

**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

DEPARTMENT OF BIOLOGY, CHEMISTRY AND PHYSICS

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 5
COURSE CODE: GNC501S	COURSE NAME: GENERAL CHEMISTRY 1A
SESSION: JUNE 2023	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	MRS. LEONORITHA R. NAOMAS
MODERATOR:	DR. MARIUS MUTORWA

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly4. All written work must be done in blue or black ink and sketches can be done in pencil5. No books, notes and other additional aids are allowed

PERMISSABLE MATERIALS

Non-programmable calculators

ATTACHMENTS

1. List of useful constants
2. Periodic Table

THIS QUESTION PAPER CONSISTS OF 9 PAGES

(Including this front page, list of constants and periodic table)

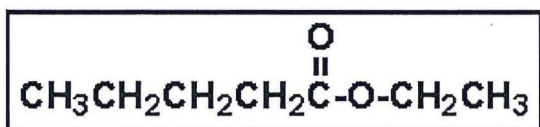
QUESTION 1: Multiple Choice Questions

[60]

- *There are 20 multiple choice questions in this section. Each question carries 3 marks.*
- *Answer ALL questions by selecting the letter of the correct answer.*
- *Choose the best possible answer for each question, even if you think there is another possible answer that is not given.*

1. Which of the following pairs does not show an acid and its conjugate base?
A. HNO_3 and NO_3^-
B. H_2SO_4 and HSO_4^-
C. H_2SO_4 and SO_4^{2-}
D. HSO_4^- and SO_4^{2-}
2. A sample of helium gas occupies 2.65 L at 1.20 atm. What pressure would this sample of gas exert in a 1.50-L container at the same temperature?
A. 3.31 atm
B. 1.20 atm
C. 2.12 atm
D. 0.679 atm
3. If the temperature of an ideal gas is raised from 100°C to 200°C , while the pressure remains constant, the volume:
A. remains the same
B. doubles
C. goes to $1/2$ the original volume
D. none of these
4. Which conditions of P and T are most ideal for a gas?
A. low P, high T
B. high P, low T
C. high P, high T
D. depends on the gas
5. Calculate the number of atoms in 54.0 g of aluminum.
A. 1.21×10^{24} atoms Al
B. 2.11×10^{21} atoms Al
C. 0.73×10^{24} atoms Al
D. 1.94×10^{24} atoms Al

6. The compound given below is called _____.



- A. butyl acetate
B. ethyl pentanoate
C. propyl pentanoate
D. ethyl butanoate
7. Which is NOT a physical property of alcohols or phenols?
A. Phenols are generally only slightly soluble in water.
B. The solubilities of normal primary alcohols in water decrease with increasing molecular weight.
C. The hydroxyl group of an alcohol is nonpolar.
D. Due to hydrogen bonding, boiling points of alcohols are much higher than those of corresponding alkanes.
8. A compound with a composition of 87.5 % N and 12.5 % H was recently discovered. What is the empirical formula for this compound?
A. NH_2
B. N_2H_3
C. NH
D. N_2H_2
9. The electronic configuration of the element whose atomic number is 26 is:
A. $1s^2 2s 2p^6 3s^2 3p^6 4s^0 3d^8$
B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4 4p^2$
10. Consider a $3d_{xz}$ orbital. Which of the following statements is incorrect?
A. The xz plane is a nodal surface.
B. The xz plane divides the electron probability distribution into two identical mirror-image halves.
C. The xy plane divides the electron probability distribution into two identical mirror-image halves.
D. The yz plane divides the electron probability distribution into two identical mirror-image halves.

11. Which of the following has the largest radius?
- A. F
 - B. N
 - C. C
 - D. O
12. What is the mass of one mole of acetylsalicylic acid (aspirin), $C_9H_8O_4$?
- A. 29 g
 - B. 196 g
 - C. 180 g
 - D. none of the above
13. Which of the following combinations of names and formulas is incorrect?
- A. H_3PO_4 phosphoric acid
 - B. HNO_3 nitric acid
 - C. $NaHCO_3$ sodium carbonate
 - D. H_2CO_3 carbonic acid
14. What is the name of NaI ?
- A. sodium iodide
 - B. sodium(I) iodide
 - C. sodium monoiodide
 - D. sodious iodide
15. The freezing point of pure camphor is $178.4\text{ }^\circ\text{C}$, and its molal freezing-point constant, K_f is $40.0\text{ }^\circ\text{C/m}$. Find the freezing point of a solution containing 3.00 g of a compound of molar mass 125 g/mol in 45.0 g of camphor.
- A. $174.1\text{ }^\circ\text{C}$
 - B. $157.1\text{ }^\circ\text{C}$
 - C. $135.2\text{ }^\circ\text{C}$
 - D. $140.4\text{ }^\circ\text{C}$
16. Which of the following is a correct description of the natural direction of a Brønsted-Lowry acid-base reaction?
- A. weaker acid + weaker base \rightarrow stronger acid + stronger base
 - B. weaker acid + stronger base \rightarrow stronger acid + weaker base
 - C. stronger acid + weaker base \rightarrow weaker acid + stronger base
 - D. stronger acid + stronger base \rightarrow weaker acid + weaker base

