THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS

CH312 GEOCHEMISTRY/MINERAL TECHNOLOGY

FRIDAY 03RD JUNE, 2022 – 08:20 A.M.

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES:

1. You have ten minutes to read the paper. You must not begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS.**
3. All answers must be written in the answer book provided.
4. Calculators are permitted in the examination room.
5. **NOTES, MOBILE PHONES AND TEXTBOOKS ARE NOT ALLOWED.**
6. Show all workings and calculations in the answer book.
7. **DRAW** any **FIGURES** clearly and visibly.
8. **DO NOT** over write.
9. Write your name, student number and other details clearly in the front page of the answer book. **DO IT NOW.**

MARKING SCHEME:

[TOTAL = 50 MARKS]

1. Define any FIVE of the following terms.

(a) Ore
(b) Flux
(c) Charge
(d) Fusion
(e) Lead button
(f) Cupellation
(g) Bead
(h) Slag
(i) Reducing power
(j) Gangue

(5 marks)

2. (a) Briefly, discuss the cupellation process in fire assay. [4 marks]

(b) Discuss the rational for including blanks and duplicates in the fire assay procedure. [3 marks]

(c) Discuss the importance of implementing QA/QC in the fire assay laboratory. [3 marks]

(Total = 10 marks)

3. (a) Describe how an ore sample size is reduced and subdivided. [3 marks]

(b) Define "parting" and discuss the importance of inquartation during the parting process. [3 marks]

(c) Briefly, discuss the fusion process in fire assay. [4 marks]

(Total = 10 marks)

4. (a) Describe the main steps involved in a typical quantitative analyses of an ore sample from sample preparation to Flame Atomic Absorption Spectroscopic (FAAS) analysis. [5 marks]

(b) Differentiate between XRF and XRD spectroscopy. [3 marks]

(c) Calculate the weight (g) of Pb button produced when a 1g of sphalerite (ZnS) ore was fused with fluxes (assume all S is converted to SO_3). Equation: $ZnS + 4PbO \longrightarrow ZnO + 4Pb + SO_3$

(refer to page 3 for data). [4 marks]

(Total = 12 marks)

5. Assume that the following experimental data were generated in your practical experiment #3&4 during the Flame AAS analysis of the bead, ore pulp and a reference sample for gold concentration.

Table 1. Sample Data

Sample	Weight (g)	Digest vol. (mL)	Absorbance	Dilution
Ore	50.0531	50.0	0.145	10
Pulp	0.9989	50.0	0.025	1
Pulp duplicate	1.0051	50.0	0.024	1
Reference	1.0021	50.0	0.031	1
Linear regression equation for the calibration: y = 0.06x				

(a) Calculate the gold concentrations in mg Au/L for each of the samples. Note that the ore sample is diluted 10 times during FAAS analysis. Report final concentrations to 2 decimal places. [4 marks]

(b) Calculate the gold concentrations in mg Au/Kg for each of the samples. Report final concentrations to 2 decimal places. [4 marks]

(c) Calculate the recovery of the method. Accepted value of reference sample is 25.0 mg Au/Kg. [2.5 marks]

(d) Calculate the relative percentage difference (RPD) of the duplicates. [2.5 marks]

(Total = 13 marks)

IUPAC Periodic Table of the Elements

1	2											13	14	15	16	17	18
1 **H** hydrogen 1.008 [1.0078, 1.0082]																	2 **He** helium 4.0026
3 **Li** lithium 6.94 [6.938, 6.997]	4 **Be** beryllium 9.0122		Key: atomic number **Symbol** name conventional atomic weight standard atomic weight									5 **B** boron 10.81 [10.806, 10.821]	6 **C** carbon 12.011 [12.009, 12.012]	7 **N** nitrogen 14.007 [14.006, 14.008]	8 **O** oxygen 15.999 [15.999, 16.000]	9 **F** fluorine 18.998	10 **Ne** neon 20.180
11 **Na** sodium 22.990	12 **Mg** magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12	13 **Al** aluminium 26.982	14 **Si** silicon 28.085 [28.084, 28.086]	15 **P** phosphorus 30.974	16 **S** sulfur 32.06 [32.059, 32.076]	17 **Cl** chlorine 35.45 [35.446, 35.457]	18 **Ar** argon 39.948
19 **K** potassium 39.098	20 **Ca** calcium 40.078(4)	21 **Sc** scandium 44.956	22 **Ti** titanium 47.867	23 **V** vanadium 50.942	24 **Cr** chromium 51.996	25 **Mn** manganese 54.938	26 **Fe** iron 55.845(2)	27 **Co** cobalt 58.933	28 **Ni** nickel 58.693	29 **Cu** copper 63.546(3)	30 **Zn** zinc 65.38(2)	31 **Ga** gallium 69.723	32 **Ge** germanium 72.630(8)	33 **As** arsenic 74.922	34 **Se** selenium 78.971(8)	35 **Br** bromine 79.904 [79.901, 79.907]	36 **Kr** krypton 83.798(2)
37 **Rb** rubidium 85.468	38 **Sr** strontium 87.62	39 **Y** yttrium 88.906	40 **Zr** zirconium 91.224(2)	41 **Nb** niobium 92.906	42 **Mo** molybdenum 95.95	43 **Tc** technetium	44 **Ru** ruthenium 101.07(2)	45 **Rh** rhodium 102.91	46 **Pd** palladium 106.42	47 **Ag** silver 107.87	48 **Cd** cadmium 112.41	49 **In** indium 114.82	50 **Sn** tin 118.71	51 **Sb** antimony 121.76	52 **Te** tellurium 127.60(3)	53 **I** iodine 126.90	54 **Xe** xenon 131.29
55 **Cs** caesium 132.91	56 **Ba** barium 137.33	57-71 lanthanoids	72 **Hf** hafnium 178.49(2)	73 **Ta** tantalum 180.95	74 **W** tungsten 183.84	75 **Re** rhenium 186.21	76 **Os** osmium 190.23(3)	77 **Ir** iridium 192.22	78 **Pt** platinum 195.08	79 **Au** gold 196.97	80 **Hg** mercury 200.59	81 **Tl** thallium 204.38 [204.38, 204.39]	82 **Pb** lead 207.2	83 **Bi** bismuth 208.98	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89-103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium	113 **Nh** nihonium	114 **Fl** flerovium	115 **Mc** moscovium	116 **Lv** livermorium	117 **Ts** tennessine	118 **Og** oganesson

57 **La** lanthanum 138.91	58 **Ce** cerium 140.12	59 **Pr** praseodymium 140.91	60 **Nd** neodymium 144.24	61 **Pm** promethium	62 **Sm** samarium 150.36(2)	63 **Eu** europium 151.96	64 **Gd** gadolinium 157.25(3)	65 **Tb** terbium 158.93	66 **Dy** dysprosium 162.50	67 **Ho** holmium 164.93	68 **Er** erbium 167.26	69 **Tm** thulium 168.93	70 **Yb** ytterbium 173.05	71 **Lu** lutetium 174.97
89 **Ac** actinium	90 **Th** thorium 232.04	91 **Pa** protactinium 231.04	92 **U** uranium 238.03	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium

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For notes and updates to this table, see www.iupac.org. This version is dated 28 November 2016.