



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 5
COURSE CODE: GNC501S	COURSE NAME: GENERAL CHEMISTRY 1A
SESSION: JULY 2022	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	DR. EUODIA HESS
MODERATOR:	DR. MARIUS MUTORWA

<p style="text-align: center;">INSTRUCTIONS</p> <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 8 PAGES (Including this front page, list of useful constants and Periodic Table)

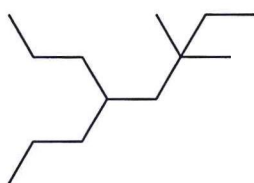
SECTION A: MULTIPLE CHOICE QUESTIONS**[60]**

- 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. What type of ions have names ending with *-ide*?
 - A. Only cations
 - B. Only anions
 - C. Only metal ions
 - D. Only gaseous ions
 2. When Group 2A elements form ions, they _____
 - A. Lose two protons
 - B. Lose two electrons
 - C. Gain two protons
 - D. Gain two electrons
 3. What is the correct name for N^{3-} ion?
 - A. Nitrate ion
 - B. Nitride ion
 - C. Nitrogen ion
 - D. Nitrite ion
 4. Aluminium is a Group 3A metal. Which ion does Al typically form?
 - A. Al^{3-}
 - B. Al^{3+}
 - C. Al^{5-}
 - D. Al^{5+}
 5. Bohr's atomic model
 - A. proposes that electrons occupy specific energy levels.
 - B. explains the emission spectra of hydrogen atoms.
 - C. predicts the energy level of multi-electron atoms
 - D. both A and B
 6. _____ orbitals are spherically symmetrical.
 - A. f
 - B. d
 - C. p
 - D. s
 7. The $n = 1$ shell contains _____ p sub-orbitals. All other shells contain _____ p sub-orbitals.
 - A. 3, 6

- B. 0, 3
C. 6, 2
D. 0, 6
8. There are _____ orbitals in the second shell.
A. 1
B. 2
C. 3
D. 4
9. An unknown amount of C_3H_8 was burned completely to H_2O and CO_2 , with 36 g of H_2O recovered.
How many moles of the hydrocarbon were originally present?
A. 0.25
B. 0.50
C. 2
D. $\frac{36}{8}$
10. A compound having an empirical formula of SO_3 is found to have a molecular weight of 80.
What is its molecular formula?
A. S_3O_9
B. S_2O_6
C. SO_3
D. SO_4
11. Balance the following reaction:
$$S + O_2 \rightarrow SO_3$$

A. $S + O_3 \rightarrow SO_3$
B. $4S + 2O_2 \rightarrow 4SO_3$
C. $2S + 3O_2 \rightarrow 2SO_3$
D. $3S + 2O_2 \rightarrow 3SO_3$
12. What is the formula weight of $Al_2(SO_4)_3$?
A. 150
B. 123
C. 342
D. 315
13. Standard conditions (STP) are:
A. $0^\circ C$ and 2 atm
B. $32^\circ F$ and 76 torr
C. 273 K and 760 mmHg
D. $4^\circ C$ and 7.6 mmHg

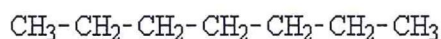
14. What is the name of the following hydrocarbon according to the IUPAC rules?



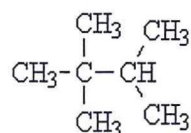
- A. 3,3-dimethyl-5-propylhexane
- B. 6,6-dimethyl-4-propyloctane
- C. 3,3-diethyl-5-propyloctane
- D. 3,3-dimethyl-5-propyloctane

15. Which of the following alkanes would have the highest boiling point?

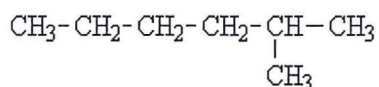
(a)



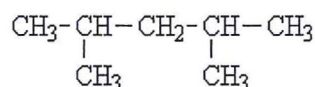
(b)



(c)



(d)

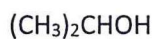


- A. (a)
- B. (b)
- C. (c)
- D. (d)

