UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

BSc OF SCIENCE IN ENVIRONMENTAL HEALTH
FINAL EXAMINATION PAPER 2018

TITLE OF PAPER	:	ORGANIC CHEMISTRY FOR HEALTH SCIENCES
COURSE CODE	:	EHS112
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	:	ANSWER **ANY FOUR** QUESTIONS
	:	EACH QUESTION **CARRIES 25** MARKS.
	:	WRITE NEATLY & CLEARLY
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM.
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE

a. C_2H_5Br undergoes a substitution reaction to produce a corresponding alcohol.

(i) What type of substitution reaction will the alkyl halide undergo? **[3 Marks]**

(ii) Give two reasons for your answer in (i) **[4 Marks]**

(iii) Draw a 3-D structure of the reactant and the product? **[6 Marks]**

b. Draw saturated structures for the following compounds and fill in non-bonding valence electrons where they can be found.

i) 1,2 dichloroethane

ii) *N,N* diethyl amine

iii) Dimethyl ether

iv) 2-bromo-4-methoxyhexanoic acid **[12 Marks]**

QUESTION TWO

a. PCBs are synthetic chlorinated hydrocarbons that have been used extensively since 1930 for a variety of industrial uses. PCBs have been shown to present a threat to human health and the environment because of their chemical stability and persistence.

(i) Draw three examples of PCBs and name each compound **[6 Marks]**

(ii) Under what international convention was the production of these compounds banned **[2 Marks]**

(iii) Name any other three chemicals/ classes of chemicals listed under the convention in (ii) **[3 Marks]**

b. Chlorinated and brominated organic compounds that come from natural sources are generated primarily by_____? **[4 Marks]**

c. What are the three classes of humic substances? **[6 Marks]**

d. What is the source of humic substances? **[4 Marks]**

QUESTION THREE

a. The general formula of cellulose can be represented as $(C_6H_{10}O_5)_x$. If the molecular weight of a molecule of cellulose is 400,000, what is the estimated value of x? **[7 Marks]**

b. What is the function of a hydrolase enzyme? **[4 Marks]**

c. The most common lipids are triglycerides formed from _____ **[4 Marks]**

d. Compare S_N1 and S_N2 reactions and state the factors that affect these reactions. **[10 Marks]**

QUESTION FOUR

a. Fill in the blanks in the following statements.

(i) Protein denaturation consists of disruption of_____

(ii) Some steroids are _____that act as "messengers" from one part of the body to another.

(iii) Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are the two major kinds of_____

(iv) Biochemical processes that involve the alteration of biomolecules are termed as _____

(v) Enzymes are proteinaceous substances with highly specific structures that function as biochemical_____

[5 × 3Marks]

b. What is the difference between elimination and addition reactions? Give examples of each type of reaction. **[6 Marks]**

c. Draw all structural isomers of pentene, C_5H_{10}, that have unbranched carbon chains. **[4 Marks]**

QUESTION FIVE

a. Define, with examples, what is meant by isomerism. **[4 Marks]**

b. Use the two forms of 1,2-dichloroethene to illustrate *cis-trans* isomerism.

[6 Marks]

c. Draw structures of the compounds described below and give the IUPAC name for each structure

(i) A compound with five carbons, ketone functional group on the second carbon and a methoxy substituent on the fourth carbon.

(ii) A benzene ring with three nitro groups on positions 1,3,5 and a methyl group on the fourth position.

(iii) An unsaturated compound, C_4H_8, undergoes a halogenation reaction to produce dichloride product, A. Draw all possible molecular structures of Product A.

[15 Marks]

