THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS

CH341 GEOCHEMISTRY/MINERAL TECHNOLOGY

FRIDAY 19TH JUNE, 2020 – 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 books 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 and student number clearly in the front page. **DO IT NOW.**

MARKING SCHEME

[TOTAL = 60 MARKS]

1. (a) Name the FOUR main classes according to the Goldschmidt Classification scheme, and briefly describe each of them. [6 marks]

   (b) Name the THREE types of ore-grinding, and give the primary reason for undertaking this process. [4 marks]

   (c) In your practical experiment #2, an ore sample was separated using the froth flotation technique. Briefly, discuss this technique. [2 marks]

   (d) 2 kg (2 mm size) of an ore sample was used in the froth flotation experiment #2 which yielded a concentrate of 728.8 g. Calculate the tailing and comment on the recovery. [2 marks]

   (Total = 14 marks)

2. (a) List THREE manual sampling procedures for ore samples. [3 marks]

   (b) List the steps involved in a mining operation. [3 marks]

   (c) Define geochemical surveys and state the objective for carrying out these surveys. [2 marks]

   (Total = 8 marks)

3. (a) Describe primary halo, and the primary dispersion of elements. [3 marks]

   (b) Define pathfinder (indicator) elements and give TWO reasons why they are successful in identifying mineral ore deposits? [3 marks]

   (c) Define hydrolysis reaction and state one important aspect of the hydrolysis of silicate and carbonate minerals. [2 marks]

   (Total = 8 marks)

4. (a) Define fire assay and list the main steps involved. [5 marks]

   (b) Explain the importance of including flour in the flux during fire assay. [3 marks]

   (c) Calculate the weight (g) of Pb button produced when a 1g of sphalerite (ZnS) ore was fire assayed (assume all S is converted to SO_3). Equation: $ZnS + 4PbO \longrightarrow ZnO + 4Pb + SO_3$ [4 marks]
   (refer to page 3 for data)

   (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 head, concentrate and tailing of an ore sample for Cu.

Determination of Cu by FAAS			
Standard Conc. (mg Cu/L)	**Abs**	**Blank corrected Abs**	
0.00	0.005		
0.50	0.035		
1.00	0.065		
2.00	0.125		
2.50	0.155		
Samples	**Abs**	**mg Cu/L (from graph)**	**g Cu/ton**
Head (1.0531 g)	0.095		
Concentrate (0.9989 g)	0.120		
Tailing (1.0021 g)	0.025		

(a) Construct a calibration plot from the experimental data. Use blank corrected absorbance of the standards for the calibration. [5 marks]

(b) Determine the Cu concentrations of the samples in the digest from the calibration plot (no blank correction required). [2 marks]

(c) From a final sample digest volume of 100mL, express the concentration of copper in grams per ton. [3 marks]

(Total = 10 marks)

6. (a) List the main steps in a typical quantitative analyses of ore samples. [2 marks]

(b) Name THREE atomic spectrometric methods for analysing ore samples. [3 marks]

(c) Briefly, discuss the principle of FAAS method. [3 marks]

(Total = 8 marks)

IUPAC Periodic Table of the Elements

1																	18
1 H hydrogen 1.008 [1.00784, 1.00811]	2		Key: atomic number **Symbol** name conventional atomic weight standard atomic weight										13	14	15	16	17	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122												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.