

**THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY**

**FIRST SEMESTER EXAMINATION – 2020**

**APPLIED SCIENCES DEPARTMENT  
FOOD TECHNOLOGY - FIRST YEAR DEGREE**

**AS113 - CHEMISTRY FOR APPLIED SCIENCES**

**MONDAY 15<sup>TH</sup> JUNE 2020 12:50 PM**

**TIME ALLOWED: 3 HOURS**

**STUDENT NAME:** \_\_\_\_\_

**STUDENT NO:** \_\_\_\_\_

**COURSE:** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

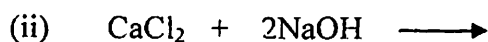
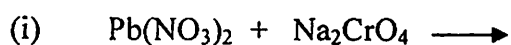
**INFORMATION FOR CANDIDATES**

1. You have 10 minutes to read the paper. You must not begin writing in the examination paper during this time.
2. **ANSWER ALL QUESTIONS**
3. Answers must be written on the spaces provided. Show all workings and calculations for each step in a question in the space provided.
4. Write your name, number and course clearly on this page where indicated. **Do it now.**
5. Calculators are permitted in the examination room. Notes, textbooks, bags, **MOBILE PHONES** and electronic devices are **NOT** allowed.

**TOTAL [100 MARKS]**

- 1 (a) (i) What are the combinations that exist between binary ionic and binary covalent compounds? [2 marks]
- (ii) Explain the naming rule for acids bearing oxygen atom. [2 marks]
- (b) For the following chemical statements, write out the corresponding balanced chemical equations including their appropriate states.
- (i) Formation of sodium chloride by direct combination of the elements including states. [2 marks]
- (ii) When water is electrolysed it decomposes into its constituent elements. [2 marks]
- (iii) Heating potassium chlorate to form oxygen, leaves solid potassium chloride. [2 marks]
- (c) A solution of lead (II) nitrate is added to a solution of sodium chloride and lead chloride precipitates.
- (i) Write out the conventional equation of the reaction. [2 marks]
- (ii) Write the corresponding ionic equation of the reaction. [2 marks]
- (iii) Write the net ionic equation of the reaction. [2 marks]

- (d) Using solubility guidelines (attached) complete and balance the equations below and predict if these are precipitation reactions or not. [4 marks]



- (iii) Iron (III) bromide in aqueous solution is mixed with an aqueous solution of sodium sulphide. Write a balanced equation and predict if it is a precipitation reaction or not. [3 marks]

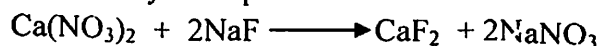
(Total = 23 Marks)

2. (a) What would be the weight in grams of  $2.70 \times 10^{24}$  Fe atoms? [3 marks]

- (b) (i) How many moles of oxygen are required to burn 2.40 moles of propane,  $\text{C}_3\text{H}_8$ . [4 marks]

- (ii) Calculate the average atomic weight of potassium (K) at 93.1%  $\text{K-39}$  (amu = 38.96371), 0.00118%  $\text{K-40}$  (amu = 39.974) and 6.88%  $\text{K-41}$  (amu = 40.96184). [2 marks]

- (c) A solution containing 29.0 grams of calcium nitrate is added to a solution containing 33.0 grams of sodium fluoride. Calcium fluoride precipitates as shown by the equation.

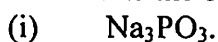


- (i) How many grams of calcium fluoride will precipitate? [5 marks]

- (ii) How many grams of which reactant are in excess? [3 marks]

**(Total = 17 Marks)**

3. (a) Determine the oxidation number of P in each of the formula below.



- (ii)  $\text{H}_2\text{PO}_4^-$  [4 marks]

- (b) Combine the half reactions below to produce a balanced redox equation. Identify also the oxidation half-reaction and reduction half-reaction. [3 marks]



- (c) For the follow formulas,  $\text{H}_2\text{O}$ ,  $\text{PBr}_3$ ,  $\text{HCN}$ ;

- (i) Write Lewis structures. [6 marks]

- (ii) Determine the formal charge of each of the constituent elements of each compound above. [7 marks]

**(Total = 20 Marks)**

4. (a) Define

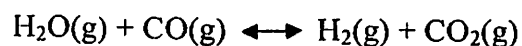
(i) Avogadro's Law.

(ii) Gay-Lussac's Law.

(iii) Dalton's Law of Partial Pressure. [3 marks]

(b) 1.44 liters of gas at 0.935 atmosphere are compressed to a volume of 0.275 litres. Find the new pressure in atm. [2 marks]

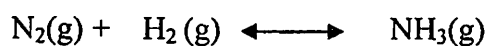
(c) For the equation below at equilibrium in a closed vessel, how would the concentrations of each products and reactants compare to the original concentrations if adjustment is made to one.



(i) If CO is added.

