

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.

QUESTION 1**SOALAN 1**

- | | |
|------|---|
| CLO1 | <p>(a) Define the density.
<i>Takrifkan ketumpatan.</i></p> <p style="text-align: right;">[2 marks]
[2 markah]</p> |
| CLO1 | <p>(b) Gasoline is flowing through a pipe at a rate of $650 \text{ m}^3/\text{h}$. Molecular weight of gasoline is 145 g/mol. Specific gravity of gasoline is 0.739.
<i>Gasolin mengalir melalui paip dengan kadar $650 \text{ m}^3/\text{h}$. Berat molekul gasoline ialah 145 g/mol. Graviti tentu gasoline ialah 0.739.</i></p> <p>i) Approximate mass flow rate of the stream in kg/min.
<i>Anggarkan kadar alir jisim bagi aliran ini dalam kg/min.</i></p> <p style="text-align: right;">[5 marks]
[5 markah]</p> <p>ii) Approximate the molar flow rate in mol/s.
<i>Anggarkan kadar alir molar dalam mol/s.</i></p> <p style="text-align: right;">[5 marks]
[5 markah]</p> |

CLO1

- (c) A mixture of gas stream consists of 35 mole% ethyl alcohol and 65 mole% Ethyl Acetate. Given the molecular weight of ethyl alcohol is 46 g/mol and Ethyl Acetate is 88 g/mol. Take a 100 mol sample as a basis.

Satu aliran gas campuran terdiri daripada 35mol% etil alkohol dan 65mol% etil asetat. Diberi berat molekul etil alkohol ialah 46 g/mol dan etil asetat ialah 88 g/mol. Ambil 100 mol campuran sebagai asas pengiraan.

- i) Calculate the mass composition of each component.

Kirakan komposisi jisim bagi setiap komponen.

[4 marks]

[4 markah]

- ii) Calculate the molecular weight of the mixture.

Kirakan berat molekul campuran.

[4 marks]

[4 markah]

- iii) Use the value in **b(ii)**, calculate the molar concentration of ethyl alcohol (in mol/m³), if the volume of the mixture is 2.5 liters and the total mass of the mixture is 2.5 kg.

Guna nilai dalam b(ii), kirakan kepekatan molar etil alkohol (dalam mol/m³), jika jumlah campuran adalah 2.5 liter dan jumlah jisim campuran adalah 2.5 kg.

[5 marks]

[5 markah]

QUESTION 2

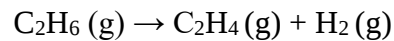
SOALAN 2

- | | |
|------|---|
| CLO2 | <p>(a) Process is the set of tasks or operations that accomplish a chemical or material transformation to produce a product. Define the following terms:
 <i>Proses ialah set tugas atau operasi yang mencapai transformasi kimia atau bahan untuk menghasilkan produk. Takrifkan</i></p> <p>i) Batch Process
 <i>Proses Berkelompok</i></p> <p>ii) Semi Batch Process
 <i>Proses Separa Berkelompok</i></p> <p style="text-align: right;">[4 marks]
[4 markah]</p> |
| CLO2 | <p>(b) A mixture of phenol-water forms two separate liquid phases, one rich in phenol and the other rich in water, the composition of layers is 75% and 7% phenol respectively (by weight). If 400kg of phenol and 700kg of water are mixed and layers allowed to separate.
 <i>Campuran fenol-air membentuk dua fasa cecair yang berasingan, satu kaya dengan fenol dan yang lain kaya dengan air, komposisi lapisan masing – masing adalah 75% dan 7% fenol (mengikut berat). Sekiranya 400kg fenol dan 700kg air dicampur dan lapisan dibenarkan untuk dipisahkan.</i></p> <p>i) Draw a flowchart of the process with complete labelling.
 <i>Lukiskan carta alir proses dengan penglabelan lengkap.</i></p> <p style="text-align: right;">[4 marks]
[4 markah]</p> <p>ii) Calculate the mass of the two layers.
 <i>Kirakan jisim kedua - dua lapisan.</i></p> <p style="text-align: right;">[5 marks]
[5 markah]</p> |

CLO2

- (c) The dehydrogenation reaction takes place in a continuous reactor under a steady state. The feed stream contains 75.0 mole% ethane (C_2H_6) and the rest is nitrogen (N_2) as an inert gas. The fractional conversion of ethane is 0.856. Take a 100 mol feed as a basic calculation.

Reaksi dehidrogenasi berlaku dalam reactor berterusan di bawah keadaan stabil. Aliran suapan mengandungi 75 mol% etana (C_2H_6) dan selebihnya adalah nitrogen (N_2) gas lengai. Penukaran pecahan etana ialah 0.856. Ambil suapan 100 mol sebagai asas pengiraan.



- i) Calculate the extent of reaction, ξ .

Kirakan takat tindak balas ξ .

[6 marks]

[6 markah]

- ii) Calculate the moles of the product gas.

Kirakan mol produk gas.

[6 marks]

[6 markah]

QUESTION 3
SOALAN 3

CLO1

- (a) Define the following terms.
Takrifkan perkara berikut.

i) Gas Constant, R
Pemalar Gas, R

ii) Ideal gas mixture
Campuran gas yang ideal

[4 marks]

[4 markah]

CLO1

- (b) 200kg of methyl chloride (CH_3Cl) vapor is contained in a storage vessel at 100°C and compressed at 12 atm. Given the molecular weight of methyl chloride is 50.5kg/kmol and use gas constant, $R = 0.08206\text{ atm.L/mol.K}$
200kg wap metil klorida (CH_3Cl) terkandung dalam bekas simpanan pada 100°C dan dimampatkan pada 12 atm. Diberikan berat molekul metil klorida adalah 50.5kg/kmol dan menggunakan pemalar gas, $R = 0.08206\text{ atm.L/mol.K}$

- i) Calculate the volume of methyl chloride vapor by using ideal gas equation.
Kirakan isipadu wap metil klorida menggunakan persamaan gas ideal.

