NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Faculty of Health and Applied Sciences

Department of Health Sciences

QUALIFICATION: BACHELOR OF MEDICAL LABORATORY SCIENCES BACHELOR OF ENVIRONMENTAL HEALTH SCIENCES BACHELOR OF SCIENCES IN HEALTH INFORMATION SYSTEMS MANAGEMENT BACHELOR OF HUMAN NUTRITION	
QUALIFICATION CODE: 08BMLS 08BOHS 07BHIS 08BOHN	**LEVEL:** 5
COURSE: HEALTH SCIENCE CHEMISTRY	**COURSE CODE:** HSC511S
DATE: JUNE 2019	**SESSION:**
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Dr. Yapo Guillaume Aboua & Mr. David Nanhapo
MODERATOR:	Dr. Marius Mutorwa

INSTRUCTIONS

1. Answer all questions.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

Permissable Material

Non programmable calculator is allowed.

Attachment: Periodic Table and formulas

THIS QUESTION PAPER CONSISTS OF 11 PAGES (Including this front page)

SECTION A [30]

QUESTION 1: [15]

SELECT ONLY ONE APPROPRIATE ANSWER FROM THE GIVEN POSSIBILITIES

1.1. What is the formula of the compound formed between magnesium and oxygen? (1)

a. MgO
b. Mg_2O
c. Mg_2O_3
d. Mg_2O_2

1.2. Isotones are the atoms of different elements having_____. (1)

a. Same mass number
b. Same atomic number
c. Same number of neutrons
d. Same number of electrons

1.3. Avogadro's hypothesis relates volume of gases and _____. (1)

a. Mass
b. Temperature
c. Pressure
d. Number of molecules

1.4. If a sample of matter is uniform throughout and cannot be separated into other substances by physical means, it is _____. (1)

a. A homogeneous mixture
b. Either a compound or an element
c. An element
d. A compound

1.5. Sour cream and Salt solutions are_____. (1)

a. Heterogeneous mixtures
b. True solutions
c. Colloidal solutions
d. Suspensions

1.6 Which one of the following statements is false? (1)

a. The masses of protons and neutrons are approximately the same.
b. Calcium commonly forms the $Ca^{2}+$ and cation.
c. If an atom gains electron it becomes negatively charged and is called an anion.
d. Different isotopes of the same element have different chemical behaviour.

1.7 What is the molarity of a solution containing 40.0 g of NaOH in 800 ml of solution? (1)

a. 1.00
b. 1.25
c. 0.5
d. 2.5

1.8 Which one of the following best defines the word "allotropes"? (1)

a. Elements that possess properties intermediate between those of metals and non-metals
b. Different structural forms of an element
c. Atoms of a given atomic number that have a specific number of neutrons
d. A pair of substances that differ by H^{+}

1.9 Vapour pressure of an aqueous solution of a non-volatile and non-electrolyte solute at certain temperature T was found to be 39.964 torr. If the vapour pressure of pure solvent at same temperature is 40 torr, find the molality of aqueous solution (1)

a. 0.05 mol
b. 0.1 mol
c. 0.004 mol
d. 0.005 mol

1.10 What is the ground state electronic configuration of K? (1)

a. $1s^2\ 2s^8\ 3^{s8}\ 4s^1$

b. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1$

c. $1s^2\ 2s^2\ 2p^6\ 2d^{10} 1s^2$

d. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

1.11 What volumes should you mix of 0.2 M NaCl and 0.1 M $CaCl_2$ solution so that in resulting solution the concentration of positive ion is 40% lesser than concentration of negative ion. Assume a total volume of solution to be 1000 ml. (1)

a. 800 ml NaCl, 200 ml $CaCl_2$

b. 400 ml NaCl , 600 ml $CaCl_2$

c. 600 ml NaCl, 400 ml $CaCl_2$

d. None of these

1.12 If 50 g oleum sample rated as 118% is mixed with 18 g water, then the correct option is? (1)

a. The resulting solution contains 68 g of pure H_2SO_4

b. The resulting solution contains 18 g of water and 118 g H_2SO_4

c. The resulting solution contains only 118 g pure H_2SO_4

d. The resulting solution contains 9 g water and 59 g H_2SO_4

1.13 Why does a can collapse when a vacuum pump removes air from the can? (1)

a. The inside and outside forces balance out and crush the can.

b. The unbalanced outside force from atmospheric pressure crushes the can.

c. The atmosphere exerts pressure on the inside of the can and crushes it

d. The vacuum pump creates a force that crushes the can.

