



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH AND APPLIED SCIENCES**

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 6
COURSE NAME: INORGANIC CHEMISTRY	COURSE CODE: ICH602S
SESSION: JANUARY 2020	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
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MODERATOR:	PROF HABAUKA KWAAMBWA

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly.4. All written work must be done in blue or black ink and sketches can be done in pencil.5. No books, notes and other additional aids are allowed.

PERMISSIBLE MATERIALS

Non-programmable Calculators

ATTACHMENTS

List of Useful Constants
Periodic Table

THIS QUESTION PAPER CONSISTS OF 8 PAGES (Including this front page, list of useful constants and Periodic Table)

SECTION A**[40]****QUESTION 1: Multiple Choice Questions****[40]**

- *There are 20 multiple choice questions in this section. Each question carries 2 marks.*
- *Answer ALL questions by selecting the letter of the correct answer.*
- *Choose the best possible answer for each question, even if you think there is another possible answer that is not given.*

1. How many electrons are there in the **third** shell (principal energy level) of the atom with atomic number **23**?

- A. 11
- B. 8
- C. 3
- D. 10

2. How many electrons are there in the “p” orbitals of the **last** shell (principal energy level) of silicon, atomic number 14?

- A. 4
- B. 3
- C. 0
- D. 2

3. Which of the following is the correct order for electrons filling in orbitals?

- A. 2p, 3s, 3p, 3d
- B. 3p, 4s, 3d, 5s
- C. 1s, 2s, 2p, 2d
- D. 3s, 3p, 4s, 3d

4. A lithium atom has an atomic number of 3 and a mass of 7. The number of electrons which it has in the 1st shell (principal energy level) is _____.

- A. 7
- B. 3
- C. 1
- D. 2

5. When $Li_{6,94}^3$ loses its single 2nd shell (principal energy level) electron, its electronic structure resembles that _____.
- A. Boron
 - B. Hydrogen
 - C. Helium
 - D. Neon
6. Bond created by overlapping of one modified orbit on another orbit is known as _____.
- A. Sigma bond
 - B. pi bond
 - C. Covalent bond
 - D. Dative bond
7. Molecular structure of SF_6 is _____
- A. octahedral
 - B. square planar
 - C. tetrahedral
 - D. trigonal bipyramidal
8. In Al_2Cl_6 , the number of electron pairs donated by each chloride ion are _____.
- A. 1
 - B. 2
 - C. 4
 - D. 6
9. Number of bonding pairs of electrons in water H_2O is _____
- A. 1
 - B. 2
 - C. 3
 - D. 4

10. What is the hybridisation of the carbon atoms in ethyne, C_2H_2 ?
- A. sp
 - B. sp^2
 - C. sp^3
 - D. sp^3d
11. What is the definition of an sp^3 hybrid orbital?
- A. It contains one s atomic orbital and three p atomic orbitals.
 - B. It contains one-third s atomic orbital and two-thirds p atomic orbitals.
 - C. It contains one-fifth s atomic orbital and four-fifths p atomic orbitals.
 - D. It contains one-quarter s atomic orbital and three-quarters p atomic orbitals
12. What is the formal charge of the oxygen atom in H_2O ?
- A. +3
 - B. +1
 - C. -2
 - D. -3
13. What is the major attraction between water molecules in the solid physical state?
- A. Dipole-dipole
 - B. Hydrogen bonds
 - C. Electrostatic attraction
 - D. Physical entanglement of molecules
14. Which of the bonds, shown by the dash, has the greatest polarity?
- A. H-Cl
 - B. H-OH
 - C. H-SH
 - D. H-NH₂
15. In which of the following compounds does ionic bonding predominate?
- A. NH_4Cl
 - B. LiBr
 - C. CH_4
 - D. CO_2

16. Ions which are produced from ligands are
- A. Cations
 - B. Anions
 - C. Complex ions
 - D. All of them
17. In a face centred cubic lattice, the number of nearest neighbours for a given lattice point is
- A. 6
 - B. 4
 - C. 8
 - D. 12
18. The molecular geometry of SO_3^{2-} as predicted by VESPR theory is _____.
- A. bent
 - B. tetrahedral
 - C. square planar
 - D. triangular pyramidal
19. In a comparison with s-block elements, melting points of transition elements are
- A. Higher
 - B. Lower
 - C. Same
 - D. Constant
20. Due to ligands' action of splitting colour of transition metal compound, this change occurs at
- A. d-orbital
 - B. p-orbital
 - C. s-orbital
 - D. f-orbital

