UNIVERSITY OF JOHANNESBURG

PROGRAM	: BENGTECH *CHEMICAL ENGINEERING*	
SUBJECT	: **Chemical Engineering Fundamentals 2A**	
CODE	: **CEFCHA2**	
DATE	: WINTER EXAMINATION 26 MAY 2018	
DURATION	: (SESSION 1): 08:30 – 11:30	
WEIGHT	: 40 : 60	
TOTAL MARKS	: 100	
EXAMINER	: DR N. MAZANA	720000739
MODERATOR	: MR PHATHUTSHEDZO KHANGALE	720039271
NUMBER OF PAGES	: 3	

INSTRUCTIONS : WORK ACCURATELY AND ANSWER ALL QUESTIONS.
NON-PROGRAMMABLE CALCULATORS PERMITTED
(ONLY ONE PER CANDIDATE).

QUESTION 1 **[15 marks]**

1000 kg of 8% by wt. sodium hydroxide (NaOH) solution is required. 20% sodium hydroxide solution in water and pure water are available. How much of each is required?

QUESTION 2 **[20 marks]**

2 moles of benzene and 3 moles of chlorine react to give 1.8 moles of monochlorobenzene and 0.1 moles dichlorobenzene. The reactions are as follows

$$C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl \qquad (1) \quad \text{Desired reaction}$$

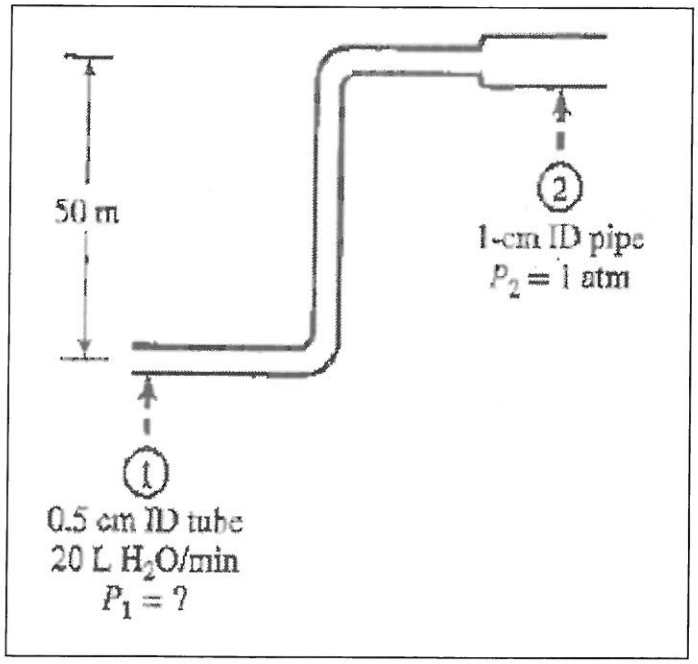
$$C_6H_6 + 2Cl_2 \rightarrow C_6H_4Cl_2 + 2HCl \qquad (2)$$

Determine the following:

1. % Excess Chlorine
2. Degree of completion
3. Conversion of benzene
4. Conversion of chlorine
5. Yield
6. Selectivity

QUESTION 3 **[35 marks]**

Water flows through the system shown in the diagram at a rate of 20 L/min. Estimate the pressure required at point 1 if friction losses are negligible.



Available formulas:

$$\frac{\Delta P}{\rho} + \frac{\Delta u^2}{2} + g\Delta z + \left(\Delta \hat{U} - \frac{\dot{Q}}{\dot{m}}\right) = \frac{\dot{W}_s}{\dot{m}}$$

$$\frac{\Delta P}{\rho} + \frac{\Delta u^2}{2} + g\Delta z + \hat{F} = \frac{\dot{W}_s}{\dot{m}}$$

$$\frac{\Delta P}{\rho} + \frac{\Delta u^2}{2} + g\Delta z = 0$$

Velocities are calculated as:

$\dot{u}(m/s) = \dot{V}(m^3/s)/A(m^2)$

QUESTION 4 **[30 marks]**

The vapour pressure of benzene is measured at two temperatures with the following results:

$T_1 = 7.6°C$ $p_1^* = 40mmHg$

$T_2 = 15.4°C$ $p_2^* = 60mmHg$

Calculate the latent heat of vaporization and the parameter B in the Clausius-Clapeyron equation (stated below) and then estimate p^* at 42.2°C using this equation.

$$\ln p^* = -\frac{\Delta \hat{H}_v}{RT} + B$$

Where

B – is a constant which varies from substance to another.

END OF PAPER