1.14 If the height of mercury in a barometer at 0° C is less than 760 mm Hg, then: (1)

a. The atmospheric pressure is less than standard atmospheric pressure.

b. The atmospheric pressure is greater than standard atmospheric pressure.

c. The atmospheric pressure is equal to standard atmospheric pressure.

d. The atmospheric pressure cannot be determined.

1.15 Volumes of gaseous reactants and products in a chemical reaction can be expressed as ratios of small whole numbers; (1)

a. if all reactants and products are gases

b. if standard temperature and pressure are maintained

c. if constant temperature and pressure are maintained

d. if each mass equals 1 mol.

QUESTION 2: [15]

FILL THE BLANKS BY ONLY WRITING DOWN THE NUMBER AND THE CORRECT WORDS OR EXPRESSION.

2.1. The _____is the number of protons in the nucleus of an atom. (1)

2.2. _____ were discovered by Ernest Rutherford in 1910. (1)

2.3. _____ are a family of compounds containing only hydrogen and carbon. (1)

2.4. _____is a homogeneous mixture. (1)

2.5. The quantum numbers provide us with a picture of the _____ arrangement in the atom relative to the nucleus. (1)

2.6. The Group 2 elements in periodical Table are known as the_____earth metals. (1)

2.7. The noble gases already have a full_____Shell. (1)

2.8. Electronegativity is the ability of an atom to attract _____ to itself. (1)

2.9. _____also increases from the bottom to the top of a column in the periodic table. (1)

2.10. Organic compounds are often classified according to the type (s) of_____ groups present. (1)

2.11. The pressure of a gas is directly proportional to the number of moles of the gas if both volume and _____ are constant. (1)

2.12. The force per unit area on a surface is called _____. (1)

2.13. The pressure exerted by each gas in a mixture is called the _____ of that gas. (1)

2.14. The lowest possible temperature, corresponding to zero on the kelvin scale, is referred to as _____. (1)

2.15. _____law establish that equal volumes of gases at the same temperature and pressure contain equal numbers of molecules. (1)

SECTION B [70]

QUESTION 3

[22]

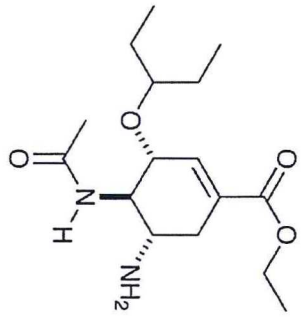
3.1. Match the physical state (number) to a state or states to which the characterizations apply (letter) by only writing down the number and the letter. (5)

	Physical state		Characteristics
1	Indefinite shape	A	freezing
2	Opposite of evaporation	B	Solid and gas states
3	Cohesive forces dominate over disruptive forces	C	Liquid state only
4	Particles are relatively close together.	D	condensation
5	An endothermic change	E	deposition
		F	evaporation
		G	sublimation
		H	Solid state only

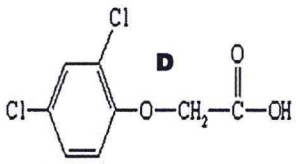
3.2. Complete the following table by filling in the compound name or formula as required. (5)

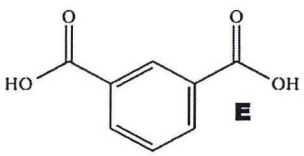
Name	Formula
Barium bromide	
	$KMnO_4$
	H_2SO_3
	$Mg(NO_3)_2$
dinitrogen pentaoxide	

