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: JULY 2019	**SESSION:**
DURATION: 3 HOURS	**MARKS:** 100

SUPPLEMENTARY/SECOND 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.

Permissible Material

Non-programmable calculator is allowed.

Attachment: Periodic Table and formulas

THIS QUESTION PAPER CONSISTS OF 12 PAGES (Including this front page)

SECTION A [30]

QUESTION 1: [15]

SELECT ONLY ONE APPROPRIATE ANSWER FROM THE GIVEN POSSIBILITIES

1.1. Identify the correct order of boiling point (1)

a. $CH_4 < SiH_4 < GeH_4 < SnH_4$

b. $HF < HCl < HBr < HI$

c. $NH_3 < PH_3 < AsH_3 < SbH_3$

d. All are correct

1.2. The general formula of monosaccharides is (1)

a. $C_nH_{2n}O_{2n}$

b. $C_nH_2O_{2n}$

c. $C_{2n}H_2O_n$

d. $C_nH_{2n}O_n$

1.3. A sugar alcohol is (1)

a. Arabinose

b. Trehalose

c. Xylulose

d. Mannitol

1.4. Starch is a (1)

a. Polysaccharide

b. Monosaccharide

c. Disaccharide

d. None of these.

1.5. The most abundant carbohydrate found in nature is (1)

a. Starch
b. Cellulose.
c. Glycogen.
d. Chitin.

1.6. Volumes of gaseous reactants and products in a chemical reaction can be expressed as ratios of small whole number; (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

1.7. If the temperature of a container of gas remains constant, how could the pressure of the gas increase? (1)

a. The mass of the gas molecules increases.
b. The diffusion of the gas molecules increases.
c. The size of the container increases.
d. The number of gas molecules in the container increases.

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. 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

1.10. In term of compositions, a dilute solution contains (1)

a. A lot of solute in a given amount of solvent
b. A lot of solvent in a given amount of solute
c. little solute in a given amount of solvent
d. As much solute as the given amount of solvent

1.11. How many significant figures are in $3.408x10^{4}$ m? (1)

a. 3
b. 4
c. 5
d. 7

1.12. In terms of bonding, elements found in group 5 tend to; (1)

a. Lose five electrons
b. Lose three electrons
c. Gain three electrons
d. Gain five electrons

1.13. The products formed when an acid and a metal react are; (1)

a. Salt and Water
b. Salt and Hydrogen
c. Salt, Hydrogen and Water
d. Salt, Carbon dioxide and Water

1.14. The ability of a measurement to be as close to the true value as possible is defined as: (1)

a. Accuracy
b. Precision
c. significant figure
d. All the above

1.15. At constant pressure, the volume of a gas sample is _____ proportional to its _____ temperature (1)

a. Directly; Celsius
b. Inversely; Celsius
c. Directly; Kelvin
d. Inversely; Kelvin

QUESTION 2: [15]

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

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

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

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

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

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

2.6. When salt dissolves in water, the water is the _____. (1)

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

2.8. _____ are different structural modifications of the same chemical element that exist in two or more different forms, in the same physical state (e.g Diamond, Graphite). (1)

2.9. _____ are atoms of different elements having same number of neutrons. (1)

2.10. Sour cream and Salt solutions are example of _____. (1)

2.11. Sublimation is the process of transformation of a state of matter from a _____to gas. (1)

2.12. _____law states that the volume of a fixed mass of gas varies inversely with the pressure at constant temperature. (1)

2.13. The separation process of a solid component of a mixture, based on its property to pass through heating direct from the solid phase into the gaseous phase, without melting, is called_____. (1)

2.14. _____ is the technique of heating a liquid to create vapor which is collected when cooled separate from the original liquid. (1)

2.15. _____ are a large class of naturally occurring polyhydroxy aldehydes and ketones. (1)

SECTION B [70]

[22]

QUESTION 3

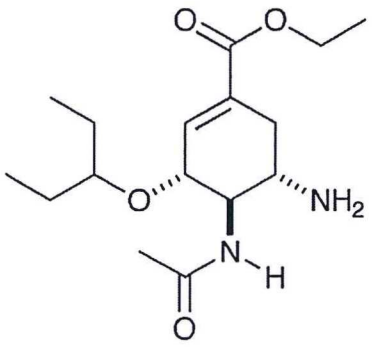
3.1. Match the items given in Column I and Column II by only writing down the number and the letter (5)

Column I	Column II
1. Saturated solution	A. Solution having same osmotic pressure at a given temperature as that of given solution.
2. Binary solution	B. A solution whose osmotic pressure is less than that of another.
3. Isotonic solution	C. Solution with two components.
4. Hypotonic solution	D. A solution which contains maximum amount of solute that can be dissolved in a given amount of solvent at a given temperature.
5. Solid solution	E. A solution whose osmotic pressure is more than that of another.
	F. A solution in solid phase.
	G Hypertonic solution
	H Solid state only

