

**UNIVERSITY OF SWAZILAND
DIPLOMA IN ENVIRONMENTAL HEALTH SCIENCE
MAIN EXAMINATION PAPER 2010**

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.....pulse/sec |
| ii) 25 mL.....L | v) 20 oz/gal.....g/L |
| iii) 50 μ g.....mg | vi) 20 in.....m |
| iv) 1.2×10^{24} atoms.....moles | |
- Recall: $1 \text{ minute} = 60 \text{ secs}$ $1 \text{ oz} = 28.4 \text{ g}$
 $1 \text{ in.} = 2.54 \text{ cm}$ $1 \text{ gal} = 3.8 \text{ L}$ $6.023 \times 10^{23} = 1 \text{ mole}$
- 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 0.2010×10^2 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 administered to a patient by a 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 the type and source of error is in these injections ? [2]
- v) A nurse (Norman) administered 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]
 - ◆ What types and likely sources of error is in the injections by Sonboy ? [2]
 - ◆

Useful Formulae:

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

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
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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: [12]
i) Electrolyte solutions
ii) Nonelectrolyte solutions
- b) i) Balance the following chemical equations. [3]
$$\text{Fe}_2(\text{SO}_4)_3 + \text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{Fe}(\text{OH})_3 + (\text{NH}_4)_2\text{SO}_4$$
- ii) Using the reaction in b(i) how much (NH₄)₂SO₄ in grams would be produced from 43 g Fe₂(SO₄)₃ [5]
- iii) If the total volume of solution was 500 ml, what would be the final concentration of (NH₄)₂SO₄ in moles per L (M). [3]
- iv) Determine the final concentration of (NH₄)₂SO₄ H₂SO₄ in b (iii) in mEq/L. [2]

Question 6 [25 Marks]

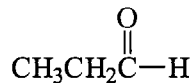
- a) i) Define water pollution. [3]
ii) Give and discuss any four major sources of water pollution. [12]
iii) Explain any two methods of water purification. [4]
- b) Explain the difference between permanent and temporary water hardness. [6]

Question 7 [25 Marks]

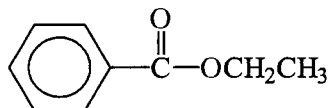
- a) Name the following organic compounds [3]



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	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18										
	IA	IIA	IIIB	IVB	VB	VIB	VIIA	VIII	VIII	VIII	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.

