UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *CHEMICAL ENGINEERING*
SUBJECT	:	**CHEMICAL PLANT 3B**
CODE	:	**ACPB321**
DATE	:	SUMMER EXAMINATION 14 NOVEMBER 2019
DURATION	:	(SESSION 1) 08:30 – 11:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	102
EXAMINER(S)	:	MISS N.T SIBIYA
MODERATOR	:	DR J PILUSA
NUMBER OF PAGES	:	4 PAGES
REQUIREMENTS	:	Use of scientific (non-programmable) calculator is permitted (only one per candidate); graph paper

HINTS AND INSTRUCTIONS TO CANDIDATE(S):

- Purpose of assessment is to determine not only if you can write down an answer, but also to assess whether you understand the concepts, principles and expressions involved. Set out solutions in a logical and concise manner with justification for the steps followed.
- **ATTEMPT ALL QUESTIONS**. Please answer each question to the best of your ability.
- Write your details (module name and code, ID number,student number etc.)on script(s).
- Number each question clearly; questions may be answered in any order.
- Make sure that you read each question carefully before attempting to answer the question.
- Show all steps (and units) in calculations; this is a 'closed book' test.
- Ensure your responses are legible, clear and include relevant units (where appropriate).

QUESTION 1: [34]

1.1.

Given:

Arrangement: Figure 1

Liquid: 50% Sodium Hydroxide

Temperature: 86° F

Static Suction Head: 8 feet

Altitude: Sea level

Blanket Pressure: 15 psig

Calculated Line Losses: 3 feet.

Find: (1) The Net Positive Suction Head available (NPSHA). (10)

(2) The maximum acceptable Net Positive Suction Head required (NPSHR), take margin of safety to be **10 feet** to rule out any potential for cavitation. (3)

Liquid Properties

Vapor pressure: 3.9 mm Hg

Specific gravity: 1.514

Viscosity: 42 cP

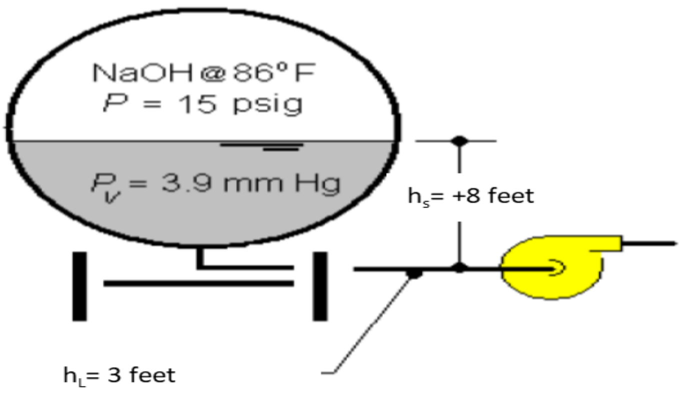

Figure 1: pressurized vessel

1.2. Does excessive amount of air at the pump suction cause cavitation? You answer should be **Yes** or **No** and explain. (4)

1.3. Explain why you would not choose centrifugal pump to pump fruits or vegetables (3)

1.4. Give two (2) advantage of diaphragm pump (4)

1.5. What is a valve? (3)

1.6. Define mixing (3)

1.7. Explain two types of liquid- liquid mixing (4)

QUESTION 2: [24]

2.1. What are the requirements for good combustion (4)

2.2. What is the importance of having an excess air in a boiler during combustion (4)

2.3. A mixture of propane and butane is burned with pure oxygen. The combustion products contain 7.4% mole H_2O. After all the water is removed from the products, the residual gas contains 69.4 mole% CO_2 and the balance O_2 (16)

QUESTION 3: [20]

3.1. Discuss the working principles of Saddle boiler (4)

3.2. Discuss the working principles of Packaged boilers (4)

3.3. How would you prevent oxidation or corrosion in the boiler (4)

3.4. Discuss four main problems encountered in a boiler (8)

QUESTION 4: [24]

4.1. What is the prime task of a cooling tower (2)

4.2. What are the working principles of cooling (6)

4.3. Make a clear distinction between natural and mechanical draft cooling towers/ include examples (12)

4.4. A cooling tower is designed to cool 11000gal/min of water from 95^{o}F to 82^{o}F. Calculate the heat rejection and evaporation rate. (4)

THE END: TOTAL MASKS [102]

FORMULA FHEET

$$\frac{dQ}{dL} = nQ \quad \text{and } Q = Q_o e^{nL}$$

$$\frac{Ka}{L} = \int_{T2}^{T1} \frac{dT}{h^{'} - h}$$

$$\frac{L}{G} = \frac{water\ flowrate}{air\ flowrate}$$

$$\frac{L}{G} = \frac{h_2 - h_1}{t_1 - t_2}$$

$$F_f = 0.96 - 0.28\sqrt{\frac{P_v}{P_c}}$$

$$Q = kl\ and \quad \frac{dQ}{dL} = k$$

$$\Delta P_{cavitation} = F_i^{\ 2}(P_1 - P_v)$$

$$C_v = Q\sqrt{\frac{S_g}{\Delta P}} \text{ or } C_v = \frac{1}{Q}\sqrt{\frac{\Delta P}{S_g}}$$

$$C_v = \frac{Q}{F_p}\sqrt{\frac{S_g}{\Delta P_a}}$$

$$h_v = \frac{2.31P}{S_g}$$

$$h_A = \frac{2.31P}{S_g}$$

$$\Delta P_{chocked} = F_l^{\ 2}\left(P_1 - F_f P_v\right)$$

$$R_e = \frac{N_4 F_d Q}{v\sqrt{F_l C_v}}\left(\frac{F_l^{\ 2} C_v^{\ 2}}{N_2 d^4} + 1\right)^{0.25}$$

$$NPSH_A = \pm h_s - h_L + h_A - h_v$$

$$range\,(^oC) = \frac{heat\,load(kcal/h)}{water\,circulation\ rate}$$