nAmIBIA UnIVERSITY
OF SCIEnCE AnD TECHnOLOGY
FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	**LEVEL:** 5
COURSE CODE: GNC501S	**COURSE NAME:** GENERAL CHEMISTRY 1A
SESSION: JUNE 2022	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	DR. EUODIA HESS
MODERATOR:	DR. MARIUS MUTORWA

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

PERMISSABLE MATERIALS
Non-programmable calculators

ATTACHMENTS
1. List of useful constants
2. Periodic Table

THIS QUESTION PAPER CONSISTS OF 8 PAGES
(Including this front page, list of constants and periodic table)

SECTION A [60]

QUESTION 1: Multiple Choice Questions [60]

- *There are 20 multiple choice questions in this section. Each question carries 3 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. When naming a transition metal ion that can have more than one common ionic charge, the numerical value of the charge is indicated by a:

   A. Prefix
   B. Suffix
   C. Roman numeral following the name
   D. Superscript after the name

2. In which of the following are the symbol and name for the ion given correctly?

   A. Fe^{2+} ferrous ion
   B. Sn^{2+} tin (III) ion
   C. Co^{2+} cobaltous ion
   D. Pb^{2+} lead ion

3. What is the correct name for $Sn_3(PO_4)_2$?

   A. tritin diphosphate
   B. tin(III) phosphate
   C. tin(II) phosphate
   D. tin(IV) phosphate

4. What is the correct formula for calcium dihydrogen phosphate?

   A. $Ca(H_2PO_4)_2$
   B. $Ca_2H_2PO_4$
   C. $Ca_2H_2HPO_4$
   D. $Ca_2(H_2PO_4)$

5. Which one of the following Name-Formula combinations is NOT correct (is FALSE)?

   A. Mercury (I) chloride, Hg_2Cl_2
   B. Dinitrogen trioxide, N_2O_3
   C. Hydrogen chloride, HCl
   D. Cerium (IV) phosphate, $Ce_4(PO_4)_3$

6. For a particular organic compound, which of the following pairs can represent the empirical and the molecular formulas, respectively?
   A. CH and CH_4
   B. CH and C_6H_6
   C. CH_2 and C_2H_2
   D. CH_2 and C_2H_3

7. The percent manganese in potassium manganate, K_2MnO_4, is:
   A. 13.2%
   B. 27.9%
   C. 29.0%
   D. 34.8%

8. What external pressure must be supplied to compress 2.76 L of a gas at 298K and 0.878 atm to 2.00 L at 298K?
   A. 484 mmHg
   B. 921 mmHg
   C. 760 mmHg
   D. 878 mmHg

9. At STP, 4 moles of CO_2 gas occupies:
   A. 20.4 L
   B. 22.4 L
   C. 89.6 L
   D. 2.24 L

10. If 0.250 mol of He(g), 0.500 mol of Ne(g) and 0.150 mol of Ar(g) are transferred to a previously empty 5.00 L container at 25°C, what is the final pressure in the container?
    A. 4.40 atm
    B. 2.86 atm
    C. 5.72 atm
    D. 3.81 atm

11. If a mixture of noble gases consists of 0.150 mole of He, 0.450 mole of Ne, and 0.300 mole of Ar, what is the mole fraction of Ar in this mixture?
    A. 0.300
    B. 0.500
    C. 0.667
    D. 0.333

12. A solution is prepared by dissolving 0.100 mole of HCl in 75.0 g of water. Calculate the mass percent HCl in this solution.

    A. 0.133%
    B. 4.64%
    C. 4.87%
    D. 4.01%

13. To what volume, mL, must 50.0 mL of 3.50 M H_2SO_4 be diluted in order to make 2 M H_2SO_4?

    A. 25
    B. 60.1
    C. 87.5
    D. 93.2

14. A solution is prepared by dissolving 20.0 g of NaOH in 750 g. of water. The molality of this solution is?

    A. 1 m
    B. 26.7 m
    C. 0.0267 m
    D. 0.667 m

15. Calculate the freezing point in °C of a solution containing 0.0100 mole of a non-electrolyte in 100.0 g of water (K_f of water = 1.86 °C/m).

