THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MINING ENGINEERING

2020 SECOND SEMESTER EXAMINATION

Third Year Mineral Processing Engineering

MP321 – Process Technology (I)

DATE: **Friday 19th June, 2020.**

TIME: **12:50 PM**

TIME ALLOWED: **3 HOURS**

INFORMATION FOR CANDIDATES:

1. Write your **NAME** and **STUDENT NUMBER** clearly on the **ANSWER BOOK. DO THIS NOW.**

2. You have ten (10) minutes to read this question paper. You **MUST NOT** begin writing during this period.

3. You are to answer **ALL** questions.

4. **ALL** answers must be written on the answer booklet provided. No other written materials will be accepted.

5. You **MUST NOT LEAVE** the room in the first hour.

6. All **MOBILE PHONES, AUDIO PLAYERS, MP3, MP4 etc...MUST BE SWITCHED OFF.**

Question 1

(a) Explain/Define the following terms. *(6mks)*

- (i) Batch Process
- (ii) Steady State Operation
- (iii) Isolated System
- (iv) Bypass Stream
- (v) Metallurgical Balance
- (vi) Conservation of Mass

(b) Name any four (4) quantities that can be balanced in mineral processing plants. *(4mks)*

(c) Give four (4) reasons why material balances are carried out. *(4mks)*

(d) List the four (4) most important applications metallurgical balances. *(4mks)*

(e) From your list in (d), select only one application and describe in detail the importance of metallurgical balance in this application. *(4mks)*

Question 2.

(a) Apart from specific gravity, specific weight and specific volume, list the other eight (8) important properties of fluids. *(8mks)*

(b) Differentiate between Newtonian and Non-Newtonian fluids. Use diagram(s) to aid your explanation. *(5mks)*

(c) Name five (5) rheological characteristics of slurry? *(5mks)*

(d) From your list in (c) select only two (2) characteristics and describe how they affect hydraulic transportation. *(4mks)*

(e) Describe the behaviour of settling and non-settling slurry. Use diagram(s) to aid your explanation. *(6mks)*

Question 3.

(a) Below *(Figure 1)* is a simple flow diagram for a galena (PbS) concentrator.

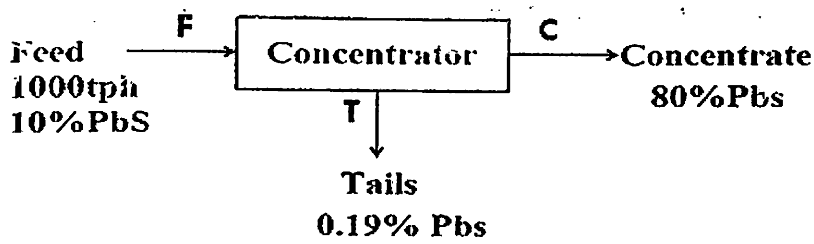


Figure 1: Simple flow sheet for a concentrator

(i) Calculate the ass reporting to the concentrate (C) and tails (T) respectively. *(6mks)*

(ii) Calculate the Mass of PbS in the concentrate and the tails. *(2mks)*

(iii) How much PbS was concentrated in May 2020? *(2mks)*

(b) A hydro-cyclone is fed 180kg/h at 35% solids by volume. The overflow is a quarter of the feed and 65% of the water goes to the underflow. If the density of the solids is 2450kg/m^3.

Calculate the:

(i) Volume of slurry in feed, overflow and underflow. *(12mks)*

(ii) Percentage (%) solids by mass in the underflow. *(3mks)*

Question 4

(a) Water flows at 5.0 L/s through a horizontal pipe that narrows smoothly from a 50cm diameter to 10cm. diameter. A pressure gauge in the narrow section reads 75000Pa. Assuming no loss in the pipe, determine the reading of a pressure gauge in the wide section in psi. *(5mks)*