SECTION B: [60]**QUESTION 1:** [20]

1.1 Use the VSEPR model to predict the geometry of the following molecules and ions. (10)

- a) AsH₃
- b) OF₂
- c) AlCl₄
- d) I₃⁻
- e) C₂H₄

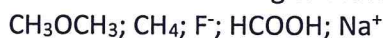
1.2 Predict whether each of the following molecules has dipole moment and give an explanation for each. (6)

- a) BrCl
- b) BF₃ (trigonal planar)
- c) CH₂Cl₂ (tetrahedral)

1.3 Describe the hybridization state of phosphorus in PBr₅. (4)

QUESTION 2: [10]

2.1 Which of the following can form hydrogen bonds in water and why? (2)



2.2 When silver crystallizes, it forms face-centered cubic cells. The unit cell edge length is 409 pm. Calculate the density of silver. (8)

QUESTION 3: [20]

3.1 Write the systematic names of the following coordination compounds: (8)

- a) Ni(CO)₄
- b) NaAuF₄
- c) K₃[Fe(CN)₆]
- d) [Cr(en)₃]Cl₃

3.2 What are the geometries of the following two complexes? (2)

- a) [AlCl₄]⁻
- b) [Ag(NH₃)₂]⁺

3.3 Write the formula of each of the following coordination compounds: (10)

- a) Tetraammineplatinum(II) chloride
- b) Sodium hexacyanoferrate(III)
- c) Tris(ethylenediamine)platinum(IV) sulfate
- d) Diamminesilver(I) nitrate
- e) Potassium diaquadioxalatocobaltate(III)

QUESTION 4: [10]

4.1 Calculate the amount of energy (in kJ) needed to heat 346 g of liquid water from 0°C to 182°C. Assume that the specific heat of water is 4.184 J/g·°C over the entire liquid range and that the specific heat of steam is 1.99 J/g·°C (ΔH_{vap} = 40.79 kJ/mol for water). (5)

4.2 Gold crystallizes in cubic close packed structure (fcc) and has a density of 19.3 g/cm^3 .
Calculate the atomic radius of gold in picometers.

(5)

END OF EXAMINATION

USEFUL CONSTANTS:

Gas constant, $R = 8.3145 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} = 0.083145 \text{ dm}^3 \cdot \text{bar} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \cdot \text{K}^{-1}$

$1 \text{ Pa} \cdot \text{m}^3 = 1 \text{ kPa} \cdot \text{L} = 1 \text{ N} \cdot \text{m} = 1 \text{ J}$

$1 \text{ atm} = 101\,325 \text{ Pa} = 760 \text{ mmHg} = 760 \text{ torr}$

Avogadro's Number, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ Js}$

Speed of light, $c = 2.998 \times 10^8 \text{ ms}^{-1}$

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H 1.00794	2 He 4.00260											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.179	
3 Li 6.941	4 Be 9.01218											13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.06	17 Cl 35.453	18 Ar 39.948	
11 Na 22.9898	12 Mg 24.305											31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.8	
19 K 39.0983	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.38	49 In 75.71	50 Sn 118.69	51 Sb 121.75	52 Te 127.6	53 I 126.9	54 Xe 131.29	
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.41	81 Tl 204.383	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)	
55 Cs 132.905	56 Ba 137.33	71 Lu 174.967	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	114 Uuq (114)	115 Uub (115)	116 Uuh (116)	117 Uuq (117)	118 Uuo (118)		
87 Fr (223)	88 Ra 226.025	103 Lr (260)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Uun (269)	111 Uuu (272)	112 Uub (269)							

Lanthanides:

57 La 138.906	58 Ce 140.12	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 161.930	68 Er 167.26	69 Tm 166.934	70 Yb 173.04
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Actinides:

89 Ac 227.028	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)
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