

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	8	60
Total		80

- 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 11 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.

Question 7

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 show an excited state.

1 mark

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

3 marks

Total 5 marks

Question 8

A sample of HNO_3 contains twice as many atoms as there are ions in 6.846 g of $\text{Al}_2(\text{SO}_4)_3$. Calculate the mass of the HNO_3 in the sample.

6 marks

END OF EXAMINATION

Question 5

Health authorities in many countries support the addition of fluoride ions to water supplies to prevent tooth decay. If the recommended fluoride ion concentration is set at 0.90 mg of fluoride ions per litre of drinking water, calculate

- a. i. the amount, in mol, of fluoride ions in 1.0 L of the drinking water.

- ii. the number of fluoride ions in 200 mL of the drinking water.

3 marks

- b. Sodium fluoride, NaF, is usually the substance added to drinking water to provide the fluoride ions. Determine the mass of sodium fluoride, in grams, that must be in each litre of the water for the concentration of fluoride ions to be 0.90 mg L⁻¹?

3 marks

Total 6 marks

Question 6

Complete the following table.

Name of compound	Formula of compound
calcium nitride	
sodium sulfide	
iron(III) chloride	
	CH ₃ CH ₂ CH ₂ OH
	CH ₃ CH ₂ CH(CH ₃)CH ₃
	CH ₂ CHCH ₂ CH ₃
3-methylbutanoic acid	semi-structural formula required
	CH ₃ CH ₂ CHClCH ₃

8 marks

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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

Question 4

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 potassium and chlorine.

1 mark

- b. With reference to shell electron configuration, explain the changes that occur in both the potassium and chlorine atoms during this reaction.

2 marks

- c. The melting point of the potassium chloride formed is much higher than that of chlorine. Use your understanding of structure and bonding of each substance to explain why.

6 marks

Total 9 marks

Question 3

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

Molecule	Valence diagram	Shape
N ₂		
CHCl ₃		
SF ₂		

6 marks

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

N₂ _____

CHCl₃ _____

SF₂ _____

3 marks

Total 9 marks

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

Glen Seaborg contribution to the elements in the periodic table is considerable. He is best known for the

- A. discovery of the noble gases
- B. discovery of element 106, Sg
- C. identification of many trans-uranium elements
- D. synthesis of element 51, Sb

Question 2

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

- A. ⁵⁶Mn
- B. ⁵⁶Ni
- C. ⁵⁷Co
- D. ⁵⁸Fe

Question 3

The electronic configuration of the Mg²⁺ ion is

- A. 1s²2s²2p⁶3s²
- B. 1s²2s²2p⁶3s²3p²
- C. 1s²2s²2p⁴
- D. 1s²2s²2p⁶

Question 4

Nickel is a valuable metal. The number of electrons that are in the outer most occupied subshell of a nickel atom is

- A. 2
- B. 8
- C. 10
- D. 18

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 sample of the element lithium ($A_r = 6.9$) has two naturally occurring isotopes as shown in the Table below.

Identity of isotope	Relative isotopic mass
Lithium-6	6.015
Lithium-7	7.016

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

1 mark

- b. What does the term 'relative' refer to?

1 mark

- c. Calculate the percentage of Lithium-7 in the above sample.

3 marks

- d. Write the full isotopic symbol (nuclide representation) for a Lithium-7 atom. _____

1 mark

Total 6 marks

Question 10

Which of the following would have the largest radius?

- A. a sodium atom
- B. a sodium ion
- C. a potassium atom
- D. a potassium ion

Question 11

Some students set out to determine the empirical formula of black copper oxide. They started with 2.65 g of black copper oxide which was then converted in a series of reactions to metallic copper. The mass of dry copper obtained was 2.12 g. The empirical formula of the oxide is

- A. CuO
- B. Cu_2O
- C. Cu_3O_4
- D. CuO_2

Question 12

The amount of substance, in mol, of **sodium ions** in 1.64 g of sodium phosphate, Na_3PO_4 , ($M = 164 \text{ g mol}^{-1}$) is closest to

- A. 0.0100
- B. 0.0300
- C. 1.00
- D. 3.00

Question 13

The number of hydrogen atoms present in 2.0 g of CH_4 is

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

Question 14

The mass in grams of 0.150 mol of butanoic acid is

- A. 9.00
- B. 11.1
- C. 11.4
- D. 13.2

Question 15

All alkenes have

- A. only single covalent bonds
- B. one or more C/C double covalent bonds
- C. similar size and shape molecules
- D. no more than one double bond