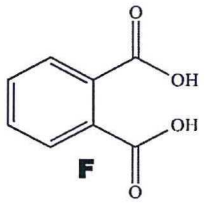
3.3. Name and label four (4) functional groups in the structure and indicate primary (1°), secondary (2°) or tertiary (3°) structure. (6)



3.4. Name structures D, E and F (6)







QUESTION 4

[24]

4.1. During a practical class you have been asked:

a. How many grams of Potassium dichromate, $K_2Cr_2O_7$, do you require to prepare 250mL solution with a concentration of 2.16M? (3)

b. To add 0.381g of glucose ($C_6H_{12}O_6$) to a reaction mixture and to calculate the volume in millilitres of a 2.53M glucose solution that you should use for this addition. (3)

4.2. Calculate the molarity of the following:

a A commercial bleach solution containing 5.25% (by mass) of NaClO in water. It has a density of 1.08 g/mL (Hints: assume you have 1.00 L of solution; molar mass of NaClO 74.4 g/mol) (3)

b A 15.0% solution of NaOH has 15.0 g for 100 g of solution. (2)

4.3. Calculate the following:

a The mass of Na_2CO_3 that must be used to make 700 mL of a 0.136 M Na_2CO_3 solution. (2)

b Calculate the volume (in mL) of 0.3500 M NaOH required to titrate 20.00 mL of 0.2500 M H_2SO_4. The reaction is $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$ (3)

c How many grams of sodium nitrate are produced when 20.0 g of sodium azide, NaN_3, react according to the following equation? (3)

$$NaN_3 + AgNO_3 \longrightarrow AgN_3 + NaNO_3$$

4.4. Consider the reaction $4Al(s) + 3O_2(g \longrightarrow 2Al_2O_3(s)$

Identify the limiting reagent in each of the following reaction mixtures. What mass of $Al_2O_3(s)$ will be produced in each case?

a. 1.0 mol Al and 1.0 mol O_2 (3)

b. 0.75 mol Al and 0.50 mol O_2 (2)

QUESTION 5

[24]

5.1. Calculate the following quantities:

a. Mass, in grams, of 0.105 moles sucrose ($C_{12}H_{22}O_{11}$) (2)

b. Moles of $Zn(NO_3)_2$ in 143.50g of this substance (2)

c. Number of molecules in 1.0×10^{-6} mol CH_3CH_2OH (2)

d. Number of N atoms in 0.410 mol NH_3 (2)

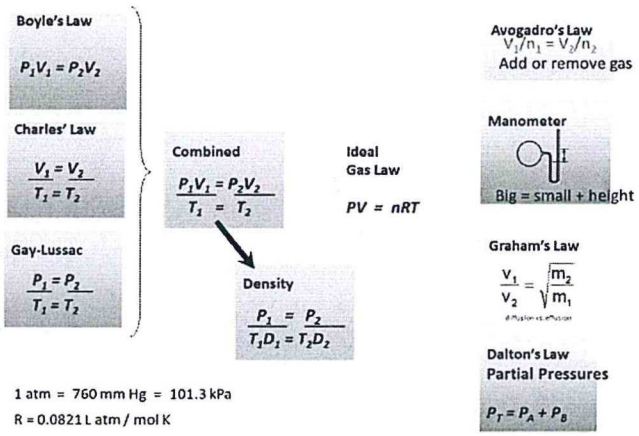
5.2. Ascorbic acid (vitamin C) contains 40.92% C, 4.58% H, and 54.50% O by mass. What is the empirical formula of ascorbic acid? (4)

5.3. Calculate the number of aluminium atoms in a block of pure aluminium that measures 2.0 cm x 2.0 cm x 3.0 cm. The density of aluminium is 2.7 g cm^{-3}. (4)

5.4. A mixture of hydrogen (1.01 g) and chlorine (17.73 g) in a container at 300 K has a total gas pressure of 98.8 kPa. What is the partial pressure of hydrogen in the mixture? (4)

