INSTRUCTION:

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

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan. Jawab **semua** soalan*

QUESTION 1

SOALAN 1

CLO1
C1

(a) Identify the correct answer for the table below.

Tentukan jawapan yang sesuai bagi jadual di bawah.

Quantity *Kuantiti*	SI Unit *Unit SI*	Symbol *Simbol*
Length *Panjang*		
Temperature *Suhu*		
Electric Current *Arus Elektrik*		

[6 marks]

[*6 markah*]

CLO1
C2

(b) Convert the following units:

Tukarkan unit-unit berikut:

i. 100 g/mm^3 to kg/m^3

100 g/mm^3 kepada kg/m^3

[3 marks]

[*3 markah*]

ii. 10 Pascal to MN/m^2

10 Pascal kepada MN/m^2

[3 marks]

[*3 markah*]

CLO1
C2

(c) Given the pressure and specific internal energy of the wet steam are 20 bar and 2455 kJ/kg. Determine:

Diberi tekanan dan tenaga dalam tentu bagi stim basah ialah 20 bar dan 2455 kJ/kg. Tentukan:

i. Dryness fraction.
Pecahan kekeringan.

[4 marks]
[4 *markah*]

ii. Specific volume.
Isipadu tentu.

[3 marks]
[*3 markah*]

iii. Specific enthalpy.
Entalpi tentu.

[3 marks]
[*3 markah*]

iv. Sketch and locate the point with a complete value on P-v diagram.
Lakar dan tentukan titik dengan nilai yang lengkap pada gambarajah P-v.

[3 marks]
[*3 markah*]

QUESTION 2

SOALAN 2

CLO1
C1

(a) Define the following terms:

Terangkan istilah-istilah berikut:

i. First Law of Thermodynamics.

Hukum Pertama Termodinamik.

[2 marks]

[2 *markah*]

ii. Energy transfer by heat.

Pemindahan tenaga haba.

[2 marks]

[2 *markah*]

CLO1
C2

(b) A quantity of gas has a pressure of 3.5 bar when the volume and the temperature are 0.03 m^3 and 35°C respectively. Specific gas constant for the gas is 0.29 kJ/kgK. Determine the mass of gas.

Satu kuantiti gas mempunyai tekanan 3.5 bar apabila isipadu dan suhunya masing-masing 0.03 m^3 dan 35°C. Pemalar gas adalah 0.29 kJ/kgK. Tentukan jisim gas tersebut.

[6 marks]

[*6 markah*]

CLO1
C3

(c) A gas with 1.8 m^3 of volume at initial temperature and pressure of 20°C and 1.38 bar is compressed through the polytrophic process with index n = 1.3 in a cylinder capacity of 0.244 m^3 volume. If the molecular mass of the gas is 29 kg/kmol and R_0 = 8.3145 kJ/kmol K, calculate:

Gas dengan isipadu 1.8 m^3 pada suhu dan tekanan awal sebanyak 20°C dan 1.38 bar dimampatkan mengikut proses politropik dengan indeks n = 1.3, di dalam sebuah silinder dengan kapasiti isipadu sebanyak 0.244 m^3. Jika jisim molekul gas ialah 29 kg/kmol dan R_0 = 8.3145 kJ/kmol K, *kirakan:*

i. Mass of the gas.
Jisim gas.

[6 marks]
[6 *markah*]

ii. Pressure and temperature of gas after the compression.
Tekanan dan suhu gas selepas mampatan.

[6 marks]
[6 *markah*]

iii. Work done to compress the gas.
Kerja untuk memampatkan gas.

[3 marks]
[3 *markah*]

QUESTION 3

SOALAN 3

CLO1 C1 (a) Draw the schematic diagram of the nozzle and the diffuser with their working mechanism.

Lukiskan gambarajah skematik bagi muncung dan peresap serta mekanisma kerjanya.

[4 marks]

[*4 markah*]

CLO1 C2 (b) Identify **THREE (3)** differences between flow process and non-flow process.

*Kenalpasti **TIGA (3)** perbezaan antara proses alir dan proses tidak alir.*

[6 marks]

[*6 markah*]

CLO1 C3 (c) A boiler has an inlet velocity of 4 m/s with a pressure of 0.98 bar and a specific volume of 0.15 m^3/kg. Hot steam produced from the boiler with velocity of 40 m/s at pressure and a specific volume of 8 bar and 0.3 m^3/kg. The specific internal energy at the outlet is 120 kJ/kg higher than the specific internal energy at the inlet. If 50 kW of heat is supplied to the boiler, calculate the mass flow rate of the hot steam produced in kg/hour.

Sebuah dandang mempunyai halaju aliran masuk sebanyak 4 m/s dengan tekanan 0.98 bar dan isipadu tentu sebanyak 0.15 m^3/kg. Wap panas yang dihasilkan dari dandang mempunyai halaju 40 m/s dengan tekanan dan isipadu tentu sebanyak 8 bar dan 0.3 m^3/kg. Tenaga dalam tentu di bahagian keluar ialah 120 kJ/kg lebih tinggi daripada tenaga dalam tentu di bahagian masuk. Sekiranya 50 kW haba dibekalkan ke dandang, kirakan kadar aliran jisim bagi wap panas yang dihasilkan dalam kg/jam.

