THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND YEAR MINERAL PROCESSING ENGINEERING

MP225 – MINERAL PROCESSING TECHNOLOGY I

SECOND SEMESTER EXAMINATION

THURSDAY 4th NOVEMBER 2021 – 8:20 AM

TIME ALLOWED – 3 HOURS

INFORMATION FOR STUDENTS

1. You have 10 minutes to read the paper. You MUST NOT begin writing during that time.
2. Attempt ALL questions. Write all answers in the answer booklet provided.
3. Write your NAME and STUDENT NUMBER clearly on the ANSWER BOOKLET. Do this NOW.
4. Materials allowed in the examination are **rulers, pens, pencils and calculators.**
5. All MOBILE PHONES, AUDIO PLAYERS, MP3, and MP4 etc... MUST BE SWITCHED OFF

Marking Scheme:

All question carry equal marks. Total mark is 100.

Question 1.0

(a) Figure 1.0 shows the abundances of minerals A and B plotted on a linear – log scale of percentage liberation verses k at uniform particle size. This figure was obtained for a value of n = 25.

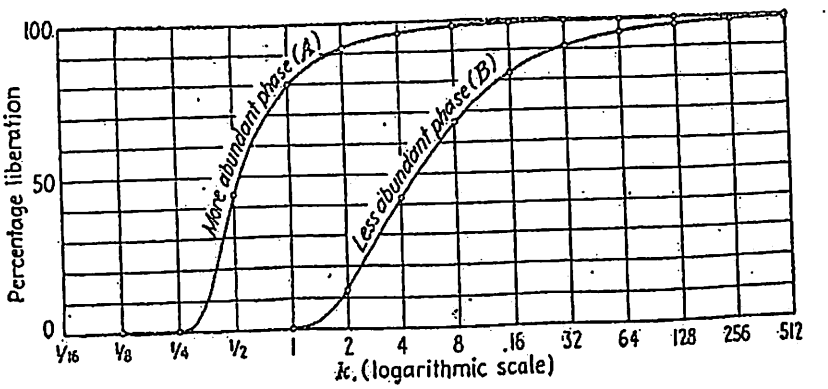


Figure 1.0 Percentage liberation of phases A & B (A>B)

i. Discuss the information depicted by Figure 1.0.

(b) You are provided with a 20kg of some sulphide ore with quartz from the Wafi gold fields to determine the assay for Cu in the form of Chalcopyrite with pyrite, limestone and quartz as the minerals and associated gangue composition. The top size of the particles within the sample is 5cm and full liberation of the mineral particles is achieved at 45μm. Using the size reduction equipment and sampling techniques at Kaindi laboratory, you are to obtain a representative sample for the analyses of the element concerned. (a=2 %, D_v =8.9, D_t =2.65, l=1, f=0.5, g=0.25).

i. List the equipment used in their order of application for size & mass reduction.

ii. Draw a Gy diagram and indicate the sample preparation stages. Gy theory applies at 90 % confidence limit and 10 % relative error (t =1.645).

iii. Determine the corresponding sample masses and sizes from the Gy diagram.

iv. Verify whether the sample prepared is safe for analysis or not.

v. Comment on your results.

Question 2.0

(a) Explain the applications of the sub-sieve techniques of sedimentation, elutriation and microscopic sizing methods.

(b) Table 1.0 shows the result of a typical sieve analysis of a laboratory ball mill product. Complete the table and perform a Schumann Plot for the size distribution of particles.

Table 1.0 Particle size distribution of a ball mill product.

Size (μm)	Wt. in grams
2360	130
	40
	19
	21
	25
	39
300	71
	180
	230
	250
	210
Passing 75	280
TOTAL	1500

i. Using the $\sqrt{2}$ series for alternative sieves, fill in sieve sizes in the table.

ii. From the plot determine the;
- P_{80}
- Size modulus
- Size parameter.
- Equation representing the size distribution of the product material.
- Comment on your plot and equation.

Question 3.0

(a) Discuss the factors affecting the screening operation.

(b) A shaking screen with an aperture of 25 mm is fed at a rate of 450 tons of ore material per hour. The size analysis of the feed, overflow and underflow shows that the fraction of material above the cut point size in the feed (f) is 0.43, overflow (c) is 0.34 and underflow (u) is 0.49.

i. Calculate the mass flow rates of the overflow.

ii. Calculate the flow rates of the underflow.

iii. Determine the recovery of the undersize material in the screen underflow.

iv. Determine the screening efficiency of the shaking screen.

i. Comment on the results.

Question 4.0

(a) Describe the three (3) types of electromagnetic radiation in spectroscopic instruments.

(b) Discuss the steps of charging, fusion, cupellation, parting and annealing in the Fire Assay technique of gold analysis.