5.5. At 338 K, pure PCl_5 gas is present in a flask at a pressure of 26.7 kPa. At 473 K this is completely dissociated into PCl_3 gas and Cl_2 gas. Calculate the pressure in the flask at 473 K. (4)

END OF EXAM QUESTIONS



Boltzmann's constant	$k =$	1.380658×10^{-16}
Atomic mass unit	$m_u =$	$1.6605402 \times 10^{-24}$
Perfect gas constant	$\mathscr{R} =$	8.3145111×10^{7}
Electron mass	$m_e =$	$9.1093897 \times 10^{-28}$
Electron charge	$e =$	$1.602177333 \times 10^{-19}\ C$
Planck's constant	$h =$	$6.6260755 \times 10^{-27}$
Speed of light	$c =$	$2.99792458 \times 10^{10}$
Radiation density constant	$a =$	$7.5659122 \times 10^{-15}$
Stefan-Boltzmann constant	$\sigma =$	5.67051×10^{-5}
Electron–Volt	1 eV =	$1.60217733 \times 10^{-11}$
Atomic weight of hydrogen	$A_H =$	1.00782500
Atomic weight of helium	$A_{He} =$	4.00260330
Ionisation potential for H	$\chi_H =$	13.595 eV
1st ionisation potential for He	$\chi_{He} =$	24.580 eV
2nd ionisation potential for He	$\chi_{He^+} =$	54.403 eV

Avogadro constant N_A=6.022x10^{23} mol^{-1}

USEFUL CONVERSION FACTORS AND RELATIONSHIPS

Length
SI unit: meter (m)
1 km = 0.62137 mi
1 mi = 5280 ft
= 1.6093 km
1 m = 1.0936 yd
1 in. = 2.54 cm (exactly)
1 cm = 0.39370 in.
1 Å = 10^{-10} m

Mass
SI unit: kilogram (kg)
1 kg = 2.2046 lb
1 lb = 453.59 g
= 16 oz
1 amu = $1.6605402 \times 10^{-24}$ g

Temperature
SI unit: Kelvin (K)
0 K = −273.15°C
= −459.67°F
K = °C + 273.15
°C = $\frac{5}{9}$ (°F − 32°)
°F = $\frac{9}{5}$ °C + 32°

Energy (derived)
SI unit: joule (J)
1 J = 1 kg-m^2/s^2
1 J = 0.2390 cal
= 1 C x 1 V
1 cal = 4.184 J
1 eV = 1.602×10^{-19} J

Pressure (derived)
SI unit: Pascal (Pa)
1 Pa = 1 N/m^2
= 1 kg/m-s^2
1 atm = 101.325 Pa
= 760 torr
= 14.70 lb/in^2
1 bar = 10^5 Pa

Volume (derived)
SI unit: cubic meter (m^3)
1 L = 10^{-3} m^3
= 1 dm^3
= 10^3 cm^3
= 1.0567 qt
1 gal = 4 qt
= 3.7854 L
1 cm^3 = 1 mL
1 in^3 = 16.4 cm^3

Properties	
Molecular Formula	H_2O
Molar Mass	18.015 g mol^{-1}
Density	1 g/cc
Boiling point	100 °C at 1 atm
Freezing point	0 °C at 1 atm
Phase	Liquid
Triple point	273.16 K at 4.6 torr
Heat of fusion	6.013 k mol^{-1}
Heat of vaporization	40.63 k mol^{-1}

Key:

element name atomic number **symbol** atomic weight (mean relative mass)