[15 marks]

[*15 markah*]

QUESTION 4

SOALAN 4

CLO1
C1

(a) Define **ONE (1)** characteristic of heat pump and give **TWO (2)** examples of heat pump.

*Nyatakan **SATU (1)** ciri-ciri pam haba dan berikan **DUA (2)** contoh pam haba.*

[4 marks]

[*4 markah*]

CLO1
C2

(b) The reversed Carnot heat engine receives heat at a temperature of 10°C and rejects the heat at a temperature of 32°C with heat transfer of 100 kW. Determine:

Enjin haba Carnot yang bertentangan menerima haba pada suhu 10°C dan memindahkan haba sebanyak 100 kW pada suhu 32°C. Tentukan:

i) The engine's coefficient of performance.
Pekali prestasi bagi enjin.

[5 marks]

[*5 markah*]

ii) The power required in kJ/hr.
Kuasa yang diperlukan dalam kJ/hr.

[4 marks]

[*4 markah*]

CLO1
C3

(c) A dry saturated steam is supplied at 50 bar to turbine and the condenser pressure is 0.060 bar. If the plant operates with the Rankine Cycle, calculate:

Stim tepu kering dibekalkan pada tekanan 50 bar kepada turbin dan tekanan pemeluwap 0.060 bar. Sekiranya loji ini beroperasi dengan Kitar Rankine, kirakan;

i. The work for tubine.
Kerja turbin.

ii. The pump feed work.
Kerja pam suaan.

iii. The specific steam consumption (s.s.c)
Penggunaan Stim Tentu

[12 marks]
[*12 markah*]

SOALAN TAMAT

1. PROPERTIES OF PURE SUBSTANCE

Steam

$v = xv_g$ $\quad h = h_f + xh_{fg}$ $\quad u = u_f + x(u_g - u_f)$ $\quad s = s_f + xs_{fg}$

Ideal Gas

$PV = mRT$ $\quad R = \frac{R_o}{M}$ $\quad R = C_p - C_v$ $\quad \gamma = \frac{C_p}{C_v}$

2. FIRST LAW OF THERMODYNAMICS

$\Sigma Q = \Sigma W$ $\quad Q - W = U_2 - U_1$

Flow Process

$$\dot{m} = \rho CA = \frac{CA}{V}$$

$h = u + pv$

$h = Cp\,\Delta T$

$$Q - W = \dot{m}\left[(h_2 - h_1) + \left(\frac{C_2^{\,2} - C_1^{\,2}}{2}\right) + (Z_2 - Z_1)g\right]$$

Non-Flow Process

1. Isothermal Process ($PV = C$)

$U_2 - U_1 = 0$ $\quad Q = W$

$$W = P_1V_1 \ln\left(\frac{V_2}{V_1}\right) \quad @ \quad W = P_1V_1 \ln\left(\frac{P_1}{P_2}\right)$$

$$Q = P_1V_1 \ln\left(\frac{V_2}{V_1}\right) \quad @ \quad Q = P_1V_1 \ln\left(\frac{P_1}{P_2}\right)$$

2. Adiabatic Process ($PV^n = C$)

$U_2 - U_1 = mC_v(T_2 - T_1)$ $\quad W = \frac{P_1V_1 - P_2V_2}{\gamma - 1} = \frac{mR(T_1 - T_2)}{\gamma - 1}$

$Q = 0$ $\quad \frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

3. Politropic Process ($PV^n = C$)

$U_2 - U_1 = mC_v(T_2 - T_1)$ $\qquad W = \frac{P_1V_1 - P_2V_2}{n-1} = \frac{mR(T_1 - T_2)}{n-1}$

$Q = \frac{\gamma - n}{\gamma - 1} \times W$ $\qquad \frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$

4. Isobaric Process

$U_2 - U_1 = mC_v(T_2 - T_1)$
$W = P(V_2 - V_1) = mR(T_2 - T_1)$
$Q = mC_p(T_2 - T_1)$

5. Isometric Process

$U_2 - U_1 = mC_v(T_2 - T_1)$
$W = 0$
$Q = U_2 - U_1 = mC_v(T_2 - T_1)$

3. SECOND LAW OF THERMODYNAMICS

$$W_{net} = Q_H - Q_L$$

Heat Engine

$$\eta_{th} = \frac{W_{net,out}}{Q_H} = 1 - \frac{Q_L}{Q_H}$$

Refrigerator

$$COP_{R,rev} = \frac{T_L}{T_H - T_L} = \frac{1}{T_H/T_L - 1}$$

Heat Pump

$$COP_{HP,rev} = \frac{T_H}{T_H - T_L} = \frac{1}{1 - T_L/T_H}$$

Power Cycle

$$\eta_{Rankine} = \frac{W_T - W_P}{Q_B} = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_4)}$$

$$Work\ ratio = \frac{W_T - W_P}{W_T} = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_2)}$$

$$s.s.c = \frac{3600}{W_T - W_P} = \frac{3600}{(h_1 - h_2) - (h_4 - h_3)}$$