17. A molecule with the formula C_3H_8 is a(n):
- A. hexane
 - B. propane
 - C. decane
 - D. butane
18. The general formula for noncyclic alkenes is:
- A. C_nH_{2n}
 - B. C_nH_n
 - C. C_nH_{2n+2}
 - D. C_nH_{2n-2}
19. Standard conditions (STP) are:
- A. 0°C and 2 atm
 - B. 32°F and 76 torr
 - C. 273 K and 760 mmHg
 - D. 4°C and 7.6 mmHg
20. An object has a volume of 0.090 m^3 . Its volume given in cm^3 is
- A. 0.90
 - B. 90 000
 - C. 9000
 - D. 900

SECTION B:**[40]**

There are FOUR questions in this section. Answer all questions. Show clearly, where necessary, how you arrive at the answer as all working will carry marks.

Question 1**[15]**

1.1 A particular sample of vinegar has a pH of 2.90. If acetic acid is the only acid that vinegar contains ($K_a = 1.8 \times 10^{-5}$), calculate the concentration of acetic acid in the vinegar. (5)

1.2 A reaction requires a 500 mL solution with a pH of 2.5. What would be the mass of H_2SO_4 required to make up such solution? (5)

1.3 A 0.1044-g sample of an unknown monoprotic acid requires 22.10 mL of 0.0500 M NaOH to reach the end point. What is the molecular weight of the unknown? (5)

Question 2**[7]**

2.1 Given the equation



A 3.00-g sample of $KClO_3$ is decomposed and the oxygen at $24.0^\circ C$ and 0.982 atm is collected. What volume of oxygen gas will be collected assuming 100% yield? (4)

2.2 A balloon has a volume of 1.20 L at $24.0^\circ C$. The balloon is heated to $48.0^\circ C$. Calculate the new volume of the balloon. (3)

Question 3**[9]**

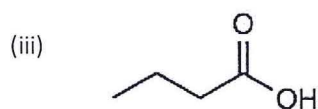
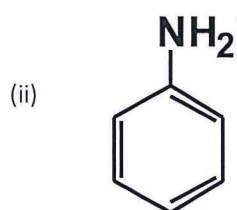
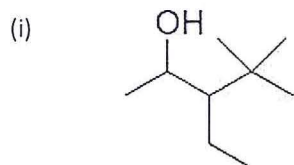
An aqueous solution is prepared by diluting 3.30 mL acetone ($d = 0.789 \text{ g/mL}$) with water to a final volume of 75.0 mL. The density of the solution is 0.993 g/mL. What is the molarity, molality and mole fraction of acetone in this solution?

Question 4

[9]

Give the IUPAC names for the following compounds:

4.1 Identify the class of the following compounds. For any alkanes, alkenes, alkynes, aromatic compounds, carboxylic acids or alcohols, provide the IUPAC name of the molecule. (6)



4.2 Draw the structural formulas for the following compounds: (3)

- a) 1-pentene
- b) 4-methylhexanoic acid
- c) 2-methyl-3-heptyne

THE END
GOODLUCK

USEFUL CONSTANTS:

Gas constant, $R = 8.3145 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} = 0.083145 \text{ dm}^3 \cdot \text{bar} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \cdot \text{K}^{-1}$

$1 \text{ Pa} \cdot \text{m}^3 = 1 \text{ kPa} \cdot \text{L} = 1 \text{ N} \cdot \text{m} = 1 \text{ J}$

$1 \text{ atm} = 101\,325 \text{ Pa} = 760 \text{ mmHg} = 760 \text{ torr}$

Avogadro's Number, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ Js}$

Speed of light, $c = 2.998 \times 10^8 \text{ ms}^{-1}$

PERIODIC TABLE OF THE ELEMENTS

1																	18
1 H 1.00794																	2 He 4.00260
	2											13	14	15	16	17	18
3 Li 6.941	4 Be 9.01218											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.179
11 Na 22.9898	12 Mg 24.305											13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.0983	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.8
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.6	53 I 126.9	54 Xe 131.29
55 Cs 132.905	56 Ba 137.33	71 Lu 174.967	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.908	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	103 Lr (260)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Uun (269)	111 Uuu (272)	112 Uub (269)		114 Uuq		116 Uuh		118 Uuo

Page 9 of 9

Lanthanides:	57 La 138.906	58 Ce 140.12	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 161.930	68 Er 167.26	69 Tm 166.934	70 Yb 173.04
---------------------	-----------------------------------	----------------------------------	-----------------------------------	----------------------------------	---------------------------------	----------------------------------	----------------------------------	----------------------------------	-----------------------------------	----------------------------------	-----------------------------------	----------------------------------	-----------------------------------	----------------------------------

Actinides:	89 Ac 227.028	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)
-------------------	-----------------------------------	-----------------------------------	-----------------------------------	----------------------------------	-----------------------------------	---------------------------------	---------------------------------	---------------------------------	---------------------------------	---------------------------------	---------------------------------	----------------------------------	----------------------------------	----------------------------------