UNIVERSITY OF SWAZILAND
DEGREE IN ENVIRONMENTAL HEALTH SCIENCE
MAIN EXAMINATION PAPER 2013/14

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) Define the term SIU used in measurements and testing. [2]

b) Express the following in SIU system.

i) 20 μg ii) 123 dm iii) 4300 g cm s^{-2} [3]

c) Give the SI units for the following: [2]
i) Mass ii) Length

d) What do the following prefixes indicate ? [3]
i) micro, μ ii) femto, f iii) Mega, M

e) Convert the following figures to the units indicated: [7]

(i). 750 μg.....kg
(ii). 213 pm----------μm
(iii). 1000 cm^3.....mL
(iv). 20 Mg.....mg
(v). $2.5x10^{24}$atoms.....moles
(vi). 20.13 gal----------L
(vii). 0.434 ml.....m^3

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

f) A 32.65 g sample of a solid is placed in a flask. Toluene, in which the solid is insoluble, is added to the flask so that the total volume of solid and liquid together is 50.00 mL. The solid and toluene together weigh 58.58 g. The density of toluene at the temperature of the experiment is 0.864 g/mL. What is the density of the solid? [3]

Express your answer to the correct degree of precision

(g) A child has a body temperature of 38.7 °C.

(1) If normal body temperature is 98.6 °F, does the child have a fever? [3]

(2) What is the child's temperature in kelvins, K? [2]

Useful Equations: $^{\circ}F = \frac{9}{5}\,^{\circ}C + 32$; $^{\circ}C = \frac{5}{9}(^{\circ}F - 32^{\circ})$; $K = {}^{\circ}C + 273$

Express your answer to the correct degree of precision.

QUESTION 2 [25 MARKS]

a) Write short notes explaining the differences between the following pairs:
   i) relative error (%RE) and relative standard deviation (%RSD) [6]
   ii) determinate and indeterminate errors [6]

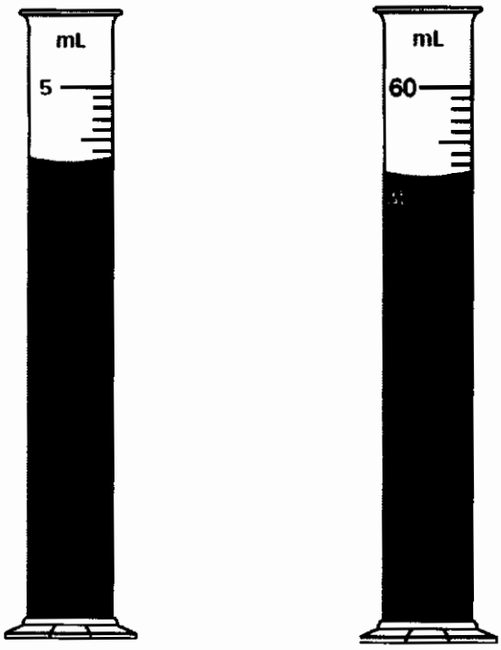
b) A patient was to be given 1.514 mg of de-worming tablets. Two doctors Mxolisi and Zwakele weighed tablets five times to get the following readings:

Mxolisi	Zwakele
1.508	1.509
1.507	1.510
1.509	1.519
1.508	1.515

Calculate (for both Mxolisi and Zwakele):
   i) the mean [2]
   ii) Standard deviation [2]
   iii) % Relative standard deviation [2]
   i) % Relative error [2]

c) Which measurements from 2(b) above are the most precise. [1]
   Justify your answer.

d) Give correct readings of the following analog instruments [2]



(i)_____ (ii) _____

e) (i) Identify and name the type of error in one of the instruments in d) [1]
   (ii) Determine the error in percentages in e(i) [1]

Useful Formulae:

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

QUESTION 3 [25 MARKS]

a) Write short notes on the following terms.
   i). Aufbau building up principle [4]
   ii). Law of Multiple proportions [1]

b) Methane and propane are both constituents of natural gas. A sample of methane contains 5.70 g of carbon atoms and 1.90 g of hydrogen atoms combined in a certain way, wheres as a sample of propane contains 4.47 g of carbon atoms and 0.933 g of hydrogen atoms combined in a different way. Prove that the two compounds obey the Law of Multiple Proportions. [2]

c) Identify and match the correct elements of Br, Pb, Fe, Au, P, S, I, Na and As represented by the pictures below [5]:

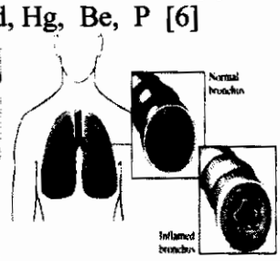




(i)---------- (ii)..... (iii) ..... (iv)..... (v).....

d) Name **any three** disorders shown by the following pictures and identify the associated elements given: As, Cd, Hg, Be, P [6]






