NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES
SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF BIOLOGY, CHEMISTRY AND PHYSICS

QUALIFICATION : BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	**LEVEL: 6**
COURSE CODE: ORC601S	**COURSE NAME**: ORGANIC CHEMISTRY 1
SESSION: JULY 2023	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	DR. MPINGANA AKAWA
MODERATOR:	PROF. HABAUKA KWAAMBWA

INSTRUCTIONS
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number the answers clearly.

PERMISSIBLE MATERIALS

Non-programmable Calculators

ATTACHMENTS

pKa Chart and Periodic Table

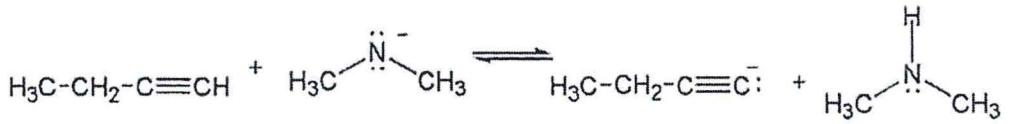
THIS QUESTION PAPER CONSISTS OF 10 PAGES (including this frontpage)

SECTION A **[50]**

QUESTION 1: Multiple Choice Questions

- There are 25 multiple choice questions in this section. Each question carries 2 marks.
- Answer ALL questions by selecting the letter of the correct answer.

1.1 Consider the following acid-base reaction. The equilibrium for this reaction lies to the:



A. Left
B. Right
C. It cannot be determined
D. The forward and reverse reactions are equally favoured

1.2 What is the hybridization of Carbon atom in CF_4?

A. sp^2
B. sp^3d
C. sp^3
D. sp

1.3 Which of the following is not a nucleophile?

A. ^-CN
B. CH_3NH_2
C. CH_3O^-
D. H_2O
E. $^+NO_2$

1.4 Consider the three isomeric alkanes n-hexane, 2, 3-dimethylbutane, and 2-methylpentane. Which of the following correctly lists these compounds in order of increasing boiling point?

A. 2, 3-dimethylbutane < 2-methylpentane < n-hexane
B. 2-methylpentane < n-hexane < 2, 3-dimethylbutane
C. 2-methylpentane < 2, 3-dimethylbutane < n-hexane
D. n-hexane < 2-methylpentane < 2, 3-dimethylbutane

1.5 Among the butane conformers, which occur(s) at energy minima on a graph of potential energy versus dihedral angle?

A. gauche only
B. eclipsed and totally eclipsed
C. gauche and anti
D. eclipsed only

1.6 The name 2,4,6-tribromobenzene is incorrect. Which of the following is the correct name?

A. tribromobenzene
B. 2,6-dibromobromobenzene
C. 3,5-dibromobromobenzene
D. 1,3,5-tribromobenzene

1.7 What is the IUPAC name of the following compound?

$CH_3C \equiv CCH_2C(CH_3)_3$

A. 4,4-dimethyl-2-hexyne
B. 5,5-dimethyl-2-hexyne
C. 5,5-dimethyl-3-hexyne
D. None of the above

1.8 Which of the following reaction conditions would result in the anti-Markovnikov addition to the alkene?

A. H_2O/H^+
B. HBr
C. HCl
D. BH_3: [2] H_2O_2/OH^-

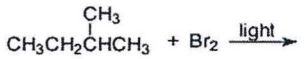
1.9 Markovnikov addition of HBr to 1-propene involves:

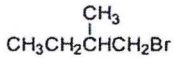
A. Initial attack of bromide ion
B. Initial attack of bromine radical
C. Formation of a secondary carbocation
D. Formation of a primary carbocation

1.10 Which is the order carbocations stability?

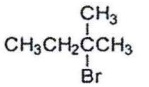
A. tertiary > secondary > primary
B. secondary > tertiary > primary
C. primary > secondary > tertiary
D. primary > tertiary > secondary

1.11 Bromination of alkanes is a much slower reaction than chlorination. Which of the following is expected to be the major organic product when 2-methylbutane is allowed to react with Br_2 in the presence of light or heat?

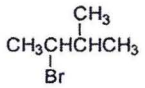




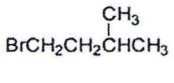
A.



B.



C.



