, by:
- drawing the structural formula (showing all lone electron pairs on the central atom where applicable) for each of the following molecules **and**
 - naming the shape of the molecule.

Molecule	Structural formula	Name of Shape
CCl_4		
PCl_3		
OF_2		

6 marks

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

 CCl_4 _____
_____ PCl_3 _____
_____ OF_2 _____

6 marks

Total 12 marks

Question 7

Chlorine forms different types of compounds with various elements. Two examples are sodium chloride and tetrachloromethane, CCl_4 . Some properties of these compounds are listed below.

Compound	Melting-point (°C)	Boiling-point (°C)	Conductivity in liquid state
NaCl	801	1465	high
CCl_4	23	77	very low

- a. Explain in terms of chemical bonding why these differences exist between the two compounds.

6 marks

- b. Draw a labelled diagram of the apparatus you would use to test the conductivity of an aqueous solution of sodium chloride.

2 marks

Total 8 marks

Question 8

Complete the following table:

Name of compound	Formula of compound
magnesium sulfate	
potassium nitride	
cobalt (II) chloride	
	$\text{Fe}_2(\text{SO}_4)_3$
	$\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$
	$\text{CH}_2\text{CHCH}_2\text{CH}_3$
hexanoic acid	semi-structural formula required
	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CClCH}_2$
	$-\text{[CH}_2\text{CH}(\text{CH}_3)]_n-$

Total 10 marks

Question 9

- a. Draw structures to represent ethene and polyethene (polyethylene)

Ethene	Polyethene

2 marks

- b. Explain why polyethene is able to be moulded.

2 marks

- c. Explain why polyethene can be easily recycled whereas the plastic in a power point backing plate cannot.

2 marks

- d. Explain the difference between HDPE and LDPE giving an example of how the polymers are used.

4 marks

Total 10 marks

Question 10

a. Describe the structure of:

i. Graphene

ii. Graphite

1 + 2 = 3 marks

b. How do the properties of graphene differ from those of graphite?

2 marks

Total 5 marks

END OF TRIAL EXAMINATION