UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	FUNDAMENTAL OF PLANT TECHNOLOGY
COURSE CODE	:	BNL 20103
PROGRAMME CODE	:	BNL
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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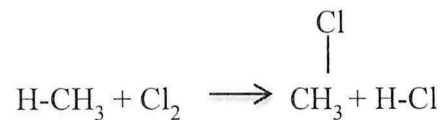
Q1   (a)   Define the term endothermic and exothermic process in terms of heat and enthalpy.

(4 marks)

(b)   Calculate the energy/enthalpy required or consumed for the following reactions by using the bond energy as shown in **Table Q1 (b)**, and estimate either the reactions is exothermic or endothermic process.

(i)   Chlorination of methane

$$H\text{-}CH_3 + Cl_2 \longrightarrow \overset{\overset{\textstyle Cl}{\textstyle |}}{CH_3} + H\text{-}Cl$$

(8 marks)

(ii)   Combustion of octane

$$2C_8H_{18}\,(g) + 25O_2\,(g) \longrightarrow 16CO_2\,(g) + 18H_2O\,(l)$$

(8 marks)

Q2   (a)   Compute the percentage of hydrogen, carbon and oxygen in pentanol ($C_5H_{11}OH$), where the molar mass of C = 12.01 (g/mol), H = 1.01 (g/mol) and O = 16 (g/mol), respectively.

(8 marks)

(b)   A mixture of gases is analyzed and found to have the following composition as shown in **Table Q2 (b).** Determine the mass of 6 mol of the gas mixture.

(12 marks)

Q3   (a) $$2Bi + 3S \longrightarrow Bi_2S_3$$

2.5 kg of bismuth (MW = 209) is heated along with 0.5 kg of sulfur (MW = 32) to form Bi_2S_3 (MW = 514). At the end of the reaction, the mass is extracted and the free sulfur recovered is 5 % of the reaction mass. Calculate:

(i)   The limiting reactant
(ii)   The percent excess reactant
(iii)   The percent conversion of sulfur to Bi_2S_3

(10 marks)

(b)   An aqueous solution of sodium hydroxide contains 30 % NaOH by mass. It is desired to produce a 12 % NaOH solution by diluting a steam of the 30 % solution with a stream of pure water as shown in **Figure Q3 (b)**.

   (i)   Calculate the ratios of (g H_2O / g feed solution) and (g product solution / g feed solution).

   (ii)   Determine the feed rates of 30 % solution and diluting water needed to produce 1048 kg/min of the 12 % solution.

(10 marks)

Q4   (a)   Show the difference between process flow diagram (PFD) and process & instrumentation diagram (P&ID).

(8 marks)

   (b)   Name the following process symbols shows in **Figure Q4 (b)** and briefly explain the function of each equipment.

(9 marks)

   (c)   Compare the primary difference between a pump and a compressor.

(3 marks)

Q5   (a)   Describe:

   (i)   Dalton's Law

(4 marks)

   (ii)   Raoult's Law

(4 marks)

   (b)   Determine the mass in grams of glucose ($C_6H_{12}O_6$) required to dissolve in 300 g of water at temperature of 40 °C to create a solution with a vapor pressure of 54 torr. (The vapor pressure of water at 40 °C is 55.3 torr) (C= 12.01g/mol, H=1.008g/mol, O=16 g/mol)

(12 marks)

– END OF QUESTIONS –

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Table Q1 (b)

Table of Bond Enthalpies (kJ/mole) at 25 °C					
Bond	**Enthalpy**	**Bond**	**Enthalpy**	**Bond**	**Enthalpy**
H-H	435	C-N	301	P≡P	490
H-F	569	C-O	352	Br-Br	193
H-Cl	431	C=O	532	Cl-Cl	243
H-Br	364	C-Br	234	H-Se	276
H-I	297	C-Cl	331	H-Te	243
H-C	414	C-F	440	S=S	427
H-N	460	N≡N	950	C-S	260
H-O	465	N-N	297	H-Si	393
H-S	377	O=O	498	H-P	318
C-C	368	O-O	213	C-Si	289
C=C	724	F-F	159	I-I	151
C≡C	963	Si-Si	339		

Table Q2 (b)
The properties of mixture gases

Compound	MW (g/mol)	Compositions (%)
CO_2	44.01	14.1
CO	28.01	7.9
CH_4	16.04	19.4
N_2	28.01	30.8
H_2	2.02	10.7
H_2O	18	12.8
SO_2	64.06	4.3

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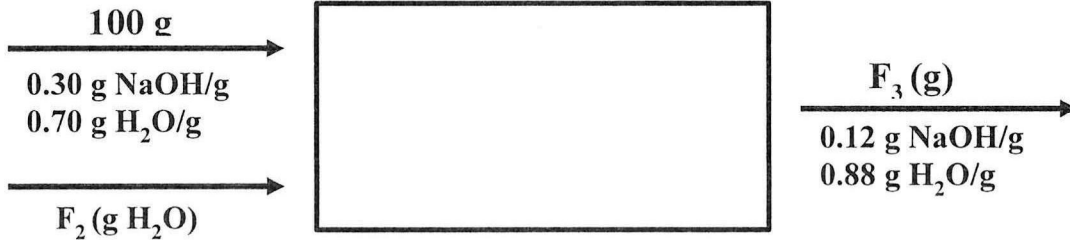
Figure Q3 (b)

(i)

(ii)

(ii)

Figure Q4 (b)

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