# namibia university
## OF SCIENCE AND TECHNOLOGY
## FACULTY OF HEALTH AND APPLIED SCIENCES

### DEPARTMENT OF NATURAL AND APPLIED SCIENCES

| QUALIFICATION: BACHELOR OF SCIENCE | |
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| QUALIFICATION CODE: 07BOSC | LEVEL: 5 |
| COURSE CODE: GNC501S | COURSE NAME: GENERAL CHEMISTRY 1A |
| SESSION: JULY 2019 | PAPER: THEORY |
| DURATION: 3 HOURS | MARKS: 100 |

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

| INSTRUCTIONS |
|---|
| 1. Answer ALL the questions. |
| 2. Write clearly and neatly. |
| 3. Number the answers clearly |
| 4. All written work must be done in blue or black ink and sketches can be done in pencil |
| 5. 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 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. When naming a transition metal ion that can have more than one common ionic charge, the numerical value of the charge is indicated by a:

   A. Prefix
   B. Suffix
   C. Roman numeral following the name
   D. Superscript after the name

2. In which of the following are the symbol and name for the ion given correctly?

   A. $Fe^{2+}$ ferrous ion
   B. $Sn^{2+}$ tin (III) ion
   C. $Co^{2+}$ cobaltous ion
   D. $Pb^{2+}$ lead ion

3. What is the correct name for $Sn_3(PO_4)_2$?

   A. tritin diphosphate
   B. tin(III) phosphate
   C. tin(II) phosphate
   D. tin(IV) phosphate

4. What is the correct formula for calcium dihydrogen phosphate?

   A. $Ca(H_2PO_4)_2$
   B. $Ca_2H_2PO_4$
   C. $Ca_2H_2HPO_4$
   D. $Ca_2(H_2PO_4)$

5. Which one of the following Name-Formula combinations is NOT correct (is FALSE)?

   A. Mercury (I) chloride, $Hg_2Cl_2$
   B. Dinitrogen trioxide, $N_2O_3$
   C. Hydrogen chloride, $HCl$
   D. Cerium (IV) phosphate, $Ce_4(PO_4)_3$

6. For a particular organic compound, which of the following pairs can represent the empirical and the molecular formulas, respectively?
   A. $CH$ and $CH_4$
   B. $CH$ and $C_6H_6$
   C. $CH_2$ and $C_2H_2$
   D. $CH_2$ and $C_2H_3$

7. The percent manganese in potassium manganate, $K_2MnO_4$, is:
   A. 13.2%
   B. 27.9%
   C. 29.0%
   D. 34.8%

8. What external pressure must be supplied to compress 2.76 L of a gas at 298K and 0.878 atm to 2.00 L at 298K?

   A. 484 mmHg
   B. 921 mmHg
   C. 760 mmHg
   D. 878 mmHg

9. At STP, 4 moles of $CO_2$ gas occupies:

   A. 20.4 L
   B. 22.4 L
   C. 89.6 L
   D. 2.24 L

10. If 0.250 mol of He(g), 0.500 mol of Ne(g) and 0.150 mol of Ar(g) are transferred to a previously empty 5.00 L container at 25°C, what is the final pressure in the container?
    A. 4.40 atm
    B. 2.86 atm
    C. 5.72 atm
    D. 3.81 atm

11. If a mixture of noble gases consists of 0.150 mole of He, 0.450 mole of Ne, and 0.300 mole of Ar, what is the mole fraction of Ar in this mixture?

    A. 0.300
    B. 0.500
    C. 0.667
    D. 0.333

12. A solution is prepared by dissolving 0.100 mole of HCl in 75.0 g of water. Calculate the mass percent HCl in this solution.

    A. 0.133%
    B. 4.64%
    C. 4.87%
    D. 4.01%

13. To what volume, mL, must 50.0 mL of 3.50 M $H_2SO_4$ be diluted in order to make 2 M $H_2SO_4$?

    A. 25
    B. 60.1
    C. 87.5
    D. 93.2

14. A solution is prepared by dissolving 20.0 g of NaOH in 750 g. of water. The molality of this solution is?

    A. 1 m
    B. 26.7 m
    C. 0.0267 m
    D. 0.667 m

15. Calculate the freezing point in °C of a solution containing 0.0100 mole of a non-electrolyte in 100.0 g of water ($K_f$ of water = 1.86 °C/m).