General data and fundamental constants

Quantity	Symbol	Value
Speed of light	c	$2.997\,924\,58 \times 10^{8}$ m s^{-1}
Elementary charge	e	$1.602\,177 \times 10^{-19}$ C
Faraday constant	$F = N_A e$	9.6485×10^{4} C mol^{-1}
Boltzmann constant	k	$1.380\,66 \times 10^{-23}$ J K^{-1}
Gas constant	$R = N_A k$	8.314 51 J K^{-1} mol^{-1}
		$8.205\,78 \times 10^{-2}$ dm^3 atm K^{-1} mol^{-1}
		6.2364×10 L Torr K^{-1} mol^{-1}
Planck constant	h	$6.626\,08 \times 10^{-34}$ J s
	$\hbar = h/2\pi$	$1.054\,57 \times 10^{-34}$ J s
Avogadro constant	N_A	$6.022\,14 \times 10^{23}$ mol^{-1}
Atomic mass unit	u	$1.660\,54 \times 10^{-27}$ Kg
Mass		
electron	m_e	$9.109\,39 \times 10^{-31}$ Kg
proton	m_p	$1.672\,62 \times 10^{-27}$ Kg
neutron	m_n	$1.674\,93 \times 10^{-27}$ Kg
Vacuum permittivity	$\varepsilon_0 = 1/c^2\mu_0$	$8.854\,19 \times 10^{-12}$ J^{-1} C^2 m^{-1}
	$4\pi\varepsilon_0$	$1.112\,65 \times 10^{-10}$ J^{-1} C^2 m^{-1}
Vacuum permeability	μ_0	$4\pi \times 10^{-7}$ J s^2 C^{-2} m^{-1}
		$4\pi \times 10^{-7}$ T^2 J^{-1} m^3
Magneton		
Bohr	$\mu_B = e\hbar/2m_e$	$9.274\,02 \times 10^{-24}$ J T^{-1}
nuclear	$\mu_N = e\hbar/2m_p$	$5.050\,79 \times 10^{-27}$ J T^{-1}
g value	g_e	2.002 32
Bohr radius	$a_0 = 4\pi\varepsilon_0\hbar/m_e e^2$	$5.291\,77 \times 10^{-11}$ m
Fine-structure constant	$\alpha = \mu_0 e^2 c/2h$	$7.297\,35 \times 10^{-3}$
Rydberg constant	$R_\infty = m_e e^4/8h^3 c\varepsilon_0^2$	$1.097\,37 \times 10^{7}$ m^{-1}
Standard acceleration of free fall	g	9.806 65 m s^{-2}
Gravitational constant	G	$6.672\,59 \times 10^{-11}$ N m^2 Kg^{-2}

Conversion factors

1 cal	=	4.184 joules (J)	1 erg	=	1×10^{-7} J
1 eV	=	$1.602\,2 \times 10^{-19}$ J	1 eV/molecule	=	96 485 kJ mol^{-1}

Prefixes

f	p	n	μ	m	c	d	k	M	G
femto	pico	nano	micro	milli	centi	deci	kilo	mega	giga
10^{-15}	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^{3}	10^{6}	10^{9}

PERIODIC TABLE OF ELEMENTS

GROUPS

PERIODS	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.180 Ne 10
3	22.990 Na 11	24.305 Mg 12											26.982 Al 13	28.086 Si 14	30.974 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18
4	39.098 K 19	40.078 Ca 20	44.956 Sc 21	47.88 Ti 22	50.942 V 23	51.996 Cr 24	54.938 Mn 25	55.847 Fe 26	58.933 Co 27	58.69 Ni 28	63.546 Cu 29	65.39 Zn 30	69.723 Ga 31	72.61 Ge 32	74.922 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
5	85.468 Rb 37	87.62 Sr 38	88.906 Y 39	91.224 Zr 40	92.906 Nb 41	95.94 Mo 42	98.907 Tc 43	101.07 Ru 44	102.91 Rh 45	106.42 Pd 46	107.87 Ag 47	112.41 Cd 48	114.82 In 49	118.71 Sn 50	121.75 Sb 51	127.60 Te 52	126.90 I 53	131.29 Xe 54
6	132.91 Cs 55	137.33 Ba 56	138.91 *La 57	178.49 Hf 72	180.95 Ta 73	183.85 W 74	186.21 Re 75	190.2 Os 76	192.22 Ir 77	195.08 Pt 78	196.97 Au 79	200.59 Hg 80	204.38 Tl 81	207.2 Pb 82	208.98 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86
7	223 Fr 87	226.03 Ra 88	(227) **Ac 89	(261) Rf 104	(262) Ha 105	(263) Unh 106	(262) Uns 107	(265) Uno 108	(266) Une 109	(267) Uun 110								

Atomic mass → 10.811
Symbol → B
Atomic No. → 5

TRANSITION ELEMENTS

*Lanthanide Series	140.12 Ce 58	140.91 Pr 59	144.24 Nd 60	(145) Pm 61	150.36 Sm 62	151.96 Eu 63	157.25 Gd 64	158.93 Tb 65	162.50 Dy 66	164.93 Ho 67	167.26 Er 68	168.93 Tm 69	173.04 Yb 70	174.97 Lu 71
**Actinide Series	232.04 Th 90	231.04 Pa 91	238.03 U 92	237.05 Np 93	(244) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(252) Es 99	(257) Fm 100	(258) Md 101	(259) No 102	(260) Lr 103

( ) indicates the mass number of the isotope with the longest half-life.