



UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science
BACHELOR OF SCIENCE IN ENVIRONMENTAL HEALTH

RE-SIT EXAMINATION PAPER 2019

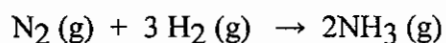
TITLE OF PAPER	:	CHEMISTRY FOR HEALTH SCIENCES
COURSE CODE	:	EHS111
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	:	ANSWER <u>ANY FOUR</u> QUESTIONS
	:	EACH QUESTION <u>CARRIES 25</u> MARKS.
	:	WRITE NEATLY & CLEARLY
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM.
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE

- a. Elements in the modern version of the periodic table are arranged in order of increasing _____ . **[2 Marks]**

- b. Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:

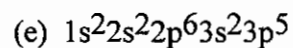
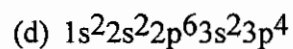
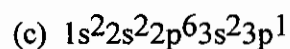
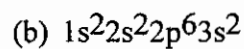
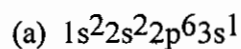


A 9.3-g sample of nitrogen requires _____ g of H_2 for a complete reaction.

[8 Marks]

- c. What is the mass of 8.12×10^{19} atoms of magnesium sulphate? **[6 Marks]**

- d. Consider the following electron configurations to answer the questions that follow:



- (i) The electron configuration belonging to the atom with the highest second ionization energy is _____.

- (ii) The electron configuration that belongs to the atom with the lowest second ionization energy is _____.

- (iii) The electron configuration of the atom with the most negative electron affinity is _____.

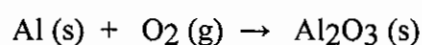
[3 × 3 Marks]

QUESTION TWO

- a. An unknown element is found to have three naturally occurring isotopes with atomic masses of 35.9675 (0.337%), 37.9627 (0.063%), and 39.9624 (99.600%).

[8 Marks]

- b. Solid aluminum and gaseous oxygen react in a combination reaction to produce aluminum oxide:



In a particular experiment, the reaction of 2.5 g of Al with 2.5 g of O₂ produced 3.45 g of Al₂O₃.

- (i) Balance the chemical reaction equation. [3 Marks]
(ii) What is the % yield of the reaction? [5 Marks]
(iii) Identify the limiting reagent. [3 Marks]

- c. Draw the Lewis structures for the following compounds:

- (i) PF₃
(ii) H₂SO₄ [6 Marks]

QUESTION THREE

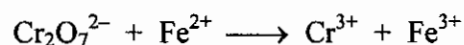
- a. Which of the following acids is the weakest and the strongest acid?

- (i) HF ($K_a = 6.8 \times 10^{-4}$)
(ii) HClO ($K_a = 3.0 \times 10^{-8}$)
(iii) HNO₂ ($K_a = 4.5 \times 10^{-4}$)
(iv) HCN ($K_a = 4.9 \times 10^{-10}$)

(v) Acetic acid ($K_a = 1.8 \times 10^{-5}$)

[4 Marks]

b. Balance the following redox reaction equation in both acidic and basic media. In your answer, identify the oxidizing and reducing agent and show how oxidation numbers were assigned to each compound/ion.



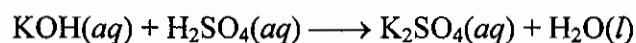
[18 Marks]

c. The formula of palladium(IV) sulfide is _____.

[3 Marks]

QUESTION FOUR

a. Eighteen grams (18.0 g) of potassium hydroxide are dissolved in 850.0 mL of deionised water. The resulting solution reacts with sulfuric acid according to the following equation:



(i) Determine the number of moles in the KOH solution? [3 Marks]

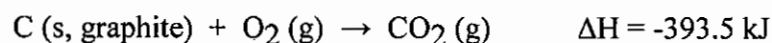
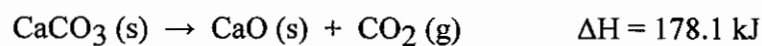
(ii) Calculate the number of moles/L of the sulfuric acid solution if 500.0 mL of the KOH reacts with 800.0 mL of the acid. [5 Marks]

(iii) Give the IUPAC name of the sulfur-containing product. [3 Marks]

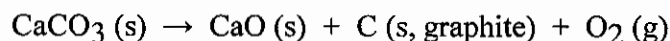
b. A certain alcohol contains only three elements, carbon, hydrogen, and oxygen. Combustion of a 15.00 gram sample of the alcohol produced 28.65 grams of CO_2 and 17.61 grams of H_2O . What is the empirical formula of the alcohol?

[9 Marks]

c. Given the following reactions



the enthalpy of the reaction

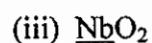
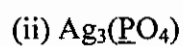
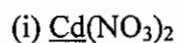


is _____ kJ.

[5 Marks]

QUESTION FIVE

a. Give the charge and electron configuration on the ion which is underlined in the following compounds:



[3 × 3 Marks]

b. State the first law of thermodynamics.

[3 Marks]

c. Electronegativity _____ from left to right within a period and _____ from top to bottom within a group.

[3 Marks]

d. Complete the following statements;

(i) Accuracy refers to _____.

(ii) A separation process that depends on differing abilities of substances to form gases is called _____.

(iii) A common English set of units for expressing velocity is miles/hour. The SI unit for velocity is _____.

(iv) Gold has a density of 0.01932 kg/cm^3 . What volume (in cm^3) would be occupied by a 33.3 g sample of gold?

(v) Aluminum reacts with a certain nonmetallic element to form a compound with the general formula Al_2X_3 . Element X must be from Group _____ of the Periodic Table of Elements.