(ii) If CO<sub>2</sub> is added. [4 marks]

- (d) Write the equilibrium constant ( $K_c$ ) expression involving concentration for the equation below. **Note the equation is not balanced.** [2 marks]



- (e)  $\text{CaCO}_3$  reacts with  $\text{HCl}$  to produce  $\text{CO}_2$ . Sketch a graphical representation of the production of  $\text{CO}_2$  at high and low temperatures. [4 marks]

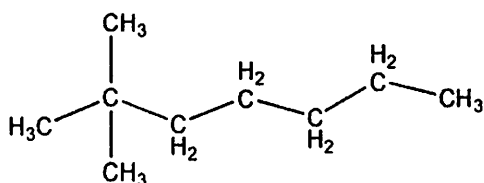
- (f) (i) Why is it important to soften hard water for steam generation in a boiler for industrial use? [2 marks]

- (ii) Write the pH expression in terms of hydrogen ion concentration. [1 mark]

- (iii) Using the expression for ionic product of water, calculate the pH of  $2 \times 10^{-3}$  moles/L of  $\text{NaOH}$ . [2 marks]

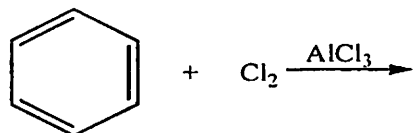
**(Total = 20 Marks)**

5. (a) (i) Based on the IUPAC rule, name the structure below. [3 marks]



(ii) Draw the structure of 2,2,4-trimethylhexane. [3 marks]

(iii) Complete the equation below. [2 marks]



(b) Draw the structure of;

(i) 3-methyl-1-pentanol.

(ii) diethyl ether. [2 marks]

(c) Define

(i) Biochemistry.

(ii) Metabolism. [2 marks]

(d) (i) Which biochemical compounds are classified as lipids? Give an example one such class of compounds. [2 marks]

(ii) What are the three key roles lipids play in the body? [3 marks]

(e) Briefly explain the functions of the following carbohydrates.

(i) Starch.

(ii) Glycogen.

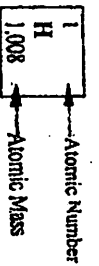
(iii) Cellulose.

[3 marks]

**(Total = 20 Marks)**



# Periodic Table of Elements



Group	Period																			
	1	2	Transition Elements										11	12	13	14	15	16	17	18
	I	II	3	4	5	6	7	8	9	10	11	12	III	IV	V	VI	VII	VIII		
1	H 1.008																			
2	Li 6.941	Be 9.012											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18		
3	Na 22.99	Mg 24.31	Al 26.98	Si 28.09	P 30.97	S 32.06	Cl 35.45	Ar 39.95												
4	K 39.10	Ca 40.08	Sc 44.96	Ti 47.90	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.70	Cu 63.55	Zn 65.38	Ga 69.72	Ge 72.59	As 74.92	Se 78.96	Br 79.90	Kr 83.80		
5	Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc (98)	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.4	In 114.8	Sn 118.7	Sb 121.8	Te 127.6	I 126.9	Xe 131.3		
6	Cs 132.9	Ba 137.3	La* 138.9	Hf 178.5	Ta 180.9	W 183.9	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197.0	Hg 200.6	Tl 204.4	Pb 207.2	Bi 209.0	Po (209)	At (210)	Rn (222)		
7	Fr (223)	Ra (226.0)	Ac* (227)	Unq	Unp	Uuh	Uns	Uno	Uue											

*Lanthanides										*Actinides																	
58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu
140.1		140.9		144.2		(145)		(150.4)		152.0		157.3		158.9		162.5		164.9		167.3		168.9		173.0		175.0	
90	Tb	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr
232.0		(231)		238.0		(244)		(242)		(243)		(247)		(247)		(251)		(252)		(257)		(258)		(259)		(260)	

Avogadro's number =  $6.022 \times 10^{23}$       GAS CONSTANT,  $R = 0.0821 \text{ L.atm/K.mol}$  or  $8.31 \text{ kPa dm}^3 \text{ K}^{-1}$       STP at  $0^\circ \text{C}$  (273 K) and 1 atm (760 mm Hg)  
 $c = 2.9979 \times 10^8 \text{ m/s}$       Planck's constant =  $6.626 \times 10^{-34} \text{ J.s}$

1. Salts of the alkali metals are soluble.
2. Ammonium  $\text{NH}_4^+$  salts are soluble.
3. Salts containing nitrate ( $\text{NO}_3^-$ ), chlorate ( $\text{ClO}_3^-$ ), Perchlorate ( $\text{ClO}_4^-$ ) and acetate ( $\text{C}_2\text{H}_3\text{O}_2^-$ ) are soluble.
4. All chlorides ( $\text{Cl}^-$ ), bromides ( $\text{Br}^-$ ) and iodides ( $\text{I}^-$ ) are soluble except for those of  $\text{Pb}^{2+}$ ,  $\text{Hg}_2^{2+}$  and  $\text{Ag}^+$  which are insoluble.
5. All sulfates ( $\text{SO}_4^{2-}$ ) are soluble except for those of  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Hg}^{2+}$ , and  $\text{Pb}^{2+}$  which are insoluble. The sulfate salts of  $\text{Ca}^{2+}$  and  $\text{Ag}^+$  are moderately soluble.
6. All hydroxides ( $\text{OH}^-$ ) are insoluble except for those of the alkali metals, which are soluble, and the hydroxides of  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$  and  $\text{Sr}^{2+}$  which are moderately soluble.
7. All sulfites ( $\text{SO}_3^{2-}$ ), carbonates ( $\text{CO}_3^{2-}$ ), chromates ( $\text{CrO}_4^{2-}$ ), and phosphates ( $\text{PO}_4^{3-}$ ) are insoluble except for those of  $\text{NH}_4^+$  and the alkali metals, which are soluble.
8. All sulfides ( $\text{S}^{2-}$ ) are insoluble except for those of  $\text{NH}_4^+$ , the alkali metals and the alkaline earths which are soluble.