KOLEJ YAYASAN PELAJARAN JOHOR
ONLINE FINAL EXAMINATION

COURSE NAME	**:**	**THERMODYNAMICS**
COURSE CODE	**:**	**DKM 3203**
EXAMINATION	**:**	**DECEMBER 2021**
DURATION	**:**	**3 HOURS**

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part : / (100 Marks) /
   *Kertas soalan ini mengandungi **SATU (1)** bahagian:* *(100 Markah)*

2. Answer ALL questions in the answer sheet which is A4 size paper (or other paper with the consent of the relevant lecturer). /
   Jawab SEMUA soalan di dalam kertas jawapan iaitu kertas bersaiz A4 (atau lain-lain kertas dengan persetujuan pensyarah berkaitan).

3. Write your details as follows in the upper left corner for each answer sheet: /
   Tulis butiran anda sepertimana berikut di penjuru atas kiri bagi setiap kertas jawapan:
   - *i.* Student Full Name / *Nama Penuh Pelajar*
   - ii. Identification Card (I/C) No. / *No. Kad Pengenalan*
   - iii. Class Section / *Seksyen Kelas*
   - iv. Course Code / *Kod Kursus*
   - v. Course Name / *Nama Kursus*
   - vi. Lecturer Name / *Nama Pensyarah*

4. Each answer sheet must have a page number written at the bottom right corner. /
   Setiap helai kertas jawapan mesti ditulis nombor muka surat di penjuru bawah kanan.

5. Answers should be **neat and clear in handwritten form**. /
   Jawapan hendaklah ditulis tangan, kemas dan jelas.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of **8** printed pages including front page
*Kertas soalan ini mengandungi **8** halaman bercetak termasuk muka hadapan*

This part consists of **FOUR (4)** questions. Answer **ALL** the questions in the answer sheet.
*Bahagian ini mengandungi **EMPAT (4)** soalan. Jawab **SEMUA** soalan di dalam kertas jawapan.*

QUESTION 1/*SOALAN 1*

a. Convert the following units:

(i) 1 g/mm^3 to kg/m^3

(3 marks / *markah*)

(ii) 10 m/s to km/hr

(3 marks / *markah*)

(iii) 20 mg/litre to kg/m^3

(3 marks / *markah*)

Tukarkan unit-unit berikut:

(i) *1 g/mm^3 kepada kg/m^3*

(ii) *10 m/s kepada km/j*

(iii) *20 mg/liter kepada kg/m^3*

b. **Figure 1** below shows a certain process, which undergoes a complete cycle of operation. Determine the missing properties in system below in unit KJ and state either it is in/out of the system.
***Rajah 1** di bawah menunjukkan proses tertentu, yang menjalani operasi yang lengkap. Tentukan sifat yang hilang dalam sistem di bawah dalam unit KJ dan nyatakan sama ada ia masuk / keluar dari sistem.*

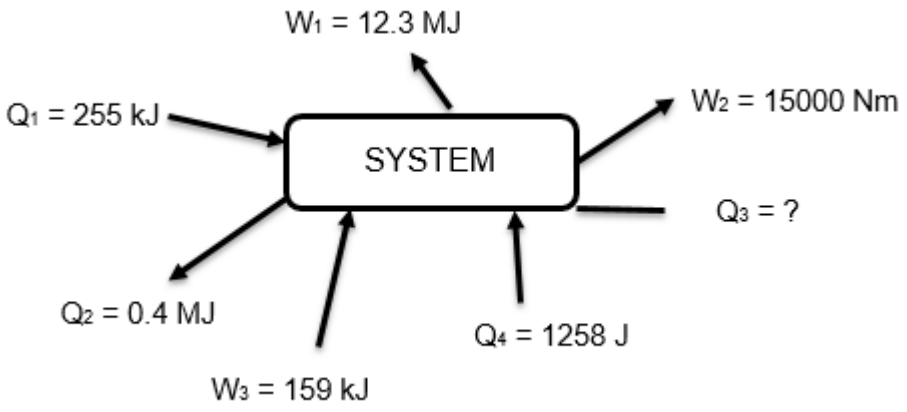

Figure 1/ *Rajah 1*

c. At a pressure of 35 bar and dryness fraction of 0.62, determine the:

(i) specific volume of wet steam.
(3 marks / *markah*)

(ii) specific enthalpy of wet steam.
(3 marks / *markah*)

(iii) specific internal energy of wet steam.
(3 marks / *markah*)

(iv) Sketch and locate the dryness fraction on the P-v diagram.
(1 marks / *markah*)

Pada tekanan 35 bar dan pecahan kekeringan 0.62, tentukan:

(i) isi padu tentu stim basah.