D.

1.12 Which of the following is a product of the acid-catalyzed hydration of 3-methyl-2-pentene?

A. 2-methylpentane
B. 3-methyl-1-pentanol
C. 3-methyl-3-pentanol
D. 2-methyl-2,3-pentadiol

1.13 What is the molecular geometry of the central atom in CH_3OCH_3?

A. Trigonal planar
B. Trigonal pyramidal
C. Tetrahedral
D. Bent

1.14 Carbon-carbon double bonds consist of:

A. one σ bond, one π bond
B. two σ bonds, one π bond
C. one σ bond, two π bonds
D. two σ bonds, two π bonds

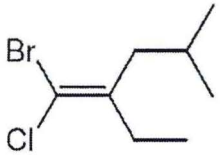
1.15 Which of the following anions is the best leaving group?

A. NH_2^-
B. Cl^-
C. CH_3^-
D. OH^-

1.16 Which of the following reaction conditions would result in the anti-Markovnikov addition to the alkene?

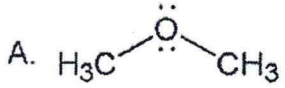
A. H_2O/H^+
B. HBr
C. HCl
D. [1] BH_3 [2] H_2O_2/OH^-

1.17 Give the IUPAC name for the following compound.



A. (Z)-1-bromo-2-chloro-2-ethyl-4-methyl-1-pentene
B. (E)-1-bromo-1-chloro-2-ethyl-4-methyl-2-pentene
C. (Z)-1-bromo-1-chloro-2-ethyl-4-methyl-1-pentene
D. (E)-1-bromo-1-chloro-2-ethyl-4-methyl-1-pentene

1.18 What is the nucleophilic site in each of the following molecules?

A.  B.  C. 

A. A: hydrogen; B: nitrogen; C: 2 electrons in bond
B. A: oxygen: B: nitrogen: C: carbon
C. A: oxygen; B: nitrogen; C: 2 electrons in bond
D. A: oxygen: B: carbon; C: 7 electrons in bond

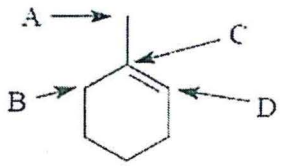
1.19 Which molecule has a nonzero dipole moment?

A. Cl_2
B. CO_2
C. CCl_4
D. $CHCl_3$

1.20 Which of the following properties are not identical for constitutional isomers?
I. Molecular formula II. Molecular Weight III. Order of attachment of atoms. IV. Physical Properties

A. I; IV
B. II; III
C. I; II
D. III; IV

1.21 Using Markovnikov's rule, predict the position of the Cl atom in the major product from the reaction of 1-methylcyclohexene with HCl.



A. A
B. B
C. C
D. D

1.22 Which of the following reagents must be used with HBr to convert 1-hexene to 1-bromohexane?

A. HSO^{3-}
B. $NaBH_4$
C. ROOR
D. Pd/C
E. no other reagent is necessary.

1.23 The reactivity of alkyl halides in E2 elimination reactions follows the order_____

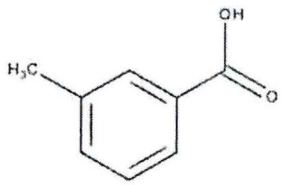
A. R–I < R–Br < R–Cl < R–F
B. R–F < R–Cl < R–Br < R–I
C. R–I > R–Cl > R–Br < R–F
D. R–I < R–Br < R–F < R–Cl

1.24 Give the IUPAC name of the following compound.

$CH_3C(CH_3)_2CH_2C{\equiv}CCH_2CH(CH_2CH_2CH_3)CH_3$

A. 2,2,7-trimethyl-4-nonyne
B. 2,2,7-trimethyl-4-decyne
C. 3,3,7-trimethyl-4-decyne
D. 2,2,6-trimethyl-4-undecyne

25. What is the correct name of the following compound



A. 3-methylbenzoic acid
B. m-methylbenzoate
C. tolylcarboxylate
D. methylbenzoate

SECTION B [50]

- There are SIX questions in this section. Answer all Questions.

QUESTION 2 [3]

2.1 Explain the following observations

a) The boiling points of unbranched alkanes increases with increase in molecular weight.
b) Alkanes are insoluble in water
c) The melting points of isomeric alkanes increases on branching.