[4 marks]

[4 markah]

- ii) Calculate the volume of methyl chloride by using the standard condition equation as a comparison.
Kirakan isipadu metil klorida menggunakan persamaan keadaan standard sebagai perbandingan.

[4 marks]

[4 markah]

CLO1

- (c) A stream of air (21 mole% and the rest is N_2) flows at a rate of 200 mol/h and it is mixed with a stream of CO_2 at a rate of $20 \text{ m}^3/\text{h}$ at 150°C and 2atm. Then, the mixture gases are stored in the container at absolute pressure of 8 bars. By assuming the ideal gas system and use gas constant, $R = 0.08206 \text{ atm.L/mol.K}$. The block flow diagram as shown in Figure 3(c).

Aliran udara (21 mol% dan selebihnya adalah N_2) yang mengalir pada kadar 200 mol/j dan ia bercampur dengan aliran CO_2 pada kadar $20 \text{ m}^3/\text{j}$ pada 150°C dan 2 atm. Kemudian, gas campuran disimpan dalam bekas pada tekanan mutlak 8 bar. Dengan menganggap sistem gas yang ideal dan menggunakan pemalar gas, $R = 0.08206 \text{ atm.L/mol.K}$. Dengan gambarajah aliran blok adalah seperti dalam Rajah 3(c).

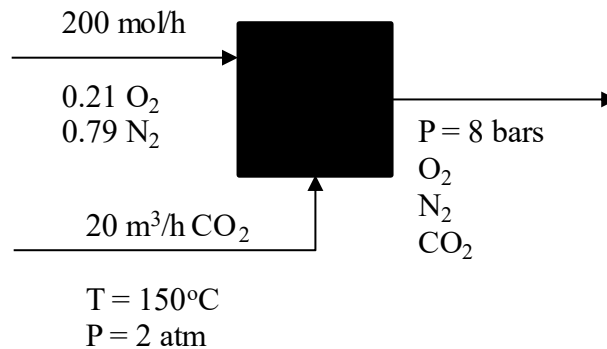


Figure 3(c)/Rajah 3(c)

- i) Calculate the mole fraction of mixture gases.

Kirakan pecahan mol gas campuran.

[7 marks]

[7 markah]

- ii) Calculate the partial pressure (in atm) of each species.

Kirakan tekanan separa (dalam atm) setiap spesis.

[6 marks]

[6 markah]

QUESTION 4

SOALAN 4

CLO2

- (a) Define the following items

Takrifkan perkara berikut

- i) Kinetic Energy

Tenaga Kinetik

- ii) Enthalpy

Entalpi

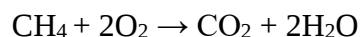
[4 marks]

[4 markah]

CLO2

- (b) 200 mol of methane is burned with 30% excess air in a continuous steady-state combustion reactor to yield a mixture of carbon dioxide and water. Given the molecular weight of air is 29 g/mol and methane is 16 g/mol. The reactions taking place is

200 mol metana dibakar dengan 30% udara berlebihan dalam reaktor pembakaran dalam keadaan stabil yang berterusan untuk menghasilkan campuran karbon dioksida dan air. Diberikan berat molekul udara ialah 29g/mol dan metana ialah 16g/mol. Tindak balas yang berlaku ialah



- i) Approximate the mass of air supplied to the reactor.

Anggarkan jisim udara yang dibekalkan kepada reaktor.

[4 marks]

[4 markah]

- ii) Approximate the air-fuel ratio for this complete combustion of methane.

Anggarkan nisbah udara-bahan api untuk pembakaran lengkap metana.

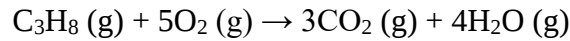
[4 marks]

[4 markah]

CLO2

- (c) (i) Calculate the heat combustion (kJ) of propane (C_3H_8) according to the heat formation given below:

Kirakan haba pembakaran (kJ) propana (C_3H_8) mengikut pembentukan haba yang diberikan di bawah:



Given:

Diberikan:



[4 marks]

[4 markah]

- (ii) 120 kmol/h of propane liquid is flowing through a pipe to be heated from 10 °C to 120°C. The polynomial heat capacity formula for propane is given by the equation below. Calculate the specific internal energy, $\Delta \hat{U}$

(kJ/kmol) of propane.

120 kmol/j cecair propana mengalir melalui paip untuk dipanaskan dari 10 hingga 120°C. Formula kapasiti haba polinomial haba propana diberi di bawah. Kirakan tenaga dalaman tentu, $\Delta \hat{U}$ (kJ/kmol) bagi propana.

$$C_v \left(\frac{\text{kJ}}{\text{kmol} \cdot ^\circ\text{C}} \right) = -4.04 + 0.3048T$$

[5 marks]

[5 markah]

- (iii) Calculate the heat, Q (kJ/s) based on C(ii).

Kirakan haba Q(kJ/s) berdasarkan C(ii)

[4 marks]

[4 markah]

SOALAN TAMAT