UNIVERSITY OF SWAZILAND
DIPLOMA IN ENVIRONMENTAL HEALTH SCIENCE
FINAL EXAMINATION PAPER 2012

TITLE OF PAPER	:	**CHEMISTRY FOR HEALTH SCIENCES**
COURSE CODE	:	**HSC 106**
TIME	:	**3 HOURS**
TOTAL MARKS	:	**100 MARKS**
INSTRUCTIONS	:	**THIS QUESTION PAPER HAS SIX (6) QUESTIONS**
	:	**ANSWER FOUR (4) QUESTIONS ONLY**
	:	**EACH QUESTION IS 25 MARKS**
	:	**A PERIODIC TABLE AND DATA SHEETS ARE PROVIDED WITH THIS EXAMINATION PAPER**
	:	**NO FORM OF ANY PAPER SHOULD BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM**
	:	**BEGIN THE ANSWER TO EACH QUESTION ON A SEPARATE SHEET OF PAPER**
	:	**ALL CALCULATIONS/WORKOUT DETAILS SHOULD BE SUBMITTED WITH YOUR ANSWER SHEET(S)**

DO NOT OPEN THIS EXAMINATION PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

QUESTION 1 [25 MARKS]

a) Convert the following figures to the units indicated: [12]

i) 6.04 kg/L …… mg/cm^3
ii) 35 cm^3…… …..dL
iii) 50 000 pg…… fg
iv) $1.2x10^{24}$ atoms…….. ...moles
v) 100 pulses/sec …… pulse/min
vi) 5.03 g/L …….. oz/L

Recall:
1 in. = 2.54 cm
1 minute = 60 secs
1 gal = 3.8 L
1 oz = 28.4 g
$6.023x10^{23}$ = 1mole

b) Carry out the following calculations and express each answer with the **correct number of decimal, significant figures and units**. [6]

i) 24.567 g + 0.04478 g =
ii) 4.6742 g ÷ 0.00 371 L =
iii) $\frac{3.41\,g - 0.02310\,g}{5.2331\,ml} * 0.2051\,ml + 12.12g =$

c) Celucolo tested a river sample for toxic Arsenic (III) and gave levels of 90.54 pg/ml. How much arsenic in 'ng' would be found in a 2.5 L sample of water. [4]

1 lb = 0.4536 kg

Express your answer with the correct degree of certainity

d) A nurse by the name of "Baphelele" recorded the temperature of a patient as 98.7 °F. Another nurse "Nomkhosi" recorded the temperature of another patient as 38.5 °C. Which patient has fever ? [3]
Useful equation:

$$^oF = \frac{9}{5}{}^oC + 32^o$$

Express your answer with the correct degree of certainity

QUESTION 2 [25 MARKS]

a) Write short notes explaining the differences between **Accuracy and precision** [6].
In your discussion give examples and methods of quantification.

b) Environmental Inspectors, Zandile and Sibusiso tested air samples from Ubombo distillers for sulphur dioxide gas (SO_2) and found the following data in ug/ml.

Zandile	Sibusiso
152.3	**195.8**
155.1	**180.3**
154.2	**250.1**
153.5	**120.3**
150.7	**201.2**

One sample of air was sent to an accredited laboratory in South Africa and gave a value for SO_2 of 185.5±2.5 ug/ml.

Calculate (for both Zandile and Sibusiso):

i) the mean [4]
ii) Standard deviation [4]
iii) % Coefficient of variation [4]
iv) % Relative error [4]

c) Which measurements between Zandile and Sibusiso above are the most ? [2]
i) accurate
ii) precise
give reasons.

d) Based on your observations in 2(c) what recommendations would you give to either Zandile or Sibusiso on their analysis. Give a justification [1]

Useful Formulae:

$$standard\ deviation\ S_x = \sqrt{\frac{\sum_{i=1}^{N}(\bar{x} - x_i)^2}{N-1}};\quad mean\quad \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

QUESTION 3 [25 MARKS]

a). Explain the difference between Any THREE of the following pairs of terms. Give examples for each pair.

i). Ionic bonding and Covalent bond [5]
ii). Co-ordinate bond and Metallic bonding [5]
ii). Octet Rule and the periodic Law [5]
iv). Compounds and elements [5]
v) Hunds rule and Agfbau builing up principle [5]

b). Draw Lewis structures or diagrams to show and name the type of bonding for each of the following: [5]

(i) Magnesium chloride

(ii) NH_4^+

(iii) H_2O

(iv) PCl_3+O

(v) CH_2CH_2

c). i) Using Hunds rule, Afbau builing up principle and the periodic table write the electronic configurations of **any Two** of the following elements. [2]

ii) Also indicate their environmental hazards and most likely source of the **Two** you have chosen in c(i): [3]