(c) A barium assay by atomic absorption spectroscopy to obtain an indication of the purity of the compound. About 21.0 mg of the compound was dissolved in dilute HNO_3 and was diluted to 100 mL by distilled water. About 20.0 mL of the resultant solution was further diluted to 100 mL in distilled water. Absorbance reading for the blank, six standards were recorded in the table 2.0.

Table 2.0 Absorbance readings for the Ba standards.

Sample	Absorbance
Blank	0
1 ppm Ba	44
4 ppm Ba	178
10 ppm Ba	483
14 ppm Ba	684
20 ppm Ba	993
30 ppm Ba	1512
Test sample	762

i. Plot the calibration curve and determine the percentage of barium by weight in the original compound.

END of PAPER

DATA SHEET

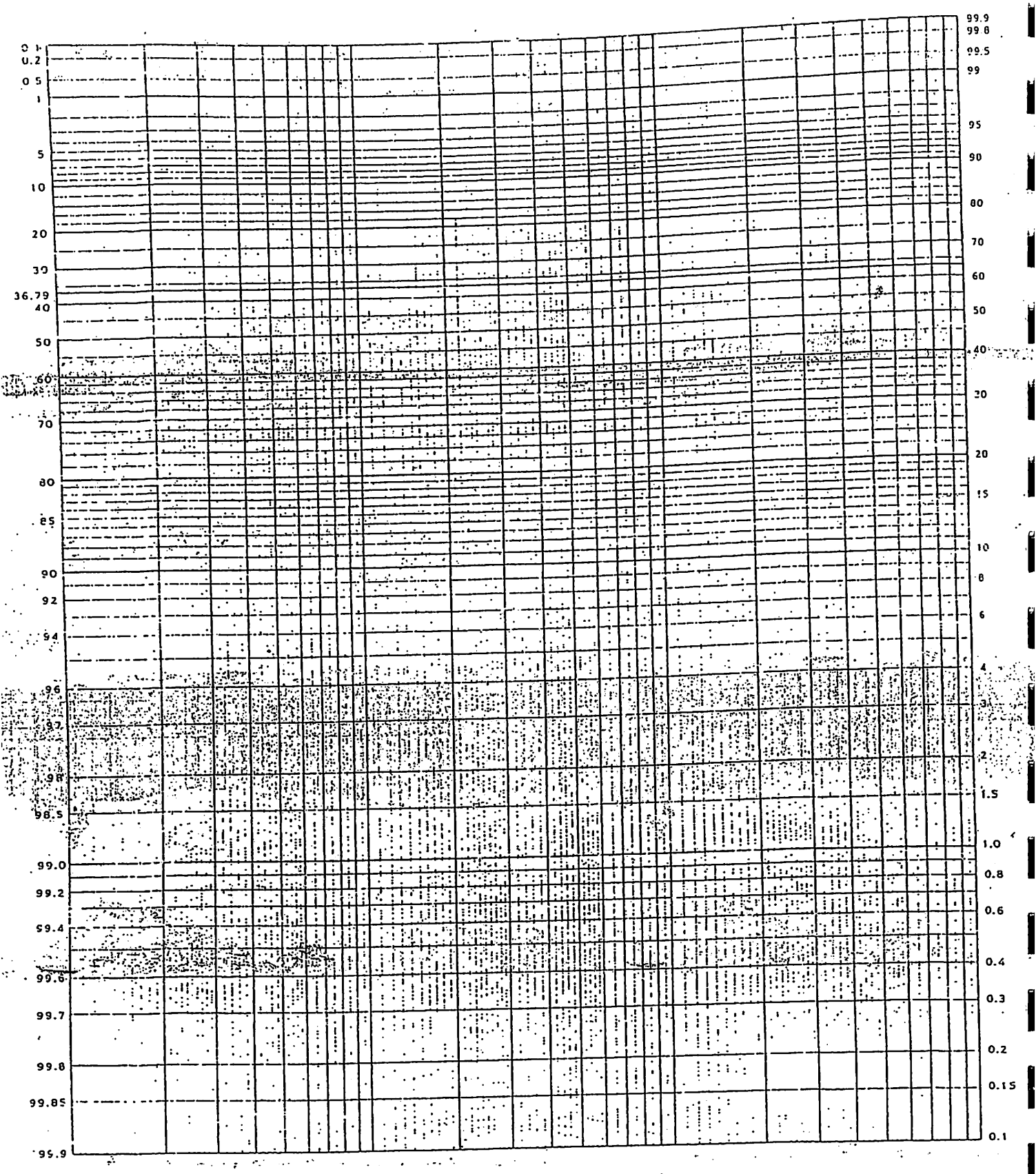
$$C = \frac{1-a}{a}[(1-a)D_v + aD_t]lfg, \qquad M = \frac{Cd^3}{s^2}$$

$$F = C + U, \qquad Ff = Cc + Uu \ , \frac{Cc}{Ff} = \frac{c(f-u)}{f(c-u)} \ , \qquad E = \frac{c-f}{c(1-f)}$$