QUESTION 3 [10]

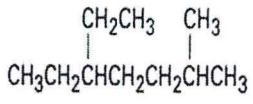
3.1 Draw the structural formulas or bond line (zigzag) formula of the following compounds:

a) 3,3-dichloro-2-methylhexane
b) 3,4-dimethyl-2-pentanol
c) 2,3,3-Trimethyl-1,4,6-octatriene
d) 5,5-dimethyl-2-hexyne
e) 2,5-dimethyl-3,6-octadiene

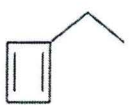
QUESTION 4. [10]

4.1 Give systematic IUPAC names of the following organic compounds.

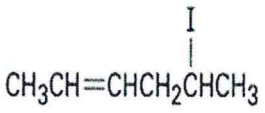
(a)



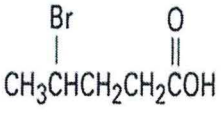
(b)



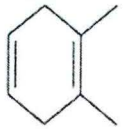
(c)



(d)



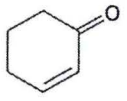
(e)



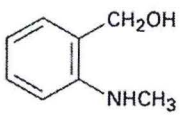
QUESTION 5 [8]

5.1 Write and identify the functional groups in the following molecules.

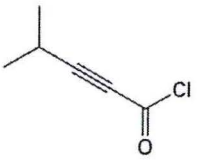
(a)



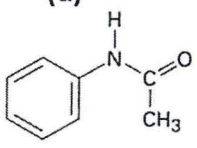
(b)



(c)



(d)



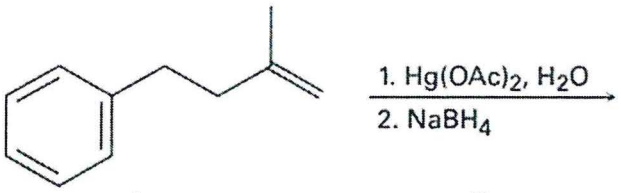
QUESTION 6 [7]

6.1 Draw a full detailed mechanism of the reaction of 2-methylpropene with hydrochloric acid. Give the IUPAC name of the product. In order to receive full marks, show the flow of electrons using arrows and all the intermediates, which are formed during the reaction.

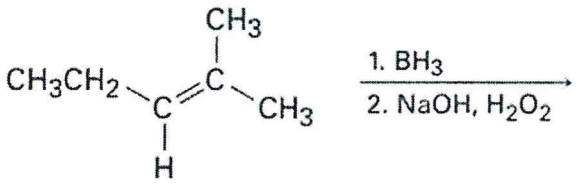
QUESTION 7 **[12]**

7.1 Predict the product(s) of the following reaction

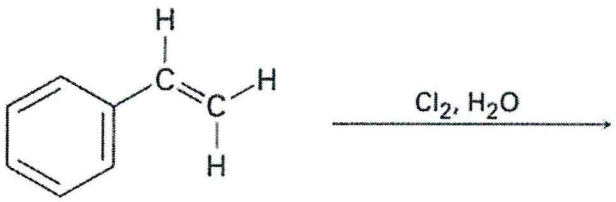
(a)



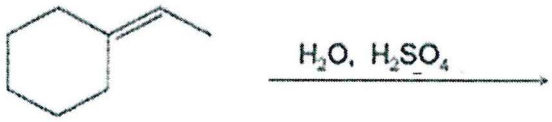
(b)



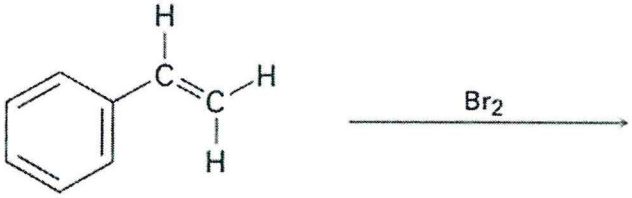
(c)



(d)

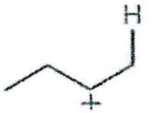
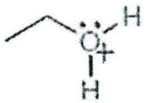
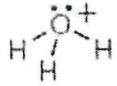
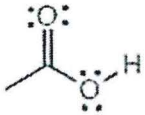
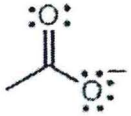


