UNAM
UNIVERSITY OF NAMIBIA

FACULTY	AGRICULTURE, ENGINEERING AND NATURAL SCIENCE		
SCHOOL	SCIENCE		
DEPARTMENT	PHYSICS, CHEMISTRY & MATERIAL SCIENCE		
SUBJECT	CHEMISTRY SUPPORT I & Chemistry 1A		
SUBJECT CODE	S3431CS & CHM3511		
DATE	JUNE 2026		
DURATION	3 HOURS	MARKS	115

FIRST OPPORTUNITY EXAMINATION

Examiner: Mrs T. Amakali, Mrs H. Stuurmann, Ms H. Iipinge, Dr. W. Nashidengo
Internal Moderator: Mr G. Uiseb

This Question Paper consists of **5 pages** including this cover page.

Instructions

- Clearly indicate **your module code** on the answer book
- You must answer all the questions
- Number your questions correctly.
- Write neatly and legibly
- Show all calculations and equations.

UNIVERSITY OF NAMIBIA EXAMINATIONS

Useful information information:

$N_A = 6.022\times10^{23}$ $c = 3.00\times10^{8}\ m/s$ $hcR_H = 2.18\times10^{-19}\ J$ $h = 6.63\times10^{-34}\ J.s$

Question 1 [25 marks]

1.1 State whether each of the following statement is **True** or **False**: [5]

a) The process by which iodine crystals changes directly to gas is called deposition.
b) Silane is an example of a homogeneous mixture.
c) Expressing a number in scientific notation removes ambiguity as to the significant figures.
d) The fact that diamond is hard describes its intensive property.
e) When the measurement '0.3450 m is correctly rounded off to 2 significant figures it becomes 0.35 m.

1.2 Report the answers to the following calculations with correct number of significant figures. [4]

a) (19.67 cm - 12.2 cm)(3.99) / (1.36 cm + 11.366 cm) =

b) 0.0021 cm^3 + 1.060 cm^3

1.3 A typical mercury thermometer has a mass of 5.3×10^2 mg of mercury in it. What volume of mercury (**in mL**) is in the thermometer, (density of mercury is 13.6 g/mL)? [4]

1.4 A water bath used to incubate enzyme samples is set to **37.0 °C**, the standard biological temperature. Convert **37.0 °C** to **°F**. [3]

1.5 A certain isotope has 25 protons and a mass number of 55 and a charge of +3 [4]

a) How many neutrons does it have?
b) Write its nuclear symbol

1.6 Copper has two isotopes: Cu-63: abundance = **69.17%**; and Cu-65: mass = **64.927 u** with the abundance of **30.83 u**. The average atomic mass of Copper = **63.55 amu**. Calculate the **mass of the Cu-63 isotope**. [5]

Question 2 [29 marks]

2.1 Write the correct chemical **formula** or **IUPAC name** of the compounds given below: [5]

a) hypochlorous acid
b) calcium nitride
c) $Cu(NO_3)_2{\cdot}3H2O$
d) P_2O_3
e) MnO_2

2.2 Balance and classify the following reactions [4]

a) $C\ell_2(g) + KBr(aq) \rightarrow KC\ell(aq) + Br_2$
b) $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$

2.3 Calculate the mass [in grams (g)] of carbon in 3.78×10^{22} molecules of C_3H_8. [4]

2.4 Adipic acid is used as a gelling aid in the production of gelatine. The composition of this acid is 49.3g C, 6.90 g H and 43.8 g O by mass. What is the empirical formula? [9]

2.5 Magnesium reacts with hydrochloric acid to form magnesium chloride:

$$Mg(s) + 2\ HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

A sample of 2.50 g Mg was reacted with 6.00 g $HC\ell$,

a) Find the limiting reactant? [5]
b) Calculate the theoretical yield of $MgC\ell_2$. [2]

Question 3 [21 marks]

3.1 For the reaction between aqueous solutions of sodium hydroxide (NaOH) and Zinc chloride ($ZnC\ell_2$), write:

a) the balanced molecular equation indicating all the phases. [2]
b) the ionic equation. [2]
c) the net ionic equation. [2]

3.2 Commercial HNO_3 is 15.6 M HNO_3. If 5.00 mL of this acid was diluted to a final volume of 250.00 mL, calculate the concentration of the new solution. [2]

3.3 Calculate the molar concentration of the $C\ell^-$ ions in a solution prepared by dissolving 3.50 g $A\ell C\ell_3$ in sufficient water to form 25.0 mL of solution. [4]

3.5 Work out the oxidation number of **Cℓ** in the following species: [4]

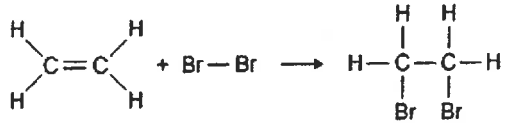
a) Na**Cℓ** b) Na**Cℓ**O c) Na**Cℓ**O_3 d) **Cℓ**$_2$

3.6 Write the conjugate acid of the following bases: [5]

a) H_2O
b) HCO_3^-
c) $H_2PO_4^-$
d) NH_3
e) NO_3^-

Question 4 [23 marks]

4.1 Using the table of average bond energies below, calculate the ΔH_{rxn} for the reaction below: [5]



Bond:	C–C	C=C	Br-Br	H-Br	C-Br	C-H
Bond ΔH_{rxn} (kJ/mol):	348	614	193	368	276	413

4.2 Give the maximum number orbitals in an atom that can have a quantum number $n = 5$. [2]

4.3 Consider the subshell with quantum numbers n = 4 and $\ell = 2$? [3]

a) What is the designation for this subshell?

b) How many orbitals are in this subshell?

c) Write the values of $m\ell$ for each of these orbitals.

4.4 What are the four quantum numbers for the last electron added to the lithium atom? [3]

4.5 Electromagnetic radiation at the blue end of the visible spectrum has a wavelength of 400. nm. Calculate the energy of one photon of this radiation. [4]

4.6 Write the electron configurations using orbital diagram representations of the species given below and state whether they are diamagnetic or paramagnetic. [6]

a) P^{3-} b) N

Question 5 [17 marks]

5.1 Draw the three resonance structures of the NO_3^- ion: [3]

5.2 State whether the following statement are true or false. [3]

a) Molecules with unpaired electrons are diamagnetic.

b) Sigma bonds are formed as a result of side-by-side overlap of atomic orbitals.

c) A double bond consists of one pi bond.

5.3 In a certain molecule, the central atom has three lone pairs and two bonds. What will the electron domain geometry and molecular shape geometry be? [2]

5.4 a) Draw the Lewis structure of NOCℓ and state the hybridization of the central atom. [3]

b) What is the molecular geometry of the NOCℓ molecule? [2]

5.5. Write the molecular orbital electron configuration of the Li_2 molecule and calculate its bond order. [4]

Periodic Table of the Elements

1																	18
1 H 1.01	2											13	14	15	16	17	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 51.99	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-71	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po [208.98]	85 At 209.99	86 Rn 222.02
87 Fr 223.02	88 Ra 226.03	89-103	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [269]	109 Mt [278]	110 Ds [281]	111 Rg [280]	112 Cn [285]	113 Nh [286]	114 Fl [289]	115 Mc [289]	116 Lv [293]	117 Ts [294]	118 Og [294]

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 144.91	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.06	71 Lu 174.97
89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu 244.06	95 Am 243.06	96 Cm 247.07	97 Bk 247.07	98 Cf 251.08	99 Es [254]	100 Fm 257.10	101 Md 258.1	102 No 259.10	103 Lr [262]