ΠΑΜΙΒΙΑ UΠIVERSITY
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: JULY 2022	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAM	
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 13 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. Convert 12300 to scientific notation.

   A. 1,2300

   B. 1.23×10^{-4}

   C. 1.2300×10^4

   D. 1.23×10^4

2. Assuming all numbers are measured quantities, do the indicated arithmetic, and give the answer to the correct number of significant figures.

   $$4.18 - 58.16 \times (3.38 - 3.01)$$

   A. -17.0

   B. -21.0

   C. -19.0

   D. -0.16

3. How many feet long is a 5 km indoor race?

   A. 14408 ft

   B. 17025 ft

   C. 16408 ft

   D. 15435 ft

4. The hottest place on record is said to have reached a temperature of 134^0 F. What is this temperature reading in Kelvin?

   A. 279.2 K

   B. 349.2 K

   C. 329.9 K

   D. 314.4 K

5. Arrange the following atoms in order of increasing electronegativity: **Sb, I, Sn, Te**

    A. I, Te, Sb, Sn

    B. Sb, I, Sn, Te

    C. Sn, Sb, Te, I

    D. Sn, Te, Sb, I

6. Which of the following set of quantum numbers is allowed:

    A. $n = 2, \ell = 1, m\ell = -1, m_s = -1$

    B. $n = 5, \ell = -4, m\ell = 2, m_s = +1/2$

    C. $n = 3, \ell = 1, m\ell = 2, m_s = -1/2$

    D. $n = 4, \ell = 1, m\ell = 1, m_s = +1/2$

7. Give the full electron configuration of the following element: **Ca^{+2}**

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

    B. $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6$

    C. $1s^1\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^1$

    D. $1s^2\, 2s^2\, 2p^5\, 3s^2\, 3p^6$

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

    $$\_Al\,(OH)_3 + \_H_2SO_4 \rightarrow \_Al_2\,(SO_4)_3 + \_H_2O$$
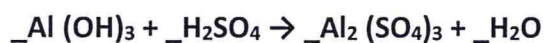
    A. 1, 3, 1, 2

    B. 2, 3, 2, 6

    C. 2, 3, 1, 6

    D. 2, 6, 1, 3

9. How many moles are in 4.6×10^{24} of sulfur atoms?

    A. 2.8 moles

    B. 7.6 moles

    C. 6.7 moles

    D. 76.0 moles

10. How many grams of Na₂SO₄, are required to make 0.350 L of 0.500 M Na₂SO₄?

   A. 24.9 g Na₂SO₄

   B. 23.4 g Na₂SO₄

   C. 34.9 g Na₂SO₄

   D. 28.9 g Na₂SO₄

11. Which of the following combination of oxidation numbers is correct for the following compound: **NaIO₃**?

   A. Na = +1, O = -2, I = +5

   B. Na = +1, O = -3, I = +5

   C. Na = +2, O = -3, I = +6

   D. Na = +1, O = -4, I = +3

12. Name the two phases of a colloidal system.

   A. Dispersion and dispersed phase

   B. The two phases cannot be distinguished

   C. Continuous phase and discontinuous phase

   D. A and C

13. What is the molality of a solution that contains 128g of methanol (CH₃OH) in 108g of water?

   A. 26m CH₃OH

   B. 47m CH₃OH

   C. 37m CH₃OH

   D. 39m CH₃OH

14. Which one of the following name-formula combinations is **NOT** correct?

    A. Mercury (I) nitrate, $HgNO_3$

    B. Calcium phosphate, $Ca_3(PO_4)_2$

    C. Copper (II) sulfate pentahydrate, $CuSO_4·5H_2O$

    D. Hydrofluoric acid, $HF(aq)$

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?

$$CH_3$$
$$|$$
$$CH_3 - CH_2 - C = CH - CH_3$$
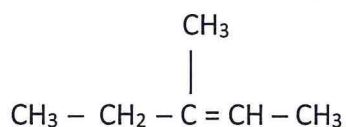
    A. 2-ethyl-3-pentene

    B. 3-ethyl-2-pentene

    C. 3-methyl-2-pentene

    D. 3- pentene -2- ethyl

17. If 0.00251 mol of NH_3 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. In general, colloidal particles remain dispersed because of

   A. their size.

   B. their rapid motion.

   C. their electric charge.

   D. the reduction in viscosity continuous phase.

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

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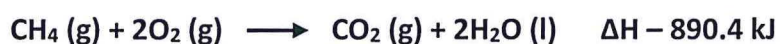
   A. -1204 kJ

   B. -2402 kJ

   C. -1102 kJ

   D. -2204 kJ

20. How many moles are there in 36.0g of C?

   A. 4.1 moles C

   B. 3.0 moles C

   C. 3.2 moles C

   D. 3.4 moles C

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]

Gallium has two naturally occurring isotopes, ^{69}Ga and ^{71}Ga with masses of 68.9257 amu and 70.9249 amu, respectively. Calculate the percent abundances of these isotopes of gallium. The average atomic weight of gallium is 69.723 amu.

Question 2

Caffeine has an elemental analysis of 49.48% carbon, 5.190%, hydrogen, 16.47% oxygen, and 28.85% nitrogen. It has a molar mass of 194.19 g/mol.

     A. What is the empirical formula of caffeine?   [4]

     B. What is its molecular formula?   [2]

Question 3

In a process for producing acetic acid, oxygen gas is bubbled into acetaldehyde, CH_3CHO, containing manganese (II) acetate under pressure at 60^0C.

    $2CH_3CHO(l) + O_2(g) \rightarrow 2HC_2H_3O_2(l)$
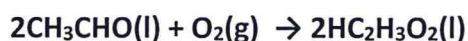
In a laboratory test of this reaction, 20.0 g CH_3CHO and 10.0 g O_2 were put into a reaction vessel.

     A. How many grams of acetic acid can be produced by this reaction from these amounts of reactants?   [3]

     B. How many grams of the excess reactant remain after the reaction is complete?   [2]

C. If you obtain 23.8 g of acetic acid from the experiment, what is the percentage yield of acetic acid? [1]

Question 4 [8]

The breatholyzer test for blood alcohol requires breathing into a tube containing a gel impregnated with an acidic solution of potassium dichromate. Alcohol in the breath will be oxidized to CO_2, and the yellow dichromate will be reduced to the green chromium (III) ion. Balance the following equation which represents the redox process:

$$C_2H_5OH + Cr_2O_7^{2-} \longrightarrow CO_2 + Cr^{3+} + H_2O$$

Question 5 [7]

Several methods are applied in practice to control settling and formation of dilatants "clays" in colloidal dispersions such as pharmaceuticals, paints, agrochemicals and cosmetics. Briefly discuss the role of the following in colloid stability of such dispersions:

A. **Viscosity of dispersion medium:**

B. **Size of colloidal particles:**

C. **Brownian motion:**

D. **Concentration of the dispersion:**

Question 6

210.0 g of the nonvolatile solute sucrose ($C_{12}H_{22}O_{11}$) is added to 485.0 g of water at 25.0°C. What will be the pressure of the water vapor over this solution? (The vapor pressure of pure water is 23.8 torr at 25.0 °C.)

    A. Determine the moles of water and sucrose: [2]

    B. Determine the mole fraction of the solvent: [2]

C. Determine the vapor pressure: [1]

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}

1.609km = 1mile

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}

1 kg = 2.2 lb

Planck's constant, h = 6.626 x 10^{-34} Js

1mile = 5280ft

Speed of light, c = 2.998 x 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 63.546	**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]