(b) Use *Figure 2* to calculate the pressure in the pipe. *(10mks)*

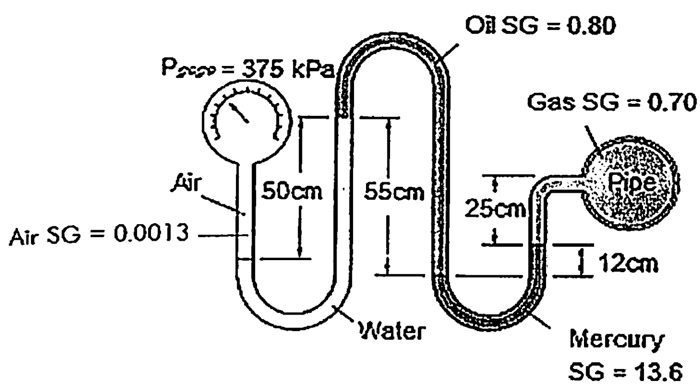
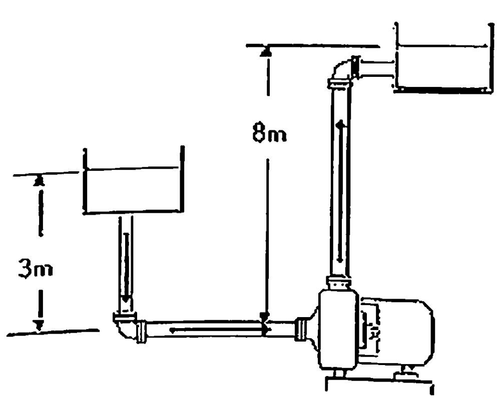


Figure 2: Multi-fluid manometer

(c) For the system shown in *Figure 3*, assume the pipe is made of welded steel. The slurry with a density of 1350kg/m^3 flows at a rate of 180m^3/h. Other data are given below.



z_s =3m
z_d =8m
Di = 30cm
L_s = 4.5m
L_d = 10m
ε = 0.045mm
P_s= 101325Pa
P_d= 101325Pa
μ = 0.055$Pa.s$

Use Aldul's Equation to obtain value for 'f'.

Figure 3: Slurry System

Calculate the:

(i) Total Discharge Head. *(7mks)*

(ii) Brake-Horsepower if pump efficiency is 80%. *(3mks)*

DATA SHEET

Formula

$$h_L = \frac{\Delta p}{\rho g} = K_L \frac{v^2}{2g}$$

$$\frac{p_1 - p_2}{\rho g} = (z_2 - z_1) + f \frac{L}{D} \frac{V^2}{2g}$$

$$Re = \frac{\rho v d}{\mu} = \frac{vd}{\nu}$$

$$P_E = \rho g Q \Delta h$$

$$P_B = \frac{100 P_H}{\eta}$$

$$\Delta h_{fs} = f \left(\frac{\sum L_{es}}{D_i}\right) \frac{V^2}{2g}$$

$$\Delta h_{fd} = f \left(\frac{\sum L_{ed}}{D_i}\right) \frac{V^2}{2g}$$

$$f = 0.11 \left(\frac{\varepsilon}{D} + \frac{68}{Re}\right)^{0.25}$$

$$\frac{v_1^2}{2g} + \frac{p_1}{\rho g} + z_1 = \frac{v_2^2}{2g} + \frac{p_2}{\rho g} + z_2$$

$$\frac{v_1^2}{2g} + \frac{p_1}{\rho g} + z_1 = \frac{v_2^2}{2g} + \frac{p_2}{\rho g} + z_2 + \Delta h_l$$

$$\Delta h = (z_d - z_s) + \frac{(P_d - P_s)}{\rho g} + f \left(\frac{\sum L_{ed} + \sum L_{es}}{D_i}\right) \frac{v^2}{2g}$$

$$\Delta h = (z_d - z_s) + \frac{(P_d - P_s)}{\rho g} + \frac{f}{2g} \left(\frac{\sum L_{ed} + \sum L_{es}}{D_i}\right) \left(\frac{Q}{\pi d_i^2/4}\right)^2$$

Use these constants where necessary:

$\rho_{water} = 1000 kg/m^3$

$g = 9.81 m/s^2$

1h.p = 745watts

101.325kPa = 14.7 psi

Flow Conditions:

Laminar: $Re < 2300$

Transition: $2300 < Re < 4000$

Turbulent: $Re > 4000$

$$h_s = z_s + \frac{P_s}{\rho g} - h_{fs}$$

$$h_d = z_d + \frac{P_d}{\rho g} + h_{fd}$$

$$\Delta h = h_d - h_s$$