    A. -0.186
    B. +0.186
    C. 0.010
    D. -0.010

16. What is the best name for the following compound?
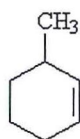
    A. 2-methylcyclohexene
    B. 2-methylcyclohexene
    C. 1-methylcyclohex-2-ene
    D. 3-methylcyclohexene

17. The condensed structural formula for 2,2-dimethylbutane is:

    A. $CH_3C(CH_3)_2CH_2CH_3$
    B. C_6H_{14}
    C. $CH_3CH(CH_3)CH(CH_3)CH_3$
    D. C_3H_7

18. Which one of the following is the correct structural formula for cyclohexane?

 A. C_6H_{12}
 B. C_5H_{10}
 C. C_6H_{14}
 D. C_6H_{10}

19. Which of the following is the general formula of the alkynes?

 A. C_nH_{2n}
 B. C_nH_n
 C. C_nH_{2n+2}
 D. C_nH_{2n-2}

20. What is the best name for the following compound?

 A. 3-methylenehexane

 B. 2-propyl-1-butene

 C. 4-ethyl-4-pentene

 D. 2-ethyl-1-pentene

SECTION B: [40]

There are FOUR questions in this section. Answer all questions. Show clearly, where necessary, how you arrive at the answer as all working will carry marks.
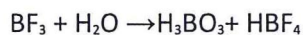
Question 1 [10]

a) A fertilizer has mass percent composition 20.00 % C, 6.71 % H, 46.65 % N, and 26.64 % O.
 What is its empirical formula? (3)
b) Consider this reaction:

$$BF_3 + H_2O \rightarrow H_3BO_3 + HBF_4$$

 The reacting mixture contains 0.496 mol BF_3 and 0.313 mol H_2O.
 i) Which compound is the limiting reactant? (4)
 ii) How many moles of HBF_4 can be produced? (3)

Question 2 [7]

A solution contains 750 g of ethanol (CH_3CH_2OH) and 85.0 g of sucrose (molar mass = 180 g/mol). The volume of the solution is 810.0 mL. Determine:
(i) the density of the solution. (1)
(ii) the mass percent of sucrose in the solution (2)
(iii) the mole fraction of sucrose. (2)
(iv) the molality of the solution. (1)

(v) the molarity of the solution. (1)

Question 3 [14]

a) Ethylene glycol $CH_2(OH)CH_2(OH)$ is a common automobile antifreeze. It is water soluble and non-volatile (b.p 197°C). Calculate the freezing point of a solution containing 651 g of this substance 2505 g of water. (K_f = 1.86°C/m) (7)
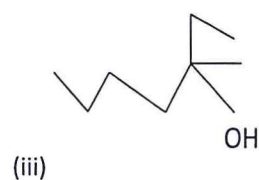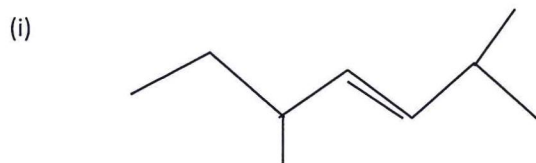
b) The average osmotic pressure of seawater is about 30.0 atm at 25 °C. Calculate the molar concentration of an aqueous solution of sucrose ($C_{12}H_{22}O_{11}$) that is isotonic with seawater. (4)

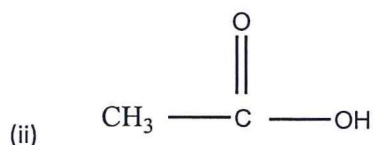c) What are the factors that affect solubility? (3)
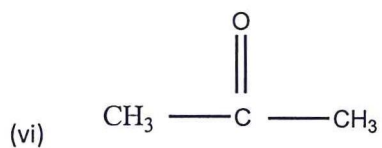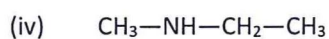
Question 4 [9]

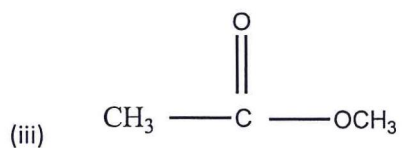Give the IUPAC names for the following compounds:

(a) Write the IUPAC names of the following compounds: (3)

(i)

(ii)

(iii)

OH

(b) State the functional group in each of the following compounds: (6)

(i) $CH_3 \!-\!\!-\! O \!-\!\!-\! CH_3$

(ii) $CH_3 \!-\!\!-\! \overset{\displaystyle O}{\overset{\|}{C}} \!-\!\!-\! OH$

(iii)

$$CH_3 \overset{\displaystyle O}{\overset{\displaystyle \|}{-C}} -OCH_3$$

(iv) $CH_3-NH-CH_2-CH_3$

(v) $CH_3 -OH$

(vi)

$$CH_3 \overset{\displaystyle O}{\overset{\displaystyle \|}{-C}} -CH_3$$

THE END

GOODLUCK

USEFUL CONSTANTS:

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

$1 \ Pa \cdot m^3 = 1 \ kPa.L = 1 \ N \cdot m = 1 \ J$

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

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

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

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

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
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											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)