Question 16

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

- A. 8
- B. 9
- C. 10
- D. 11

Question 17

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

- A. $\text{CH}_3(\text{CH}_2)_5\text{CHCl}_2$
- B. $\text{C}_2\text{H}_2\text{Cl}_2$
- C. $\text{C}_2\text{H}_3\text{Cl}$
- D. $\text{CH}_3\text{CHClCH}_2\text{Cl}$

Question 18

The number of different structural isomers represented by the formula C_5H_{12} is

- A. 2
- B. 3
- C. 4
- D. 5

Question 19

The list below contains **molecular** formulae of three organic compounds.

- I. $\text{C}_2\text{H}_4\text{O}_2$
- II. $\text{C}_2\text{H}_6\text{O}$
- III. $\text{C}_2\text{H}_6\text{O}_2$

The listed formulae that could represent carboxylic (alkanoic) acids are

- A. I only
- B. III only
- C. I and III only
- D. I, II, and III

Question 20

Which of the following substances is expected to have the **highest** boiling point?

- A. CH_4
- B. C_2H_6
- C. CCl_4
- D. C_2Cl_6

END OF SECTION A

CHEMISTRY

Unit 1 Trial Examination

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DATA SHEET

Directions to students

Detach this data sheet during reading time.
This data sheet is provided for your reference.

Periodic table of the elements

1 H 1.0 Hydrogen		79 Au 197.0 Gold – Atomic number – Symbol of element – Relative atomic mass – Name of element																2 He 4.0 Helium							
3 Li 6.9 Lithium		4 Be 9.0 Beryllium																		5 B 10.8 Boron	6 C 12.0 Carbon	7 N 14.0 Nitrogen	8 O 16.0 Oxygen	9 F 19.0 Fluorine	10 Ne 20.1 Neon
11 Na 23.0 Sodium		12 Mg 24.3 Magnesium																		13 Al 27.0 Aluminium	14 Si 28.1 Silicon	15 P 31.0 Phosphorus	16 S 32.1 Sulfur	17 Cl 35.5 Chlorine	18 Ar 39.9 Argon
19 K 39.1 Potassium		20 Ca 40.1 Calcium		21 Sc 44.9 Scandium	22 Ti 47.9 Titanium	23 V 50.9 Vanadium	24 Cr 52.0 Chromium	25 Mn 54.9 Manganese	26 Fe 55.9 Iron	27 Co 58.9 Cobalt	28 Ni 58.7 Nickel	29 Cu 63.6 Copper	30 Zn 65.4 Zinc	31 Ga 69.7 Gallium	32 Ge 72.6 Germanium	33 As 74.9 Arsenic	34 Se 79.0 Selenium	35 Br 79.9 Bromine	36 Kr 83.8 Krypton						
37 Rb 85.5 Rubidium		38 Sr 87.6 Strontium		39 Y 88.9 Yttrium	40 Zr 91.2 Zirconium	41 Nb 92.9 Niobium	42 Mo 95.9 Molybdenum	43 Tc 98.1 Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon						
55 Cs 132.9 Caesium		56 Ba 137.4 Barium		57 La 138.9 Lanthanum	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon						
87 Fr (223) Francium		88 Ra (226) Radium		89 Ac (227) Actinium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (263) Seaborgium	107 Bh (264) Bohrium	108 Hs (265) Hassium	109 Mt (268) Meitnerium	110 Ds (271) Darmstadtium	111 Rg (272) Roentgenium	112 Uub	114 Uuq	116 Uuh	118 Uuo									

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 ⁺	Mercury(II)	Hg ²⁺		
		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 ₃ COO ⁻	Dichromate	Cr ₂ O ₇ ²⁻		
Permanganate	MnO ₄ ⁻	Hydrogenphosphate	HPO ₄ ²⁻		
Hydrogencarbonate	HCO ₃ ⁻				
Hydrogensulfate	HSO ₄ ⁻				

Some electronegativity values

H	2.1
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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	2.2	S	2.6	Cl	3.2

Approximate Surface energies of some common substances

Substance	Surface energy(in mJ m ⁻²)
Copper	1370
Magnesium oxide	1200
Diamond	9820
Paraffin wax	50
Polyethene	32
Teflon	16
Mercury	476
Water	72
Ethanol	22
Heptane	20
Petrol (octane)	20