16. Which of these would be least soluble in water?

- A. octanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{-OH}$)
- B. butanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{-OH}$)
- C. pentanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{-OH}$)
- D. hexanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{-OH}$)

17. The alcohol shown below is a:



- A. Primary alcohol
- B. Secondary alcohol
- C. Tertiary alcohol
- D. Allylic alcohol

18. A hydrocarbon with the general formula $\text{C}_n\text{H}_{2n-2}$ can be:

- A. an alkyne or a cycloalkene
- B. an alkyne or a cycloalkane
- C. a cycloalkane or an alkene
- D. a cycloalkene

19. Smoke is an example of a colloid termed:

- A. a foam
- B. an aerosol
- C. a gel
- D. sol

20. What is the boiling point in °C of a solution of a 2.15 m aqueous solution of glycerol? ($K_b = 0.512^\circ\text{C}/m$)?

- A. 101.1
- B. 100.2
- C. 100
- D. 1.1

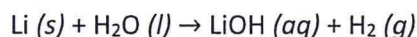
SECTION B: **[40]**

There are FIVE questions in this section. Answer all Questions.

Show clearly, where necessary, how you arrive at the answer as the working will carry marks to.

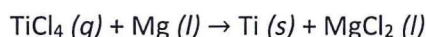
Question 1 **[10]**

a) All alkali metals react with water to produce hydrogen gas and the corresponding alkali metal hydroxide. A typical reaction is that between lithium and water:



How many grams of Li is needed to produce 9.89 g of H_2 ? (2)

b) Titanium is prepared by the reaction of titanium(IV) chloride with molten magnesium between 950°C and 1150°C .



If 3.54×10^7 g of TiCl_4 reacts with 1.13×10^7 g of Mg:

(i) Calculate the theoretical yield of Ti in grams. (6)

(ii) Calculate the percent yield if 7.91×10^6 g of Ti are actually obtained. (2)

Question 2 **[6]**

a) How many grams of potassium dichromate are required to prepare a 250 mL solution whose concentration is 2.16 M? (3)

b) Describe how you would prepare 5.00×10^2 mL of a 1.75 M sulphuric acid solution, starting with a 8.16 M stock solution. (3)

Question 3 **[8]**

a) Sulfur hexafluoride is a colorless and odourless gas. Due to its lack of chemical reactivity, it is used as an insulator in electronic equipment. Calculate the pressure (in atm) exerted by 1.82 moles of gas in a steel vessel of volume 5.43 L at 69.5°C . (2)

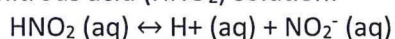
b) Calculate the volume (in L) occupied by 7.40 g of ammonia at STP. (2)

c) A flammable gas made up of carbon and hydrogen is found to effuse through a porous barrier in 1.50 min. Under the same conditions and pressure it takes an equal volume of bromine vapour 4.73 min to effuse through the same barrier. Calculate the molar mass of the unknown gas. (4)

Question 4 [12]

a) Calculate the pH of (i) a 1.0×10^{-3} M HCl solution and (ii) 0.020 M $\text{Ba}(\text{OH})_2$ solution. (6)

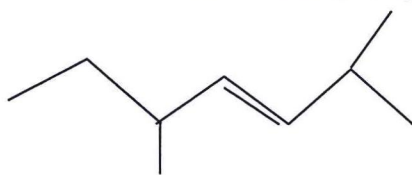
b) Calculate the pH of a 0.036 M nitrous acid (HNO_2) solution: (6)



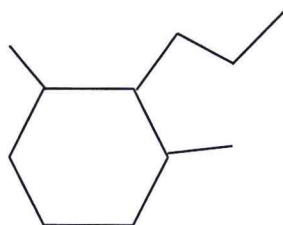
Question 5 [4]

a) Write the IUPAC names of the following compounds: (2)

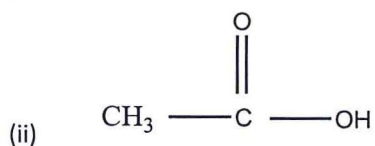
(i)



(ii)



(b) State the functional group in each of the following compounds: (3)



END OF EXAMINATION

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

