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:** 5
COURSE CODE: GNC501S	**COURSE NAME:** GENERAL CHEMISTRY 1A
SESSION: JUNE 2019	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
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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 useful constants and Periodic Table)

SECTION A: 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. What type of ions have names ending with *–ide*?
   A. Only cations
   B. Only anions
   C. Only metal ions
   D. Only gaseous ions

2. When Group 2A elements form ions, they _____
   A. Lose two protons
   B. Lose two electrons
   C. Gain two protons
   D. Gain two electrons

3. What is the correct name for N^{3-} ion?
   A. Nitrate ion
   B. Nitride ion
   C. Nitrogen ion
   D. Nitrite ion

4. Aluminium is a Group 3A metal. Which ion does Al typically form?
   A. Al^{3-}
   B. Al^{3+}
   C. Al^{5-}
   D. Al^{5+}

5. Bohr's atomic model ….
   A. proposes that electrons occupy specific energy levels.
   B. explains the emission spectra of hydrogen atoms.
   C. predicts the energy level of multi-electron atoms
   D. both A and B

6. _____ orbitals are spherically symmetrical.
   A. f
   B. d
   C. p
   D. s

7. The n = 1 shell contains _____ p sub-orbitals. All other shells contain _____ p sub-orbitals.
   A. 3, 6
   B. 0, 3
   C. 6, 2
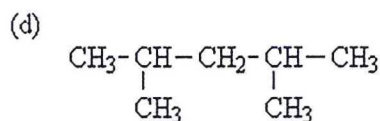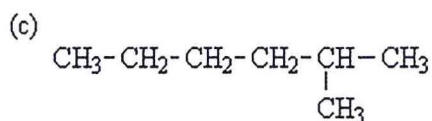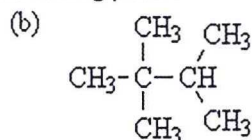   D. 0, 6
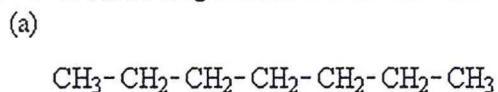
8. There are _____orbitals in the second shell.
   A. 1
   B. 2
   C. 3
   D. 4

9. An unknown amount of C_3H_8 was burned completely to H_2O and CO_2, with 36 g of H_2O recovered. How many moles of the hydrocarbon were originally present?
   A. 0.25
   B. 0.50
   C. 2
   D. $\frac{36}{8}$

10. A compound having an empirical formula of SO_3 is found to have a molecular weight of 80. What is its molecular formula?
    A. S_3O_9
    B. S_2O_6
    C. SO_3
    D. SO_4

11. Balance the following reaction:
$$S + O_2 \rightarrow SO_3$$

   A. $S + O_3 \rightarrow SO_3$
   B. $4S + 2O_2 \rightarrow 4SO_3$
   C. $2S + 3O_2 \rightarrow 2SO_3$
   D. $3S + 2O_2 \rightarrow 3SO_3$

12. What is the formula weight of $Al_2(SO_4)_3$?
    A. 150
    B. 123
    C. 342
    D. 315

13. Standard conditions (STP) are:
    A. 0°C and 2 atm
    B. 32°F and 76 torr
    C. 273 K and 760 mmHg
    D. 4°C and 7.6 mmHg

14. What is the name of the following hydrocarbon according to the IUPAC rules?
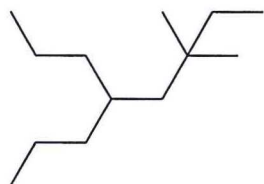
    A. 3,3-dimethyl-5-propylhexane
    B. 6,6-dimethyl-4-propyloctane
    C. 3,3-diethyl-5-propyloctane
    D. 3,3-dimethyl-5-propyloctane

15. Which of the following alkanes would have the highest boiling point?

    (a)

$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$$

    (b)

$$\begin{array}{c} \quad\; CH_3 \;\; CH_3 \\ \quad\;\; | \qquad / \\ CH_3-C-CH \\ \quad\;\; | \qquad \backslash \\ \quad\; CH_3 \;\; CH_3 \end{array}$$

    (c)

$$\begin{array}{c} CH_3-CH_2-CH_2-CH_2-CH-CH_3 \\ \qquad\qquad\qquad\qquad\quad | \\ \qquad\qquad\qquad\qquad\; CH_3 \end{array}$$

    (d)

$$\begin{array}{c} CH_3-CH-CH_2-CH-CH_3 \\ \quad\;\;\; | \qquad\qquad | \\ \quad\; CH_3 \qquad\; CH_3 \end{array}$$

