nAmIBIA UnIVERSITY
OF SCIEnCE AnD TECHnOLOGY

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF HEALTH SCIENCES

QUALIFICATION : BACHELOR OF ENVIRONMENTAL HEALTH SCIENCES	
BACHELOR OF HEALTH INFORMATION SYSTEMS MANAGEMENT	
BACHELOR OF BIOMEDICAL SCIENCES	
QUALIFICATION CODE: 08BEHS 07BHIS 50BBMS	**LEVEL:** 5
COURSE CODE: HSC511S	**COURSE NAME**: HEALTH SCIENCE CHEMISTRY
SESSION: JUNE 2022	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Mr DAVID CARELSE
MODERATOR:	Dr MARIUS MUTORWA

INSTRUCTIONS
1. Answer ALL the questions in the answer book provided.
2. Write clearly and neatly.
3. Number the answers clearly.
4. All written work MUST be done in blue or black ink.

PERMISSIBLE MATERIALS
1. Scientific Calculator

THIS QUESTION PAPER CONSISTS OF 10 PAGES
(Including this front page, 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.

1. Write the following number 0.000004013 using scientific notation.

   A. 4.013×10^{-6}

   B. 4.013

   C. 4.013×10^{6}

   D. 4.01×10^{7}

2. Do the following calculation and give the answer to the correct number of significant figures

$$\frac{2.568 \times 5.8}{4.186}$$

   A. 0.36

   B. 3.6

   C. 3.558

   D. 0.6

3. How many grams does a 65-lb. bag of cement weigh?

   A. 39545 g

   B. 29545 g

   C. 45445 g

   D. 24745 g

4. A toddler with a fever has a temperature of 103^{0} F. What is this temperature reading in Celsius?

   A. 39.4^{0} C

   B. 37.1^{0} C

   C. 42.7^{0} C

   D. 35.3^{0} C

5. List the following ions in order of increasing ionic radius: N^{3-}, Na^+, F^-, Mg^{2+}, O^{2-}

   A. Na^+, Mg^{2+}, F^-, O^{2-}, N^{3-}

   B. Mg^{2+}, Na^+, F^-, O^{2-}, N^{3-}

   C. F^-, O^{2-}, N^{3-}, Mg^{2+}, Na^+

   D. Mg^{2+}, Na^+, N^{3-}, O^{2-}, F^-

6. Identify the electron with the following quantum numbers:
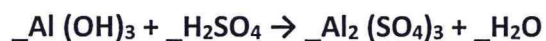 $$n=3; \ell = 2; m\ell = 1; m_s = -\tfrac{1}{2}$$

   A. $3d^8$

   B. $3p^9$

   C. $3d^9$

   D. $2d^9$

7. Give the condensed electron configuration of the following element: K^+

   A. $1s^2\ 2s^2\ 2p^6 3s^2\ 3p^6 4s^1$

   B. $[Ar]\ 4s^1$

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

   D. $[Ar]$

8. Balance the following equation by providing the missing coefficients:

   $$\_Al\ (OH)_3 + \_H_2SO_4 \rightarrow \_Al_2\ (SO_4)_3 + \_H_2O$$

   A. 1, 3, 1, 2

   B. 2, 3, 2, 6

   C. 2, 3, 1, 6

   D. 2, 6, 1, 3

9. How many molecules are in 0.77 moles of a substance?

    A. 8.3×10^{21} molecules

    B. 4.1×10^{26} molecules

    C. 3.8×10^{24} molecules

    D. 4.6×10^{23} molecules

10. How many grams of Na_2SO_4, are required to make 0.350 L of 0.500 M Na_2SO_4?

    A. 24.9 g Na_2SO_4

    B. 23.4 g Na_2SO_4

    C. 34.9 g Na_2SO_4

    D. 28.9 g Na_2SO_4

11. Which of the following is the right combination of oxidation numbers for the following compound: Mn_2O_7?

    A. Mn = +2, O = +7

    B. Mn = +14, O = -2

    C. Mn = +7, O = -2

    D. Mn = +2, O = -7

12. Which of the following are examples for colloidal systems in which the dispersed phase is solid and the dispersion phase is gas?

    A. Smoke, dust

    B. Fog, liquid sprays

    C. Milk, mayonnaise

    D. None of the above

13. What is the molality of a solution that contains 1208g of methanol (CH_3OH) in 1208g of water?

    A. 26.25m CH_3OH

    B. 47.25m CH_3OH

    C. 37.25m CH_3OH

    D. 31.25m CH_3OH'

14. From the following list select the elements that are metals:

    I. **Fe**,   II. **S**,   III. **Si**,   IV. **Na**,   V. **U**,   VI. **Hg**

    A. II, III

    B. I, III, IV, V,

    C. I, IV, V, VI

    D. III, IV, V

15. What is the freezing point of a solution that contains 8.50 g of benzoic acid (C_6H_5COOH, MW = 122) in 75.0 g of benzene, C_6H_6? (f_p=5.48 ; k_f=5.12)?