Arsenic Lead Berylium Mercury

QUESTION 4 [25 MARKS]

a) Write brief notes on **any one** of the following: [12]

(i) respiratory alkalosis

(ii) metabolic acidosis

Define the cause, symptoms and treatment.

b) Define a buffer solution [3]

c) Give the four types of buffer systems in the body [4]

d) A patient had the following laboratory values for his blood sample:

HCO_3^-	33 mEq/L	pH	7.48
PCO_2	46 mm Hg		

i) What is the mechanism of this acid-base imbalance, justify your answer [4]

ii) What treatment would you prescribe [2]

Question 5 [25 Marks]

a) Write short notes on the following terms: [15]

i) isotonic solutions

ii) hypotonic solutions

iii) hypertonic solutions

Give examples for each and define the use or dangers of each in the body.

b) i) Balance the following chemical equations.
SO_2 (g)+ HNO_3 (aq)+ H_2O (aq)→ H_2SO_4 (aq)+ NO (g) [2]

i) Using the reaction in b(i) how much acid in grams would be produced from 90 g SO_2 [3]

ii) If the total volume of solution was 500 ml, what would be the final concentration of H_2SO_4 in moles per L (M). [3]

iii) Determine the final concentration of H_2SO_4 in b (iii) in mEq/L (N). [2]

Question 6 [25 Marks]

a. (i) Write short notes on any Three of the following pollutants. [9]
Oxygen Demanding Wastes
Eutrophication
Inorganic Wastes
Organic Pesticides

(ii) Using examples briefly describe the chemical process involved in each of the following water purification methods. [12]
Ion exchange resins
Chlorination
Coagulation and sedimentation
Sequestration

b) Explain the difference between permanent and temporary water hardness. [4]

ATP NORMAL LABORATORY VALUES FOR BLOOD TESTS

	USUAL REFERENCE RANGE	
Specific Gravity		1.056
Hemoglobin Count Hb		Men: 14 - 18g /dL Women: 12 -16 g/dL
HCO^-_3 Bicarbonate	24 - 28 mmol/L	24 - 28 mEq/L
Glucose	(3.6-6.1 mmol/L)	65 - 110 mg/dL
BUN (Blood Urea Nitrogen)	2.9 - 7.1 mmol/L	8 - 20 mg/dL
Ca^{+2}	(2.1-2.6 mmol/L)	8.5 - 10.3 mg/dL
Cl^-	(96-106 mmol/L)	96 - 106 mEq/L
Cholesterol		150 - 220 mg/dL
CO_2	24-29 mmol/L	24-29 mEq/L
PCO_2		35-45 mmHg
PO_2		80 - 100 mm Hg
pH		7.35 - 7.45
Fatty acids	0.3-0.8 mmol/L	0.3-2 mg/dL
Protein		6-8 µg/dL
Phosphate	1 - 1.5 mmol/L	3-4.5 mg/dL
ketone bodies		0.3-2 mg/dL
K^+	3.5-5 mmol/L	3.5 - 5 mEq/L
Na^+	136-145 mmol/L	136 - 145 mEq/L
Uric Acid	Men: 0.18 - 0.54 Women: 0.15 - 0.46 mmol/L	Men: 3 - 9 mg/dL Women: 2.5 - 7.5 mg/dL Children: 1.5 g/L (150mg/dL)

THE PERIODIC TABLE OF ELEMENTS

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
Period 1	1 **H** 1.008																	2 He 4.003
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.9	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.01	25 **Mn** 54.9	26 **Fe** 55.85	27 **Co** 58.71	28 **Ni** 58.71	29 **Cu** 63.54	30 **Zn** 65.37	31 **Ga** 69.7	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.91	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 91.22	42 **Mo** 95.94	43 **Tc** 98.9	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
6	55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 174.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 196.9	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 208.9	84 **Po** 210	85 **At** 210	86 **Rn** 222
7	87 **Fr** 223	88 **Ra** 226.0	103 **Lr** 257	104 **Unq**	105 **Unp**	106 **Unh**	107 **Uns**	108 **Uno**	109 **Une**									

NON-METALS

METALLOIDS

METALS

Lanthanides	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** 146.9	62 **Sm** 150.9	63 **Eu** 151.3	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0
Actinides	89 **Ac** 227.0	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.1	94 **Pu** 239.1	95 **Am** 241.1	96 **Cm** 247.1	97 **Bk** 249.1	98 **Cf** 251.1	99 **Es** 254.1	100 **Fm** 257.1	101 **Md** 258.1	102 **No** 255

*Numbers **below** the symbol indicates the **atomic masses**; and the numbers above the symbol indicates the atomic numbers.*