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
hydrogen 1 **H** 1.0079																		helium 2 **He** 4.0026
lithium 3 **Li** 6.941	beryllium 4 **Be** 9.0122												boron 5 **B** 10.811	carbon 6 **C** 12.011	nitrogen 7 **N** 14.007	oxygen 8 **O** 15.999	fluorine 9 **F** 18.998	neon 10 **Ne** 20.180
sodium 11 **Na** 22.990	magnesium 12 **Mg** 24.305												aluminium 13 **Al** 26.982	silicon 14 **Si** 28.086	phosphorus 15 **P** 30.974	sulfur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.948
potassium 19 **K** 39.098	calcium 20 **Ca** 40.078		scandium 21 **Sc** 44.956	titanium 22 **Ti** 47.867	vanadium 23 **V** 50.942	chromium 24 **Cr** 51.996	manganese 25 **Mn** 54.938	iron 26 **Fe** 55.845	cobalt 27 **Co** 58.933	nickel 28 **Ni** 58.693	copper 29 **Cu** 63.546	zinc 30 **Zn** 65.38	gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.61	arsenic 33 **As** 74.922	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.80
rubidium 37 **Rb** 85.468	strontium 38 **Sr** 87.62		yttrium 39 **Y** 88.906	zirconium 40 **Zr** 91.224	niobium 41 **Nb** 92.906	molybdenum 42 **Mo** 95.96	technetium 43 **Tc** [96]	ruthenium 44 **Ru** 101.07	rhodium 45 **Rh** 102.91	palladium 46 **Pd** 106.42	silver 47 **Ag** 107.87	cadmium 48 **Cd** 112.41	indium 49 **In** 114.82	tin 50 **Sn** 118.71	antimony 51 **Sb** 121.76	tellurium 52 **Te** 127.60	iodine 53 **I** 126.90	xenon 54 **Xe** 131.29
caesium 55 **Cs** 132.91	barium 56 **Ba** 137.33	57-70 *	lutetium 71 **Lu** 174.97	hafnium 72 **Hf** 178.49	tantalum 73 **Ta** 180.95	tungsten 74 **W** 183.84	rhenium 75 **Re** 186.21	osmium 76 **Os** 190.23	iridium 77 **Ir** 192.22	platinum 78 **Pt** 195.08	gold 79 **Au** 196.97	mercury 80 **Hg** 200.59	thallium 81 **Tl** 204.38	lead 82 **Pb** 207.2	bismuth 83 **Bi** 208.98	polonium 84 **Po** [209]	astatine 85 **At** [210]	radon 86 **Rn** [222]
francium 87 **Fr** [223]	radium 88 **Ra** [226]	89-102 **	lawrencium 103 **Lr** [262]	rutherfordium 104 **Rf** [267]	dubnium 105 **Db** [268]	seaborgium 106 **Sg** [271]	bohrium 107 **Bh** [272]	hassium 108 **Hs** [270]	meitnerium 109 **Mt** [276]	darmstadtium 110 **Ds** [281]	roentgenium 111 **Rg** [280]	ununbium 112 **Uub** [285]	ununtrium 113 **Uut** [284]	ununquadium 114 **Uuq** [289]	ununpentium 115 **Uup** [288]	ununhexium 116 **Uuh** [293]	ununseptium 117 **Uus** —	ununoctium 118 **Uuo** [294]

*lanthanoids	lanthanum 57 **La** 138.91	cerium 58 **Ce** 140.12	praseodymium 59 **Pr** 140.91	neodymium 60 **Nd** 144.24	promethium 61 **Pm** [145]	samarium 62 **Sm** 150.36	europium 63 **Eu** 151.96	gadolinium 64 **Gd** 157.25	terbium 65 **Tb** 158.93	dysprosium 66 **Dy** 162.50	holmium 67 **Ho** 164.93	erbium 68 **Er** 167.26	thulium 69 **Tm** 168.93	ytterbium 70 **Yb** 173.06
**actinoids	actinium 89 **Ac** [227]	thorium 90 **Th** 232.04	protactinium 91 **Pa** 231.04	uranium 92 **U** 238.03	neptunium 93 **Np** [237]	plutonium 94 **Pu** [244]	americium 95 **Am** [243]	curium 96 **Cm** [247]	berkelium 97 **Bk** [247]	californium 98 **Cf** [251]	einsteinium 99 **Es** [252]	fermium 100 **Fm** [257]	mendelevium 101 **Md** [258]	nobelium 102 **No** [259]