    A. 0.72°C

    B. 4.76 °C

    C. 2.34°C

    D. 1.76 °C

16. What is the name of the following alkene according to the IUPAC rules?

$$CH_3 - CH_2 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} = CH - CH_3$$
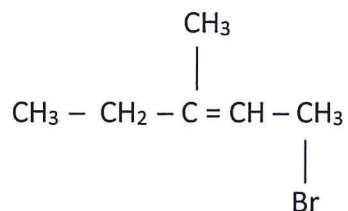
    A. 2-ethyl-4-bromo-But-2-ene

    B. 5-bromo-3-methyl-pent-3-ene

    C. 1-bromo-3-methyl-pent-2-ene

    D. 5-bromo-hex-2-ene

17. If 0.00251 mol of NH₃ effuse through a hole in 2.47 min, how much HCl would effuse in the same time?

    A. 0.0017 Moles

    B. 1.4643 Moles

    C. 0.0251 Moles

    D. 0.1701 Moles

18. A gas is least soluble in a liquid at:

    A. low temperature and low pressure.

    B. high temperature and high pressure.

    C. high temperature and low pressure.

    D. low temperature and high pressure.

19. From the following thermochemical equation, how much heat is created in 79.2 g O_2?

    $$CH_4 \text{ (g)} + 2O_2 \text{ (g)} \longrightarrow CO_2 \text{ (g)} + 2H_2O \text{ (l)} \quad \Delta H - 890.4 \text{ kJ}$$
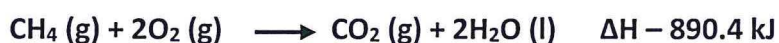
    A. − 1204 kJ

    B. − 2402 kJ

    C. − 1102 kJ

    D. − 2204 kJ

20. What is the osmotic pressure of a 0.01M solution of glucose at 25⁰C?

    A. 185.7 mmHg

    B. 255.3 mmHg

    C. 278.1 mmHg

    D. 145.4 mmHg

END OF SECTION A

SECTION B   [40]

- There are **7** questions in this section. Answer all Questions.

- Show clearly, where necessary, how you arrive at the answer as the working will carry marks too.

Question 1   [3]

An element consists of 1.40% of an isotope with mass 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

Question 2   [6]

Ethylene glycol, the substance used in the automobile antifreeze and recently vape cartridges for e-cigarettes, it is composed of 38.7% C, 9.7% H, and 51.6% O by mass. Its molar mass is 62.1 g/mol.

   A.   What is the empirical formula of ethylene glycol?

   B.   What is the molecular formula of ethylene glycol?

Question 3   [6]

In a process for producing silver, $AgNO_3$ solution and copper are reacted in an electrochemical vessel producing $Cu(NO_3)_2$ as a byproduct. The following equation represents the overall reaction.

$$Cu + 2\ AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$$
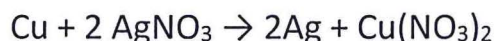
In a laboratory test of this reaction, 20.0 g Cu and 10.0 g $AgNO_3$ were put into a reaction vessel.

   A.   How many grams of silver can be produced by this reaction from these amounts of reactants?

   B.   How many grams of the excess reactant remain after the reaction is complete?

   C.   If you obtain 5.70 g of silver from the experiment, what is the percentage yield of silver?

Question 4   [8]

The following equation under acidic conditions represents a redox process involved in a spectrophotometric determination of the permanganate ion. Balance the equation.

$$MnO_4^- + I^- \rightarrow MnO_2 + I_2$$
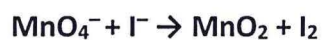
Question 5   [7]

State seven (7) factors affecting the stability of colloids

Question 6   [5]

If 0.340 mol of a non-volatile non-electrolyte are dissolved in 3.00 mol of water, what is the vapor pressure of the resulting solution? (The vapor pressure of pure water is 23.8 torr at 25.0 °C.)

   A. Calculate the mole fraction of the solvent

   B. Calculate the vapor pressure

Question 7   [5]

Briefly describe the following terms?

A. Electron Affinity

B. Colligative property

C. Colloidal particle

D. Accuracy

E. Solubility

THE END

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}

1.609 km $= 1$ mile

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

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

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

1 kg $= 2.2$ lb

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

1 mile $= 5280$ ft

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

Periodic Table of the Elements

1																		18
1 **H** Hydrogen 1.008	2											13	14	15	16	17		2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998		10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305	3	4	5	6	7	8	9	10	11	12	13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453		18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.88	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.933	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.544	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.732	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.922	34 **Se** Selenium 78.09	35 **Br** Bromine 79.904		36 **Kr** Krypton 84.80
37 **Rb** Rubidium 84.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molibdenum 95.94	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.71	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904		54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.327	57-71 Lanthanides	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.85	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.967	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987		86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103 Actinides	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [268]	110 **Ds** Darmstadtium [269]	111 **Rg** Roentgenium [272]	112 **Cn** Copernicium [277]	113 **Uut** Ununtrium unknown	114 **Fl** Flerovium [289]	115 **Uup** Ununpentium unknown	116 **Lv** Livermorium [298]	117 **Uus** Ununseptium unknown		118 **Uuo** Ununoctium unknown

57 **La** Lanthanum 138.906	58 **Ce** Cerium 140.115	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.24	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.966	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
89 **Ac** Actinium 227.028	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]