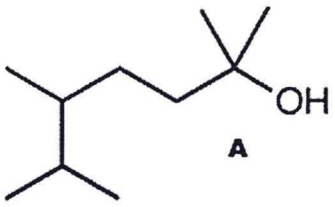
3.2. Complete the following table by filling in the compound name or formula as required. (5)

Name	Formula
lead(II) chloride	
dinitrogen trioxide	
	Na_2SO_4
	SF_6
calcium phosphate	

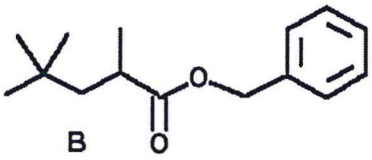
3.3. Name and label four (4) functional groups in the structure and indicate primary (1°), secondary (2°) or tertiary (3°) structure. (6)



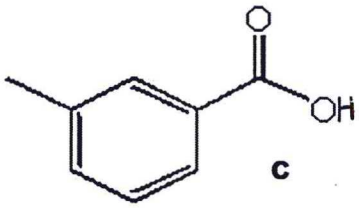
3.4. Name structures A, B and C (6)



A



B



C

QUESTION 4 [38]

4.1. During a practical class you have been asked:

a. To calculate the mass of 0.37 mol of barium chloride. (2)

b. What amount (mol) of solute is there in 125 mL of a 0.864 M solution? (2)

c. An organic compound containing only carbon, hydrogen and oxygen returns the % mass analysis: C 64.9 %; H 13.5 %. What is its empirical formula? (4)

d. Calculate the mass of sodium carbonate ($Na_2CO_3.10H_2O$) required to make 250 mL of a 0.100 M solution. (4)

e. In an experiment, 5.0 g of magnesium was dissolved in excess hydrochloric acid to give magnesium ions and hydrogen gas according to the following equation: (3)

$Mg(s) + 2H^+(aq) \longrightarrow Mg^{2+}(aq) + H_2(g)$

What amount of hydrogen gas (in mol) is produced in the reaction?

4.2. Calculate the molarity of the following:

a A commercial bleach solution contains 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. Pure formic acid (HCOOH), is a liquid monoprotic acid decomposed by heat to carbon dioxide and hydrogen.

a. What mass of the pure acid should be diluted with water to produce 1.00 litre of 2.00 M aqueous solution of formic acid? (3)

b. What volume of 0.250 M sodium hydroxide would be required to react exactly with 30.0 cm^3 of this dilute solution of formic acid? (2)

c. What is the maximum volume of carbon dioxide at 273 K and 1.00 atmosphere that could be obtained by heating 1.00 mole of formic acid? (3)

d. How many molecules of carbon dioxide would it contain? (2)

4.4. One of the components of petrol is octane, C_8H_{18}.

a. Write the balanced equation for the complete combustion of octane (with O_2) to form carbon dioxide gas and liquid water. (2)

b. What amount (in mol) of carbon dioxide is formed when 5.5 mol (1 L) of petrol is burnt? (2)

c. What volume of carbon dioxide would this represent at standard temperature and pressure? (2)

QUESTION 5 [10]

5.1 The pressure of a mass of gas is increased from 150 kPa to 750 kPa at constant temperature Determine the final volume of the gas, if its initial volume is 1.5 m^3 (2)

5.2 A quantity of gas in a cylinder occupies a volume of 2 m^3 at a pressure of 300 kPa. A piston slides in the cylinder and compresses the gas, according to Boyle's law, until the volume is 0.5 m^3. If the area of the piston is 0.02 m^2, calculate the force on the piston when the gas is compressed. (4)

5.3. A pressure vessel is subjected to a gas pressure of 8 atmospheres at a temperature of 5°C. The vessel can withstand a maximum pressure of 28 atmospheres. Calculate the gas temperature increase the vessel can withstand. (4)

END OF EXAM QUESTIONS

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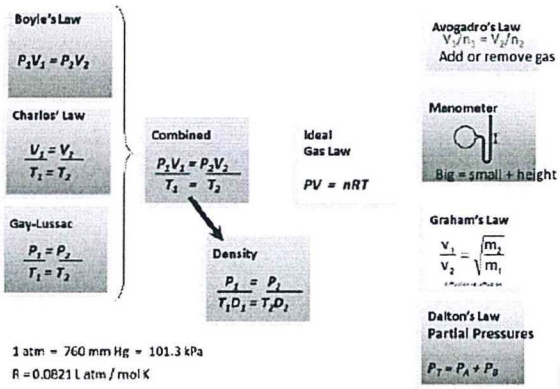
Key: element name / atomic number / **symbol** / atomic weight (mean relative mass)

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** [98]	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** 173.05
**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]

Avogadro constant N_A=6.022x1023 mol-[1]



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

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}