(ii) entalpi tentu stim basah.

(iii) tenaga dalam tentu stim basah.

(iv) Lakar dan tandakan titik pecahan kekeringan pada rajah P-v.

QUESTION 2/*SOALAN 2*

a. 2.3 kg of gas at 15 °C is heated using isobaric process from 0.52 m^3 to 0.127 m^3. Given R = 0.263 kJ/kg.K and C_v = 655 J/kg.K. Determine:

(ii) the initial pressure.
(3 marks / *markah*)

(iii) the final temperature.
(3 marks / *markah*)

(iv) the work done.
(2 marks / *markah*)

(v) the heat transfer of the gas.
(5 marks / *markah*)

2.3 kg gas pada suhu 15 °C telah dipanaskan menggunakan proses isobarik dari 0.52 m^3 kepada 0.127 m^3. Diberi R = 0.263 kJ/kg.K dan C_v = 655 J/kg.K. Tentukan:

(i) tekanan awal

(ii) suhu akhir

(iii) kerja terlaku

(iv) haba yang terpindah oleh gas.

b. According to the steam table, at pressure of 3.25 MN/m^{2,} determine:

(i) saturation temperature.

(3 marks / *markah*)

(ii) specific liquid enthalpy.

(3 marks / *markah*)

(iii) specific enthalpy of evaporation.

(3 marks / *markah*)

(iv) specific enthalpy of dry saturated steam.

(3 marks / *markah*)

Berpandukan jadual stim, pada tekanan 3.25 MN/m^2, tentukan:

(i) suhu tepu

(ii) entalpi cair tentu

(iii) entalpi tentu penyejatan

(iv) entalpi tentu stim tepu kering

QUESTION 3/ *SOALAN 3*

a. Define an open system in thermodynamics and state **two (2)** devices for the system.

*Berikan definisi sistem terbuka dalam termodinamik dan nyatakan **dua (2)** peranti untuk sistem tersebut.*

(4 marks / *markah*)

b. Based on steady flow equation below, state the quantity and unit for each equation's symbol.

Berdasarkan persamaan aliran mantap di bawah, nyatakan kuantiti dan unit bagi setiap simbol persamaan.

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

(6 marks / *markah*)

c. A turbine which is operated under steady flow condition is having these properties are shown in **Table 1** below. If heat loss to the atmosphere is at 38 kJ/s and mass flow rate of the steam is 2550 kg/hour, calculate the power produced from the steam.

Sebuah turbin beroperasi di bawah keadaan aliran tetap mempunyai ciri-ciri yang berikut seperti di dalam ***Jadual 1*** *di bawah. Jika kehilangan haba kepada atmosfera ialah 38 kJ/s dan kadar alir jisim stim ialah 2550 kg/jam, kirakan kuasa yang terhasil daripada stim.*

	Inlet ***Masukan***	**Outlet** ***Keluaran***
Pressure ***Tekanan***	6.5 bar	1.6 bar
Specific volume ***Isipadu Tentu***	0.45 m^3/kg	1.2 m^3/kg
Specific internal energy ***Tenaga dalam tentu***	3250 kJ/kg	2370 kJ/kg
Velocity ***Halaju***	7.5 m/s	9.3 m/s

Table 1/ ***Jadual 1***

QUESTION 4/*SOALAN 4*

a. Differentiate between a heat pump and a refrigerator.

Bezakan di antara pam haba dan peti sejuk.

(4 marks / *markah*)

b. A household refrigerator with a COP of 1.1 removes heat from the refrigerated space at rate of 105 kJ/h. Calculate :

(i) the electric power consumed by the refrigerator (in kW).

