UNIVERSITY OF SWAZILAND
DIPLOMA IN ENVIRONMENTAL HEALTH SCIENCE
SUPPLEMENTARY 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 SEVEN (7) 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) What does SIU stand for ? [2]

b) Give the SI units for the following: [5]

i) Mass iii) Length
ii) Force iv) Charge
v) Frequency

c) What do the following prefixes indicate ? [5]

i) Milli, m iii) deci, d v) micro, μ
ii) mega, M iv) kilo, k

d) Express the following in scientific notation: [2]

i) 145 000 kg
ii) 0.000 000 43 K

e) Convert the following: [6]

i) 1.02 kg ..... g iv) 72 pulse/min.....pulses/sec
ii) 25 mL.....L v) 20 oz/gal.....g/L
iii) 50 μg.....mg vi) 20 in.....m
iv) $1.2x10^{24}$ atoms.....moles

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

f) Urine of a patient has a normal density of 1.020 g/ml ?

i) What will be the weight in kilograms of a 250 ml sample of Urine. [3]
ii) What would be its specific gravity ? [2]

Express your answers in the right number of significant figures

QUESTION 2 [25 MARKS]

a) Write short notes explaining the differences between the following pairs:

i) Accuracy and precision [4]
ii) Systematic and random errors [4]

b) The following weights of oils drops were given to children to use as Iodine supplements: 20 g, 21 000 mg, 0.01980 kg, 21 g and 0.2010 x 10^2 g

Calculate the total mass of the oil drops in kg that were administered. [2]
Express your answer to the correct number of significant figures.

c) The following injections of a drug were given to a patient by an doctor "Mlamuli" using a graduated syringe and needle in five days: 2.8 ml, 2.7 ml, 2.9 ml, 3.0 ml, 2.7 ml

i) calculate the mean volume in ml, [2]
ii) calculate the standard deviation in ml, [2]
iii) % Coefficient of variation [2]
iv) Define type and source of error is in these injections ? [2]
v) A nurse "Norman" made the following injections to her patient 3.9 ml, 3.8 ml, 4.0 ml, 4.1 ml, 3.8 ml.

- Calculate the mean volume of these injections. [2]
- If the injections made by Mlamuli are the correct injections, calculate the % relative error for the injections made by Norman. [3]
- Comment on the types, magnitude and likely sources of error is in the injections by Norman ? [2]

Useful Formulae:

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

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) CHCH

c). i) Using Hunds rule, Agfbau 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 Cadmium 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.
   $SO_2\ (g) + HNO_3\ (aq) + H_2O\ (aq) \rightarrow H_2SO_4\ (aq) + NO\ (g)$ [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) Define water pollution. [3]

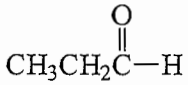
   ii) Give and discuss any four major sources of water pollution. [12]

iii) Explain any two methods of water purification. [4]

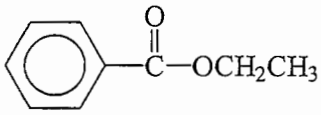
b) Explain the difference between permanent and temporary water hardness. [6]

Question 7 [25 Marks]

a) Name the following organic compounds [3]

a) $CH_3CH_2CH_2OH$ b) 

c)



b) Define and describe the building blocks, general structure and biological functions of carbohydrates [6].

c) Give and describe the four levels of protein structure. Using examples of your choice define the functions of each of the levels in body. [16]

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 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 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.*

Useful Relations

$(RT)_{298.15K}$=2.4789 kJ/mol

$(RT/F)_{298.15K}$=0.025 693 V

T/K: 100.15 298.15 500.15 1000.15

T/Cm^{-1}: 69.61 207.22 347.62 695.13

1mmHg=133.222 N m^{-2}

hc/k=1.438 78x10^{-2} m K

1atm	1 cal	1 eV	$1cm^{-1}$
=1.01325x10^5 Nm^{-2}	=4.184 J	=1.602 189x10^{-19} J	=0.124x10^{-3} eV
=760torr		=96.485 kJ/mol	=1.9864x10^{-23}J
=1 bar		= 8065.5 cm^{-1}	

SI-units:

1 L = 1000 ml = 1000cm^3 = 1 dm^3

1 dm = 0.1 m

1 cal (thermochemical) = 4.184 J

dipole moment: 1 Debye = 3.335 64x10^{-30} C m

force: ***1N=1J m^{-1}= 1kgms^{-2}***=10^5 dyne pressure: ***1Pa=1Nm^{-2}***=1Jm^{-3}

1J = 1 Nm

power: 1W = 1J s^{-1} potential: 1V =1 J C^{-1}

magnetic flux: 1T=1Vsm^{-2}=1JCsm^{-2} current: 1A=1Cs^{-1}

Prefixes:

p	n	m	m	c	d	k	M	G
pico	nano	micro	milli	centi	deci	kilo	mega	giga
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^{3}	10^{6}	10^{9}

General Data

speed of light	**c**	**2.997 925x10^8 ms^{-1}**
charge of proton	*e*	1.602 19x10^{-19} C
Faraday constant	F=L*e*	9.648 46x10^4 C mol^{-1}
Boltzmann constant	**k**	**1.380 66x10^{-23} J K^{-1}**
Gas constant	**R=Lk**	**8.314 41 J K^{-1} mol^{-1}**
		8.205 75x10^{-2} dm^3 atm K^{-1} mol^{-1}
Planck constant	**h**	**6.626 18x10^{-34} Js**
	$\hbar = \frac{h}{2\pi}$	1.054 59x10^{-34} Js
Avogadro constant	**L or N_{av}**	**6.022 14x10^{23} mol^{-1}**
Atomis mass unit	u	1.660 54x10^{-27} kg
Electron mass	**m_e**	**9.109 39x10^{-31} kg**
Proton mass	m_p	1.672 62x10^{-27} kg
Neutron mass	m_n	1.674 93x10^{-27} kg
Vacuum permittivity	$\varepsilon_o = \mu_o^{-1}c^{-2}$	8.854 188x10^{-12} J^{-1} C^2 m^{-1}
Vacuum permeability	μ_o	4πx10^{-7} Js^2C^{-2} m^{-1}
Bohr magneton	$\mu_B = e\hbar/2m_e$	9.274 02x10^{-24} JT^{-1}
Nuclear magneton	$\mu_N = e\hbar/2m_p$	5.05079x10^{-27} JT^{-1}
Gravitational constant	G	6.67259x10^{-11} Nm^2kg^{-2}
Gravitational acceleration	**g**	**9.80665 ms^{-2}**
Bohr radius	a_o	5.291 77x10^{-11} m