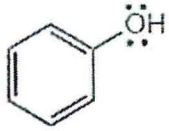
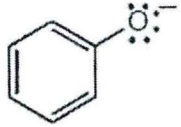
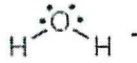
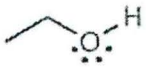
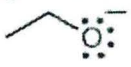
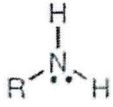
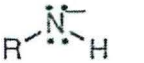
(e)

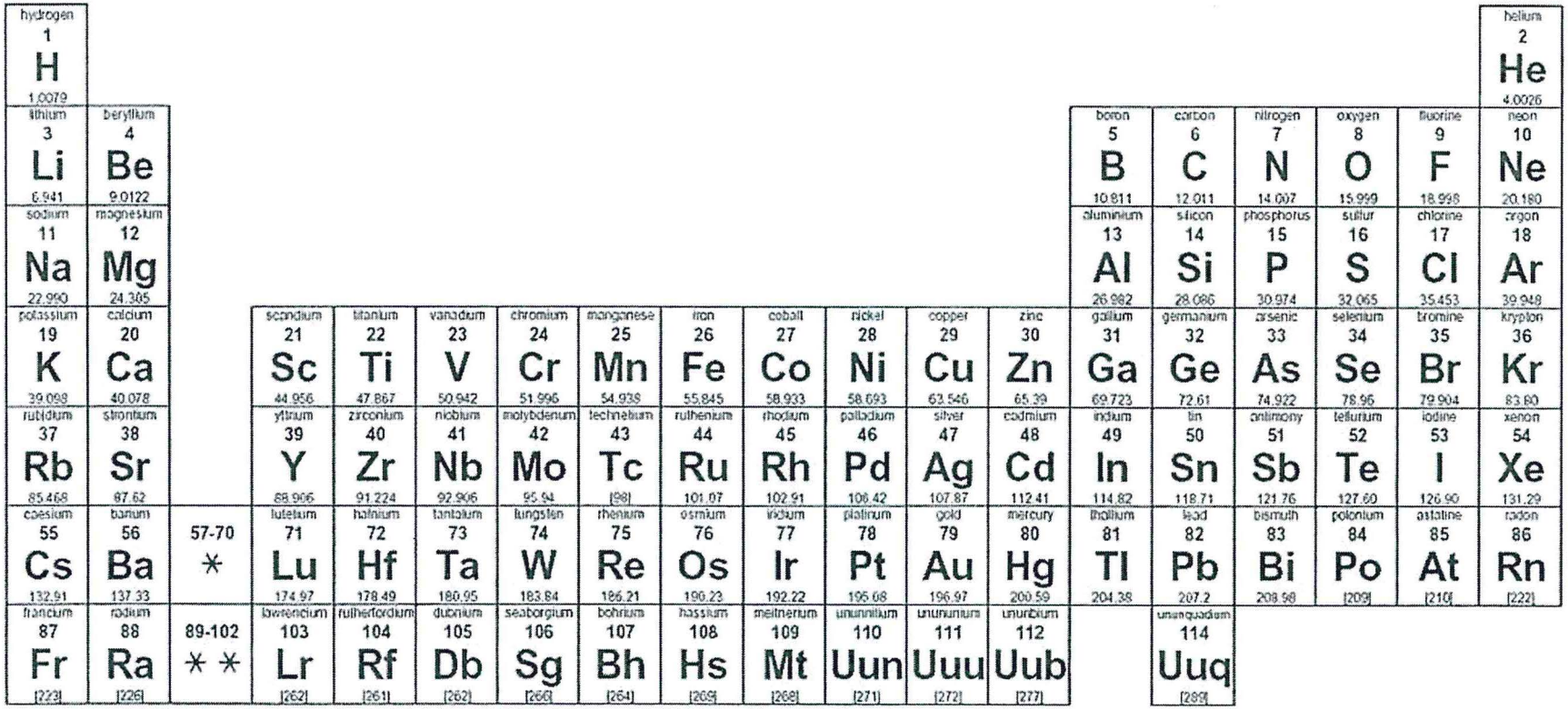


(f)

