Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	FUNDAMENTAL TO PLANT TECHNOLOGY
COURSE CODE	:	BNL 20103
PROGRAMME CODE	:	BNL
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Define the term endothermic and exothermic process.

(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) Hydrogenation of propene;

$$CH_3CH{=}CH_2 \; + \; H_2 \; \rightarrow \; CH_3CH_2CH_3$$

(8 marks)

(ii) Combustion of propane;

$$C_3H_8 \; + \; 5O_2 \; \rightarrow \; 3CO_2 \; + \; 4H_2O$$

(8 marks)

Q2 (a) Calculate the percentage of hydrogen, carbon and oxygen in ethanol (C_2H_5OH), 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 8 mol of the gas mixture.

Table Q2 (b): The properties of mixture gases

Compound	MW (g/mol)	Compositions (%)
CO_2	44.01	14.2
CO	28.01	8
CH_4	16.04	19.6
N_2	28.01	30.7
H_2	2.02	10.3
H_2O	18	11.8
SO_2	64.06	5.4

(12 marks)

Q3 (a) Describe the difference between process flow diagram (PFD) and process and instrumentation diagram (P&ID).

(8 marks)

(b) Name the following process symbols shows in **Figure Q3(b)** and briefly explain the function of each equipment.

(9 marks)

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

(3 marks)

Q4 (a) Describe briefly the following:

(i) Dalton's Law.

(4 marks)

(ii) Raoult's Law.

(4 marks)

(b) 10 grams of N_2 is mixed with 5 grams of O_2 and held at 25 °C and 0.750 bar.

(i) Determine the partial pressures of N_2 and O_2. (N = 14.007 g/mol; O = 15.999 g/mol).

(9 marks)

(ii) Determine the volume of the ideal mixture.

(3 marks)

Q5 300 kg of carbon dioxide are stored in a tank at 6 °C and 20 bar. The critical temperature and pressure of CO_2 is 304.2 K and 73.87 bar, respectively. (T_c = 304.2 K and P_c = 73.87 bar)

(a) Determine the actual volume of the tank, by using Nelson–Obert Generalize Compressibility Charts as shown in **Table Q5 (a).** (CO_2 = 44 kg/kmol)

(14 marks)

(b) Calculate the density of the CO_2 at these condition.

(6 marks)

– END OF QUESTIONS –

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Table Q 1(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		

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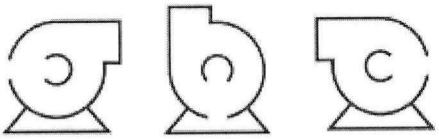
(i)

(ii)



(ii)

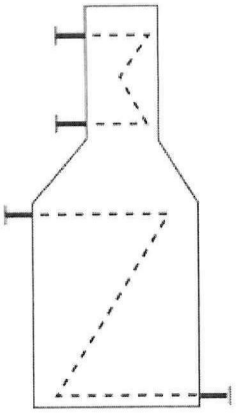


Figure Q3 (b)

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Table Q5 (a)

(a) $0 < P_r < 1.0$