



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

(MAIN CAMPUS)

**UNIVERSITY EXAMINATIONS (MAIN PAPER)
2022/2023 ACADEMIC YEAR**

FIRST YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE MEDICAL LABORATORY SCIENCE
& MEDICAL BIOTECHNOLOGY**

COURSE CODE: BML 121

COURSE TITLE: INORGANIC CHEMISTRY

DATE: 17TH APRIL 2023

TIME: 8.00-10.00AM

INSTRUCTIONS TO CANDIDATES

This paper is divided into three sections, **A B** and **C**, carrying respectively: Multiple Choice Questions (**MCQs**), Short Answer Questions (**SAQs**) and Long Answer Questions (**LAQs**). **Answer all questions. DO NOT WRITE ON THE QUESTION PAPER.**

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 6 Printed Pages. Please Turn Over

SECTION A: Multiple Choice Questions (20 marks).

1. State the composition of the subatomic particles.
 - a. Elements, protons, neutrons
 - b. Protons, atoms, electrons.
 - c. Electrons, neutrons, protons
 - d. Electrons, isotopes , protons.
2. State the maximum number of electrons that a d- orbital can accommodate.
 - a. 6
 - b. 10
 - c. 14
 - d. 2
3. Which of the following statements is true about the principle quantum number?
 - a. It describes the shape of the orbital
 - b. It describes the n value of the orbital
 - c. It describes the orientation of the orbital
 - d. It describes the size of the orbital
4. Which Rule governing the arrangement of electrons in the orbitals describes the pairing of electrons singly before pairing begins in the orbitals.
 - a. Pauli exclusion principle
 - b. Hund's rule
 - c. Aufbau principle
 - d. All of the above.
5. Write the electron configuration of Aluminum given the atomic number of aluminum is 13.
 - a. $1s^2 2s^2 2p^6 3s^2 3p^1$
 - b. $1s^2 2s^2 2p^6 3s^2 3p^2$
 - c. $1s^2 2s^2 2p^6 3s^2$
 - d. $1s^2 2s^2 2p^6 3s^2 3p^3$
6. Elements in the periodic table are arranged with increasing atomic number in rows called
 - a. Groups
 - b. Periods
 - c. Isotope
 - d. lanthanide
7. Which of the following statements is incorrect.
 - a. As we go across a period from left to right, the first ionization energy decrease.
 - b. As we go down the group, the first ionization energy increases, increases.
 - c. As we go across a period from left to right, the first ionization energy increases
 - d. As we go across a period from left to right, the first ionization energy remains constant
8. The number of protons in an atom is known as:
 - a. Atomic number
 - b. Mass number
 - c. Isotopic number
 - d. Relative atomic mass
9. The choices below show elements of the periodic table. Which set contains the transition elements?

- a. Titanium, lithium, Aluminium, Zinc, Chlorine, Helium
 - b. Copper, Iron, Nickel, Zinc, Cobalt, Manganese
 - c. Sodium, Chromium, Aluminium, Silver, Gold, Cobalt
 - d. Potassium, magnesium, Mercury, Nickel, Zinc, calcium
10. Covalent bonding involves _____
- a. Transfer of electrons
 - b. Sharing of electrons
 - c. Transfer of atoms
 - d. Sharing of protons
11. Alkali and Alkaline Earth metals belong to group 1 and group 2 of the periodic table respectively. They are collectively known as -----.
- a. P- block elements
 - b. S- block elements
 - c. S and P block elements
 - d. All of the above
12. The atom having the valence-shell configuration $4s^2 4p^5$ would be in:
- a. Group VIA and Period
 - b. Group IVB and Period 4
 - c. Group VIB and Period 7
 - d. Group VIIA and Period 4
13. Select the term best describing the series of elements: Mn, Fe, Co, Ni, Cu.
- a. d-transition metals
 - b. Representative elements
 - c. Metalloids
 - d. Alkaline earth metals
14. Which element has the **largest** atomic radius?
- a. Li
 - b. Na
 - c. Rb
 - d. F
15. Which of the following terms accurately describes the energy associated with the process:
- $$\text{Li(g)} \longrightarrow \text{Li}^+(\text{g}) + \text{e}^-$$
- a. Electron affinity
 - b. Binding energy
 - c. Ionization energy
 - d. Electronegativity
16. Which element has the **lowest** first ionization energy?
- a. He
 - b. Ne
 - c. Ar
 - d. Xe
17. How many atoms are in one mole of CH_3OH ?
- a. 6.0×10^{23}
 - b. 12.0×10
 - c. 3.6×10^{24}
 - d. 3