pKa Chart

conjugate acid		conjugate base	
sulfuric acid	H_2SO_4	HSO_4^-	-10
hydroiodic acid	HI	I^-	-9
hydrobromic acid	HBr	Br^-	-8
hydrochloric acid	$HCl:$	$:Cl:^-$	-7
carbocations			-3
protonated alcohol			-2.4
hydronium ion			-1.7
nitric acid	HNO_3	NO_3^-	-1.3
hydrofluoric acid	HF	F^-	3.2
carboxylic acids			4.8

conjugate acid		conjugate base	
hydrogen cyanide	$H-C\equiv N:$	$:\bar{C}\equiv N:$ (cyanide)	9.1
phenols			10
water		$^-:\ddot{O}-H$ (hydroxide)	15.7
primary alcohols		 (alkoxides)	16
alkynes	$C\equiv C-H$	$C\equiv C:^-$ (acetylide anions)	26
hydrogen	$H-H$	$:H^-$ (hydride)	35
ammonia/amines		 (amide bases)	36
alkanes			~60


hydrogen 1 H 1.0079
helium 2 He 4.0026
lithium 3 Li 6.941
beryllium 4 Be 9.0122
boron 5 B 10.811
carbon 6 C 12.011
nitrogen 7 N 14.007
oxygen 8 O 15.999
fluorine 9 F 18.998
neon 10 Ne 20.180
sodium 11 Na 22.990
magnesium 12 Mg 24.305
aluminium 13 Al 26.982
silicon 14 Si 28.086
phosphorus 15 P 30.974
sulfur 16 S 32.065
chlorine 17 Cl 35.453
argon 18 Ar 39.948
potassium 19 K 39.098
calcium 20 Ca 40.078
scandium 21 Sc 44.956
titanium 22 Ti 47.867
vanadium 23 V 50.942
chromium 24 Cr 51.996
manganese 25 Mn 54.938
iron 26 Fe 55.845
cobalt 27 Co 58.933
nickel 28 Ni 58.693
copper 29 Cu 63.546
zinc 30 Zn 65.39
gallium 31 Ga 69.723
germanium 32 Ge 72.61
arsenic 33 As 74.922
selenium 34 Se 78.96
bromine 35 Br 79.904
krypton 36 Kr 83.80
rubidium 37 Rb 85.468
strontium 38 Sr 87.62
yttrium 39 Y 88.906
zirconium 40 Zr 91.224
niobium 41 Nb 92.906
molybdenum 42 Mo 95.94
technetium 43 Tc [98]
ruthenium 44 Ru 101.07
rhodium 45 Rh 102.91
palladium 46 Pd 106.42
silver 47 Ag 107.87
cadmium 48 Cd 112.41
indium 49 In 114.82
tin 50 Sn 118.71
antimony 51 Sb 121.76
tellurium 52 Te 127.60
iodine 53 I 126.90
xenon 54 Xe 131.29
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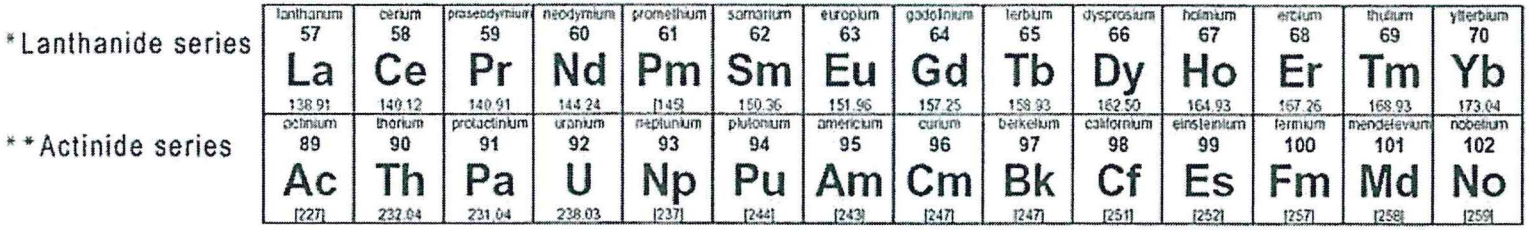
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