A. (a)
B. (b)
C. (c)
D. (d)

16. Which of these would be least soluble in water?
A. octanol ($CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2$-OH)
B. butanol ($CH_3CH_2CH_2CH_2$-OH)
C. pentanol ($CH_3CH_2CH_2CH_2CH_2$-OH)
D. hexanol ($CH_3CH_2CH_2CH_2CH_2CH_2$-OH)

17. The alcohol shown below is a:

$$(CH_3)_2CHOH$$
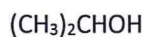
A. Primary alcohol
B. Secondary alcohol
C. Tertiary alcohol
D. Allylic alcohol

18. A hydrocarbon with the general formula C_nH_{2n-2} can be:
A. an alkyne or a cycloalkene
B. an alkyne or a cyclolkane
C. a cycloalkane or an alkene
D. a cycloalkene

19. Smoke is an example of a colloid termed:
A. a foam
B. an aerosol
C. a gel
D. sol

20. What is the boiling point in °C of a solution of a 2.15 m aqueous solution of glycerol? (K_b = 0.512°C/m)?
A. 101.1
B. 100.2
C. 100
D. 1.1

SECTION B: [40]

There are FIVE questions in this section. Answer all Questions.
Show clearly, where necessary, how you arrive at the answer as the working will carry marks to.
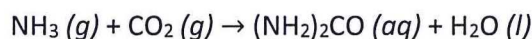
Question 1 [11]

a) Food we eat are degraded in our bodies to provide energy for growth and function. A general overall equation for this complex process represents the degradation of glucose to carbon dioxide and water:

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$$
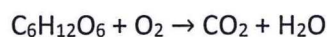
If 856 g of glucose is consumed by a person over a certain period, what is the mass of carbon dioxide produced? (5)

b) Urea is prepared by reacting ammonia with carbon dioxide:

$$NH_3\ (g) + CO_2\ (g) \rightarrow (NH_2)_2CO\ (aq) + H_2O\ (l)$$

In one process 637.2 g of NH_3 is treated with 1142 g of CO_2.
(i) Which of the two reactants is the limiting reagent? (3)
(ii) Calculate the mass of $(NH_2)_2CO$ formed. (1)
(iii) How much excess reagent (in grams) is left at the end of the reaction? (2)

Question 2 [6]

(a) How many grams of potassium dichromate are required to prepare a 250 mL solution whose concentration is 2.16 M? (3)
(b) Describe how you would prepare 5.00×10^2 mL of a 1.75 M sulphuric acid solution, starting with a 8.16 M stock solution. (3)

Question 3 [9]

a) Sulfur hexafluoride is a colorless and odourless gas. Due to its lack of chemical reactivity, it is used as an insulator in electronic equipment. Calculate the pressure (in atm) exerted by 1.82 moles of gas in a steel vessel of volume 5.43 L at 69.5 °C. (2)

b) Calculate the volume (in L) occupied by 7.40 g of ammonia at STP. (2)

c) A flammable gas made up of carbon and hydrogen is found to effuse through a porous barrier in 1.50 min. Under the same conditions and pressure it takes an equal volume of bromine vapour 4.73 min to effuse through the same barrier. Calculate the molar mass of the unknown gas. (5)

**Question 4**   **[9]**

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:

    (a) the density of the solution.   (1)
    (b) the mass percent of sucrose in the solution.   (2)
    (c) the mole fraction of sucrose.   (2)
    (d) the molality of the solution.   (2)
    (e) the molarity of the solution.   (2)

Question 5   **[5]**
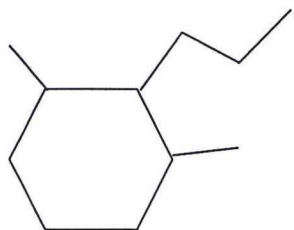
a) Write the IUPAC names of the following compounds: (2)

    (i)
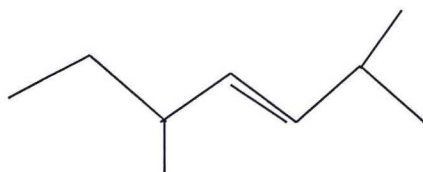
    (ii)

(b) State the functional group in each of the following compounds: (3)

    (i) $CH_3 - O - CH_3$

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

    (iii) $CH_3 - \overset{\overset{\textstyle O}{\|}}{C} - OCH_3$
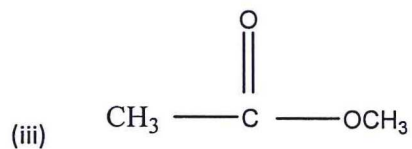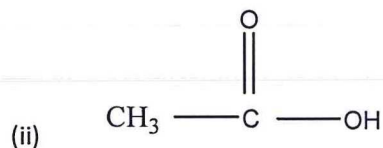
END OF EXAMINATION

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	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)