(i).....(ii).....(iii).....(iv).....(v).....

e) Explain the following trends:

(i) Atomic Radii in Angstrom units [2]

H	Li	Na	K	Rb	Cs
0.30	1.23	1.57	2.03	2.16	2.35

(ii) ionisation energies in kJ/mol [2]

Na	Mg	Al	Si	P	S	Cl	Ar
496	737	577	786	1012	999	1255	1521

f). Using Hunds rule, Aufbau building up principle and the periodic table write the electronic configurations of the following elements. [3]
   (i) Ca
   (ii) Cu
   (iii) Ag

QUESTION 4 [25 MARKS]

a) Write brief notes on **any one** of the following: [10]
   (i) respiratory alkalosis
   (ii) metabolic acidosis
   Define the cause, symptoms and treatment.

b) Define a buffer solution [2]

c) Give the three types of buffer systems in the body [3]

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

HCO_3^-	23 mEq/L	pH	7.6
PCO_2	24 mm Hg		

   i) What is the mechanism of this acid-base imbalance, justify your answer [2]
   ii) What treatment would you prescribe [2]

e) Write short notes on any Two of the following terms:
   i) isotonic solutions [2]
   ii) hypotonic solutions [2]
   iii) hypertonic solutions [2]

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

Question 5 [25 Marks]

a) Using equations and/or diagrams, explain the difference between electrolyte and non electrolyte solutions ? [6]

b) Balance each of the following chemical equations.
   i) $C_7H_{16}+O_2 \rightarrow CO_2 + H_2O$ [2]
   ii) $K_2S_2O_3 + Cl_2+H_2O \rightarrow KHSO_4 + HCl$ [2]
   iii) $NaHCO_3+H_3PO_4 \rightarrow Na_2HPO_4+ CO_2 + H_2O$ [2]

c) An antacid tablet was given to a patient to relieve stomach discomfort. Given that the antacid was magnesium hydroxide, $Mg(OH)_2$ which reacts with hydrochloric acid, HCl

$$Mg(OH)_2 + HCl \rightarrow MgCl_2 + H_2O$$

   (i). Balance this equation. [1]
   (ii). How many grams acid in the stomach will 1.50 g antacid tablet neutralise?[4]
   (iii) What would the pH of the stomach be if the antacid is not prescribed for the patient assuming fluid volume of 3 liters, L. [1]
   (iv). Using the reaction given how much salt in grams, $MgCl_2$, would be produced from 1.50 g antacid [2]
   (v). If the total fluid volume is 3 liters what would be the final concentration of $MgCl_2$ in moles per L (M). [2]
   (vi). Determine the final concentration of $MgCl_2$ in c(v) in mEq/L (N). [1]

d) i) Convert 25.3 ppm to moles/L of KOH [1]

ii) Calculate the volume of a 20% (w/v) saline solution (NaCl) that is required to prepare a 5% solution (NaCl) in a 100 ml volumetric flask. [1]

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. [8]

Ion exchange resins
Chlorination
Coagulation and sedimentation
Sequestration

b) Explain the difference between permanent and temporary water hardness. [8]

Question 7 [25 Marks]

a) Give the general chemical formulae for the following major classes of organic compounds. [10]

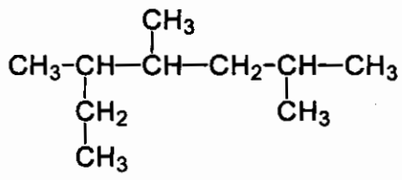
(i). carboxylic acids
(ii). aldehydes
(iii). alcohols
(iv). esters
(v). ethers

b) Give an example and one general use for each of the following [4]

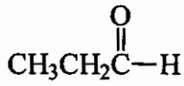
1. Alkane
2. Alkene

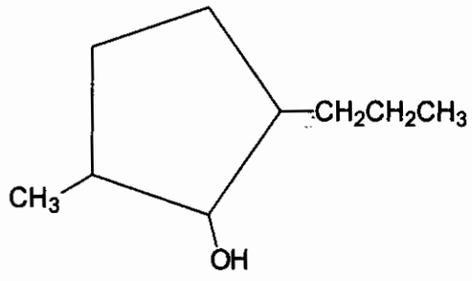
b) Name the following organic compounds

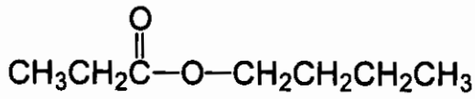
a) CH_3CH_2Cl [1]

b)  [2]

c) $CH_3CH_2\ CH_2\ CH_3$ [2]

d)  [2]

e)  (2)

f)  [2]

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 79.90	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	**g**	**9.80665 ms^{-2}**
acceleration		
Bohr radius	a_o	5.291 77x10^{-11} m