18. Which of these isoelectronic species has the **smallest** radius?

- a. Br^-
- b. Sr^{2+}
- c. Rb^+
- d. Se^{2-}

19. Analysis of a sample of a covalent compound showed that it contained 14.4% hydrogen and 85.6% carbon by mass. What is the empirical formula for the compound?

- a. CH
- b. CH_2
- c. CH_3
- d. C_2H_3

20. All of the following properties of the alkaline earth metals increase going down the group **except**

- a. Atomic radius
- b. First ionization energy
- c. Ionic radius
- d. Atomic mass

SECTION B: Short Answer Questions (40 marks).

1. (a) What is the trend for atomic radius as you go from left to right in period? Explain your answer. (4 marks)

(b) The table below shows the ionization energies for aluminium atom. Account for the general trend of the atom. (4 marks)

$\text{Al}(g) \rightarrow \text{Al}^+(g) + e^-$	$I_1 = 580 \text{ kJ/mol}$
$\text{Al}^+(g) \rightarrow \text{Al}^{2+}(g) + e^-$	$I_2 = 1815 \text{ kJ/mol}$
$\text{Al}^{2+}(g) \rightarrow \text{Al}^{3+}(g) + e^-$	$I_3 = 2740 \text{ kJ/mol}$
$\text{Al}^{3+}(g) \rightarrow \text{Al}^{4+}(g) + e^-$	$I_4 = 11,600 \text{ kJ/mol}$

(c) Predict the trend in radius for the following ions: Be^{2+} , Mg^{2+} , Ca^{2+} , and Sr^{2+} . (2 marks)

2. State the classification of matter clearly and explain the differences between a compound and a mixture. (10 marks)

3. State and account for the significance of the set of the four quantum numbers. (8 marks)

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a) What is a mole? (2 marks)

b) How will you calculate how many moles of glucose present in 320 mL of 5.0 M of glucose solution? (4 marks)

c) What is oxidation and reduction reaction? (2 marks)

d) The table below gives the values of ionization energies for all the Period 3 elements. Account for the general trend across the period. (4 marks)

**Successive Ionization
Energies in Kilojoules
per Mole for the**

Elements in Period 3							
Element	<i>I1</i>	<i>I2</i>	<i>I3</i>	<i>I4</i>	<i>I5</i>	<i>I6</i>	<i>I7</i>
Na	495	4560					
Mg	735	1445	7730				
Al	580	1815	2740	11,600			
Si	780	1575	3220	4350	16,100		
P	1060	1890	2905	4950	6270	21,200	
S	1005	2260	3375	4565	6950	8490	27,000
Cl	1255	2295	3850	5160	6560	9360	11,000
Ar	1527	2665	3945	5770	7230	8780	12,000

SECTION C: Long Answer Questions (60 marks).

- Using an example, illustrate and explain the formation of the following types of bonds and then state their properties. (20 marks)
 - Ionic bond (8 marks)
 - Dative bond (3 marks)
 - Covalent bond (4 marks)
 - Metallic bond (5 marks)
- State and demonstrate the Aufbau principle by generating the sequence of filling the electrons in their respective energy levels and use it to write the electron configuration of the following elements (20 marks)
 - Silicon
 - Sulphur
 - Chromium
 - Cobalt
 - Selenium
 - Titanium
 - Manganese
 - Argon
 - Phosphorus
 - Iron
- State and explain the factors that affect the strength of an acid, then explain the methods that are used to compare the strength of the acids. (20 marks)

Elements of the Periodic Table

	1A (1)																	8A (18)
1	1	2A (2)											3A (13)	4A (14)	5A (15)	6A (16)	7A (17)	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	3B (3)	4B (4)	5B (5)	6B (6)	7B (7)	8B (8) (9) (10)			1B (11)	2B (12)	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	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
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	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)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)	As of mid-1999, elements 110 through 112 have not yet been named.					

6	Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	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
7	Actinides	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)