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 CODE: ICH602S	**COURSE NAME:** INORGANIC CHEMISTRY
SESSION: JANUARY 2019	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

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

INSTRUCTIONS

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

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. The number of electrons in the **highest** energy level of $_{20}Ca$ is ____.

   A. 8

   B. 6

   C. 2

   D. 4

2. Which electron configuration represents a **neutral** atom of nitrogen in an excited state?

   A. $1s^2 2s^1 2p^5$

   B. $1s^2 2s^2 2p^3$

   C. $1s^2 2s^1 2p^4$

   D. $1s^2 2s^2 2p^4$

3. The atom whose outermost shell structure (principal energy level) most closely resembles that of neon (atomic number 10) has the atomic number _____.

   A. 16

   B. 11

   C. 31

   D. 18

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

   A. 7

   B. 3

   C. 1

   D. 2

5. Which of the following is a network solid?

A. SO_2 (solid)

B. I_2

C. Diamond

D. H_2O (ice)

6. What is the hybridisation of the carbon atoms in ethyne, C_2H_2?

A. sp

B. sp^2

C. sp^3

D. sp^3d

7. What is the electronic geometry for 5 regions of high electron density on a central atom?

A. octahedral

B. square planar

C. tetrahedral

D. trigonal bipyramidal

8. What angle(s) are associated with a central atom that has tetrahedral **electronic geometry**?

A. 109.5

B. 120

C. 120 and 180

D. 90 and 120

9. Which one of the following molecules is polar?

A. N_2

B. P_4

C. Cl_2

D. H_2O

10. What kind of hybrid orbitals is utilised by the carbon atom in CF_4 molecules?

A. sp

B. sp^2

C. sp^3

D. sp^3d

11. The **electronic** geometry of the central atom in PCl_3 is _____.

A. pyramidal

B. trigonal planar

C. tetrahedral

D. octahedral

12. The **molecular** geometry of PCl_3 is _____.

A. pyramidal

B. trigonal planar

C. tetrahedral

D. octahedral

13. Choose the false statement from the following:

A. A sigma bond is a bond resulting from head-on overlap of atomic orbitals.

B. A pi bond is a bond resulting from side-on overlap of atomic orbitals.

C. A double bond consists of one sigma bond and one pi bond

D. A triple bond may consist of one sigma bond and two pi bonds or of two sigma bonds and one pi bond.

E. A carbon atom involved in a double bond may not be *sp*3 hybridized.

14. How many lone pairs of electrons does the Lewis dot structure of H_2S have around its central atom and what is the shape of the molecule?

A. 0, linear

B. 0, bent

C. 1, trigonal planar

D. 2, bent

15. Number of dative bonds to central metal ion is its

A. oxidation number

B. compound number

C. dative number

D. coordination number

16. Ions which are produced from ligands are

A. Cation

B. Anion

C. Complex ion

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. Use VSEPR theory to predict the molecular geometry of $SO_3{}^{2-}$.

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. s-orbital

B. p-orbital

C. d -orbital

D. f-orbital

SECTION B: [60]

QUESTION 1: **[20]**

1.1 Use the VSEPR model to predict the geometry of the following ,molecules & ions (10)

a) AsH_3

b) OF_2

c) $AlCl_4$

d) I_3^-

e) C_2H_4

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

a) BrCl

b) BF_3 (trigonal planar)

c) CH_2Cl_2 (tetrahedral)

1.3 Describe the hybridization state of phosphorus in PBr_5. (4)

QUESTION 2: **[10]**

2.1 Which of the following can form hydrogen bonds in water and why? (2)
CH_3OCH_3; CH_4; F^-; HCOOH; Na^+

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) $NaAuF_4$

c) $K_3[Fe(CN)_6]$

d) $[Cr(en)_3]Cl_3$

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

a) $[AlCl_4]^-$

b) $[Ag(NH_3)_2]^+$

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]**

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).

END OF EXAMINATION

USEFUL CONSTANTS:

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

1 Pa · m^3 = 1 kPa.L = 1 N · m = 1 J

1 atm = 101 325 Pa = 760 mmHg = 760 torr

Avogadro's Number, N_A = 6.022 x 10^{23} mol^{-1}

Planck's constant, h = 6.626 x 10^{-34} Js

Speed of light, c = 2.998 x 10^8 ms^{-1}

PERIODIC TABLE OF THE ELEMENTS

1	2											13	14	15	16	17	18
1 **H** 1.00794																	2 **He** 4.00260
3 **Li** 6.941	4 **Be** 9.01218											5 **B** 10.81	6 **C** 12.011	7 **N** 14.0067	8 **O** 15.9994	9 **F** 18.9984	10 **Ne** 20.179
11 **Na** 22.9898	12 **Mg** 24.305	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.9815	14 **Si** 28.0855	15 **P** 30.9738	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
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	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.9216	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.8
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	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.29
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	81 **Tl** 204.383	82 **Pb** 207.2	83 **Bi** 208.908	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
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)		114 Uuq		116 Uuh		118 Uuo

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
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)