    A. -0.186
    B. +0.186
    C. 0.010
    D. -0.010

16. What is the best name for the following compound?
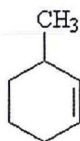


    A. 2-methylcyclohexene
    B. 2-methylcyclohexene
    C. 1-methylcyclohex-2-ene
    D. 3-methylcyclohexene

17. The condensed structural formula for 2,2-dimethylbutane is:

    A. $CH_3C(CH_3)_2CH_2CH_3$
    B. $C_6H_{14}$
    C. $CH_3CH(CH_3)CH(CH_3)CH_3$
    D. $C_3H_7$

18. Which one of the following is the correct structural formula for cyclohexane?
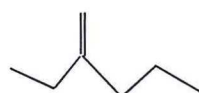
    A.  $C_6H_{12}$
    B.  $C_5H_{10}$
    C.  $C_6H_{14}$
    D.  $C_6H_{10}$

19. Which of the following is the general formula of the alkynes?

    A.  $C_nH_{2n}$
    B.  $C_nH_n$
    C.  $C_nH_{2n+2}$
    D.  $C_nH_{2n-2}$

20. What is the best name for the following compound?

    A.  3-methylenehexane

    B.  2-propyl-1-butene

    C.  4-ethyl-4-pentene

    D.  2-ethyl-1-pentene

## 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.
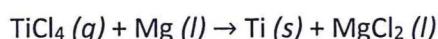
## Question 1 [10]

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

$$Li \ (s) + H_2O \ (l) \rightarrow LiOH \ (aq) + H_2 \ (g)$$

How many grams of Li are needed to produce 9.89 g of $H_2$? (3)

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

$$TiCl_4 \ (g) + Mg \ (l) \rightarrow Ti \ (s) + MgCl_2 \ (l)$$

$3.54 \times 10^7$ g of $TiCl_4$ are reacted with $1.13 \times 10^7$ g of Mg.

(i) Calculate the theoretical yield of Ti in grams (5)

(ii) Calculate the %yield if $7.91 \times 10^6$ g of Ti are actually obtained. (2)

**Question 2** [7]

An aqueous solution that contains 571.6 g sulphuric acid ($H_2SO_4$) in one liter of solution has a density of 1.329 gcm$^{-3}$. Calculate the following for the $H_2SO_4$:

(a) Molarity (1)

(b) Mass percent (2)

(c) Molality (2)

(d) Mole fraction (2)

**Question 3** [14]

a) Ethylene glycol $CH_2(OH)CH_2(OH)$ is a common automobile antifreeze. It is water soluble and non-volatile (b.p 197°C). Calculate the freezing point of a solution containing 651 g of this substance 2505 g of water. ($K_f = 1.86°C/m$) (7)

b) The average osmotic pressure of seawater is about 30.0 atm at 25 °C. Calculate the molar concentration of an aqueous solution of sucrose ($C_{12}H_{22}O_{11}$) that is isotonic with seawater. (4)

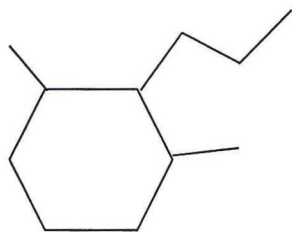c) What are the factors that affect solubility? (3)

**Question 4** [9]

Give the IUPAC names for the following compounds:

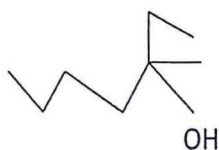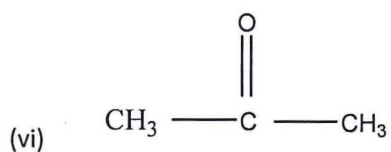(a) Write the IUPAC names of the following compounds: (3)
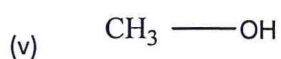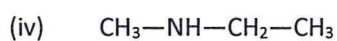
(i)

(ii)
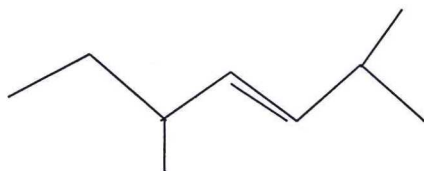
OH
(iii)

(b) State the functional group in each of the following compounds: (6)

(i) $CH_3$——O——$CH_3$

(ii) $CH_3$——$\overset{\overset{\displaystyle O}{\|}}{C}$——OH

(iii) $CH_3$——$\overset{\overset{\displaystyle O}{\|}}{C}$——$OCH_3$

(iv) $CH_3-NH-CH_2-CH_3$

(v) $CH_3$——OH

(vi) $CH_3$——$\overset{\overset{\displaystyle O}{\|}}{C}$——$CH_3$
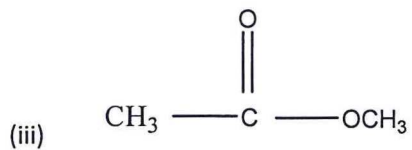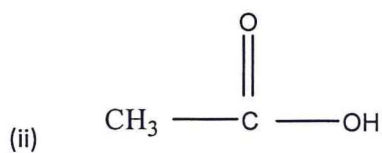
**THE END**

**GOODLUCK**

**USEFUL CONSTANTS:**

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

$1 \ Pa \cdot m^3 = 1 \ kPa.L = 1 \ N \cdot m = 1 \ J$

$1 \ atm = 101 \ 325 \ Pa = 760 \ mmHg = 760 \ torr$

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

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

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

# PERIODIC TABLE OF THE ELEMENTS

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

Lanthanides:

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

Actinides:

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