(5 marks / *markah*)

(ii) the rate of heat transferred to the kitchen air.

(3 marks / *markah*)

Sebuah peti sejuk kegunaan rumah dengan COP 1.1 menyingkirkan haba dari ruang penyejukkannya pada kadar 105 kJ/h. Kirakan :

(i) kuasa elektrik yang digunakan oleh peti sejuk (dalam kW)

(ii) kadar permintaan haba ke udara di ruang dapur.

c. A steam power plants operates between a boiler pressure 40 bar and a condenser pressure 0.04 bar. If steam entry to the turbine with dry saturated, calculate for a Rankine cycle :

(i) feed pump work.

(2 marks / *markah*)

(ii) Rankine efficiency.

(8 marks / *markah*)

(iii) specific steam consumption.

(3 marks / *markah*)

Sebuah penjana kuasa stim beroperasi diantara tekanan dandang 40 bar dan tekanan pemeluwap 0.04 bar. Sekiranya stim masuk ke dalam turbin pada tekanan tepu kering, kirakan untuk kitar Rankine :

(i) kerja suapan pam.

(ii) kecekapan kitar Rankine.

(iii) penggunaan stim tepu.

[100 MARKS / *MARKAH*]

END OF THE QUESTION PAPER / *KERTAS SOALAN TAMAT*

FORMULA

1. FIRST LAW OF THERMODYNAMICS

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

2. FLOW PROCESS

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

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

3. PROPERTIES OF PURE SUBSTANCE

Steam

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

Ideal Gas

$PV = mRT$ $\quad R = \frac{R_o}{M}$ $\quad R = c_p - c_v$ $\quad \gamma = \frac{c_p}{c_v}$

4. NON FLOW PROCESS

Isothermal Process $(PV = C)$

$U_2 - U_1 = 0$ $\quad Q = W$ $\quad W = P_1 V_1 \ln\left(\frac{V_2}{V_1}\right) @ W = P_1 V_1 \ln\left(\frac{P_1}{P_2}\right)$

Adiabatic Process $(PV^\gamma = C)$

$U_2 - U_1 = mc_v(T_2 - T_1) \quad Q = 0$ $\quad W = \frac{P_1 V_1 - P_2 V_2}{\gamma - 1} = \frac{mR(T_2 - T_1)}{\gamma - 1}$

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{(\gamma-1)/\gamma} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ $\quad \eta_{th,\,rev} = 1 - \frac{T_L}{T_H}$ $\quad nisbah\,\text{ker}\,ja = \frac{\ln\frac{V_2}{V_1}(T_1 - T_3)}{T_1 \ln\frac{V_2}{V_1} + \frac{T_1 - T_3}{\gamma - 1}}$

Isobaric Process

$Q = mC_P(T_2 - T_1)$ $\quad W = P(V_2 - V_1)$ $\quad \Delta U = Q - W$ $\quad PV = mRT$ $\quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

Isometric Process

$Q = mC_v(T_2 - T_1)$ $PV = mRT$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\Delta U = Q$

Polytropic Process $(PV^n = C)$

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$ $U_2 - U_1 = mC_v(T_2 - T_1)$ $Q = \frac{\gamma - n}{\gamma - 1} \text{ x } W$ $W = \frac{P_1V_1 - P_2V_2}{n-1} = \frac{mR(T_1 - T_2)}{n-1}$

$P_1V_1^n = P_2V_2^n$

5. *SECOND LAW OF THERMODYNAMICS*

Heat Engine

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

Heat Pump

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

Power Cycle

$$\eta_{rankine} = \frac{w_T - w_p}{q_{in}} = \frac{(h_1 - h_2) - v_f(p_4 - p_3)}{(h_1 - h_4)}$$

$$\eta_{carnot} = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_2)}$$

$$s.s.c_{rankine} = \frac{3600}{(h_1 - h_2) - v_f(p_4 - p_3)}$$

$$r_{w(rankine)} = \frac{(h_1 - h_2) - v_f(p_4 - p_3)}{(h_1 - h_2)}$$