[2 × 5 Marks]

General data and fundamental constants

Quantity	Symbol	Value
Speed of light	c	$2.997\ 924\ 58 \times 10^8 \text{ m s}^{-1}$
Elementary charge	e	$1.602\ 177 \times 10^{-19} \text{ C}$
Faraday constant	$F = N_A e$	$9.6485 \times 10^4 \text{ C mol}^{-1}$
Boltzmann constant	k	$1.380\ 66 \times 10^{-23} \text{ J K}^{-1}$
Gas constant	$R = N_A k$	$8.314\ 51 \text{ J K}^{-1} \text{ mol}^{-1}$ $8.205\ 78 \times 10^{-2} \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$ $6.2364 \times 10 \text{ L Torr K}^{-1} \text{ mol}^{-1}$
Planck constant	h $\hbar = h/2\pi$	$6.626\ 08 \times 10^{-34} \text{ J s}$ $1.054\ 57 \times 10^{-34} \text{ J s}$
Avogadro constant	N_A	$6.022\ 14 \times 10^{23} \text{ mol}^{-1}$
Atomic mass unit	u	$1.660\ 54 \times 10^{-27} \text{ Kg}$
Mass		
electron	m_e	$9.109\ 39 \times 10^{-31} \text{ Kg}$
proton	m_p	$1.672\ 62 \times 10^{-27} \text{ Kg}$
neutron	m_n	$1.674\ 93 \times 10^{-27} \text{ Kg}$
Vacuum permittivity	$\epsilon_0 = 1/c^2 \mu_0$ $4\pi\epsilon_0$	$8.854\ 19 \times 10^{-12} \text{ J}^{-1} \text{ C}^2 \text{ m}^{-1}$ $1.112\ 65 \times 10^{-10} \text{ J}^{-1} \text{ C}^2 \text{ m}^{-1}$
Vacuum permeability	μ_0	$4\pi \times 10^{-7} \text{ J s}^2 \text{ C}^{-2} \text{ m}^{-1}$ $4\pi \times 10^{-7} \text{ T}^2 \text{ J}^{-1} \text{ m}^2$
Magneton		
Bohr	$\mu_B = e\hbar/2m_e$	$9.274\ 02 \times 10^{-24} \text{ J T}^{-1}$
nuclear	$\mu_N = e\hbar/2m_p$	$5.050\ 79 \times 10^{-27} \text{ J T}^{-1}$
g value	g_e	2.002 32
Bohr radius	$a_0 = 4\pi\epsilon_0\hbar/m_e e^2$	$5.291\ 77 \times 10^{-11} \text{ m}$
Fine-structure constant	$\alpha = \mu_0 e^2 c/2h$	$7.297\ 35 \times 10^{-3}$
Rydberg constant	$R_\infty = m_e e^4/8h^3 c \epsilon_0^2$	$1.097\ 37 \times 10^7 \text{ m}^{-1}$
Standard acceleration of free fall	g	$9.806\ 65 \text{ m s}^{-2}$
Gravitational constant	G	$6.672\ 59 \times 10^{-11} \text{ N m}^2 \text{ Kg}^{-2}$

Conversion factors

1 cal	=	4.184 joules (J)	1 erg	=	$1 \times 10^{-7} \text{ J}$
1 eV	=	$1.602\ 2 \times 10^{-19} \text{ J}$	1 eV/molecule	=	96 485 kJ mol ⁻¹

Prefixes	f	p	n	μ	m	c	d	k	M	G
	femto	pico	nano	micro	milli	centi	deci	kilo	mega	giga
	10^{-15}	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^3	10^6	10^9

GROUPS

PERIODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII B	VIIIB		IB	II B	IIIA	IVA	VA	VIA	VIIA	VIIIA	
1	1.008 H																		4.003 He
2	6.941 Li	9.012 Be											10.811 B	12.011 C	14.007 N	15.999 O	18.998 F	20.180 Ne	
3	22.990 Na	24.305 Mg											26.982 Al	28.086 Si	30.974 P	32.06 S	35.453 Cl	39.948 Ar	
4	39.098 K	40.078 Ca	44.956 Sc	47.88 Ti	50.942 V	51.996 Cr	54.938 Mn	55.847 Fe	58.933 Co	58.69 Ni	63.546 Cu	65.39 Zn	69.723 Ga	72.61 Ge	74.922 As	78.96 Se	79.904 Br	83.80 Kr	
5	85.468 Rb	87.62 Sr	88.906 Y	91.224 Zr	92.906 Nb	95.94 Mo	98.907 Tc	101.07 Ru	102.91 Rh	106.42 Pd	107.87 Ag	112.41 Cd	114.82 In	118.71 Sn	121.75 Sb	127.60 Te	126.90 I	131.29 Xe	
6	132.91 Cs	137.33 Ba	138.91 *La	178.49 Hf	180.95 Ta	183.85 W	186.21 Re	190.2 Os	192.22 Ir	195.08 Pt	196.97 Au	200.59 Hg	204.38 Tl	207.2 Pb	208.98 Bi	(209) Po	(210) At	(222) Rn	
7	223 Fr	226.03 Ra	227 **Ac	(261) Rf	(262) Ha	(263) Unh	(262) Uns	(265) Uno	(266) Une	(267) Uun									

TRANSITION ELEMENTS

140.12 Ce	140.91 Pr	144.24 Nd	(145) Pm	150.36 Sm	151.96 Eu	157.25 Gd	158.93 Tb	162.50 Dy	164.93 Ho	167.26 Er	168.93 Tm	173.04 Yb	174.97 Lu
232.04 Th	231.04 Pa	238.03 U	237.05 Np	(244) Pu	(243) Am	(247) Cm	(247) Bk	(251) Cf	(252) Es	(257) Fm	(258) Md	(259) No	(260) Lr

* Lanthanide Series

** Actinide Series

() indicates the mass number of the isotope with the longest half-life.