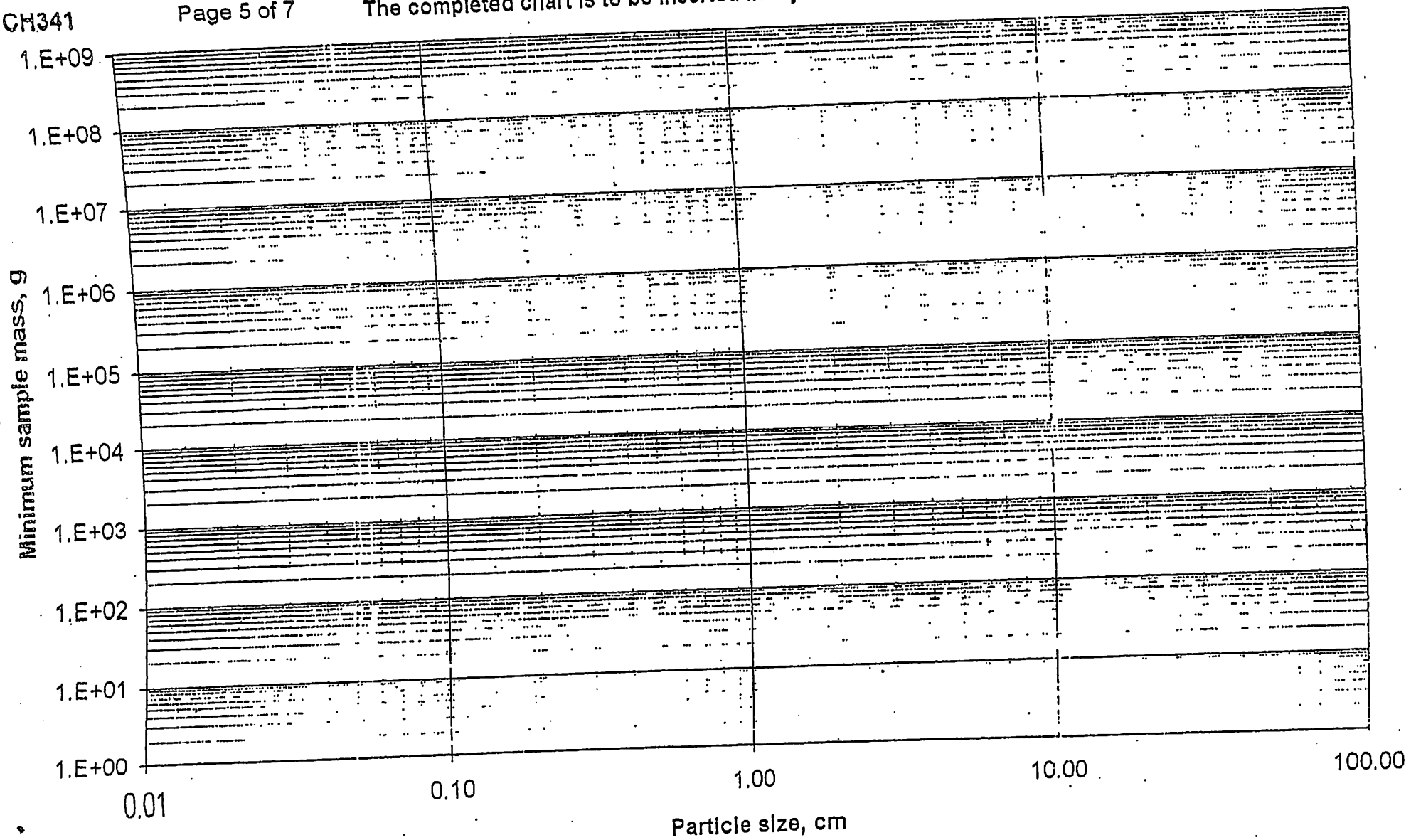
$$Y = 100\,[\frac{x}{k}]^m,$$

Common Units For Expressing Trace Concentrations

Unit	*Abbreviation*	*Wt/Wt*	*Wt/Vol*	*Vol/Vol*
Parts per million	ppm	mg/kg	mg/l	µl/l
(1 ppm = 10^{-4}%)		µg/g	µg/ml	nl/ml
Parts per billion	ppb	µg/kg	µg/l	nl/l
(1 ppb = 10^{-7}% = 10^{-3} ppm)		ng/g	ng/ml	pl/ml[a]
Milligram percent	mg%	mg/100 g	mg/100 ml	


0.1
0.2
0.5
1
5
10
20
30
36.79
40
50
60
70
80
85
90
92
94
96
97
98
98.5
99.0
99.2
99.4
99.6
99.7
99.8
99.85
99.9
99.9
99.8
99.5
99
95
90
80
70
60
50
40
30
20
15
10
8
6
4
3
2
1.5
1.0
0.8
0.6
0.4
0.3
0.2
0.15
0.1

 The completed chart is to be inserted into your Answer Book NAME .....



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