18

SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2017

DJM2043 : THERMOFLUIDS

TARIKH : 24 OKTOBER 2017
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **TUJUH (7)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

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
C1

a) Sketch and label system, surrounding and boundary. Then, give the definition of surroundings.

Lakar dan labelkan sistem, sekitaran dan sempadan. Kemudian, beri definasi sekitaran.

[5 marks]
[*5 markah*]

CLO1
C2

b) The oil consist of 5.6 m^3 volume and 46800 N weighs. Calculate:
i. mass density, ρ
ii. relative density, s.

Minyak mempunyai isipadu 5.6 m^3 dan berat 46800 N. Apakah
i. ketumpatan jisim, ρ
ii. ketumpatan relatif, s.

[8 marks]
[*8 markah*]

c) A pipe, AB splits into BC and BD. Pipe BC is 60mm in diameter. The discharge in pipe AB is 8liter/s. The diameter of pipe A is 75mm while the diameter of pipe B is 50mm. The velocity in pipe BD is 1.5m/s and the discharge in pipe BC is half than discharge in pipe BD. Calculate the,

Sebatang paip AB terpisah menjadi BC dan BD. Paip BC berdiamter 60mm. Kadar alir paip AB 8liter/s. Diameter paip A 75mm dan diameter paip B 50mm. Halaju paip BD 1.5m/s dan kadaralir paip BC adalah separuh dari kadaralir paip BD. Kirakan,

i. Discharge in pipe A, B, BC and BD
Kadaralir paip A, B, BC dan BD

ii. Velocity at pipe A, B, and BC
Halaju paip A, B dan BC

iii. Diameter of BD
Diameter BD

[12 marks]
[*12 markah*]

QUESTION 2
SOALAN 2

CLO1 C1

a) State the function of piezometer and barometer.
Nyatakan fungsi bagi piezometer dan barometer.

[5 marks]
[*5 markah*]

CLO1 C2

b) A u-tube differential manometer is connected to two pipes at A and B as in **Figure 2a**. Pipe A contains oil with specific gravity of 0.92 and pipe B is carrying water. The u-tube contains mercury. Find the different pressure between A and B. If the pressure at point A is 125kN/m^2, find the pressure at point B.

*Sebuah manometer tiub-u pembezaan disambungkan kepada dua paip, A dan B seperti **Rajah 2a**. Paip A mengandungi minyak dengan gravity tentu 0.92 dan paip B mengalirkan air. Tiub-u diisi dengan merkuri. Cari perbezaan tekanan antara A dan B. Jika tekanan pada A ialah 125kN/m^2, cari tekanan B.*

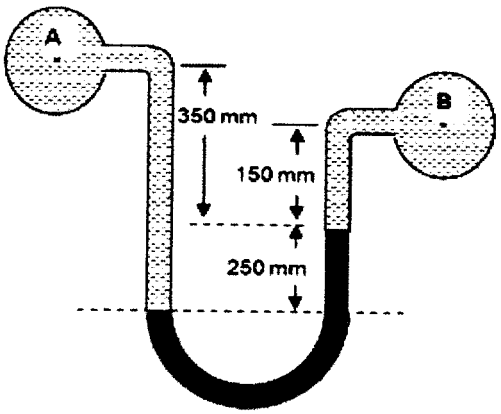

Figure 2a / *Rajah 2a*

[10 marks]
[*10 markah*]

CLO1
C3

c) A load on a hydraulic lift **(Figure 2b)** will rise by pouring oil from a thin tube. The required height of oil in the tube is required to increase the weight is to be determined. Calculate :

i. Gauge pressure, P_{gauge} in the fluid under the load

ii. required oil height, h if the density of oil is given $\rho_{oil} = 780$ kg/m^3.

*Satu beban pada lif hidraulik (**Rajah 2b**) akan dinaikkan dengan menuang minyak dari tiub nipis. Ketinggian minyak dalam tiub yang diperlukan bagi meningkatkan beban akan ditentukan. Kirakan:*

i. tekanan tolok, P_{tolok} dalam cecair di bawah beban

ii. ketinggian minyak yang diperlukan, h jika ketumpatan minyak yang diberikan ialah $\rho_{minyak} = 780$ kg / m^3.

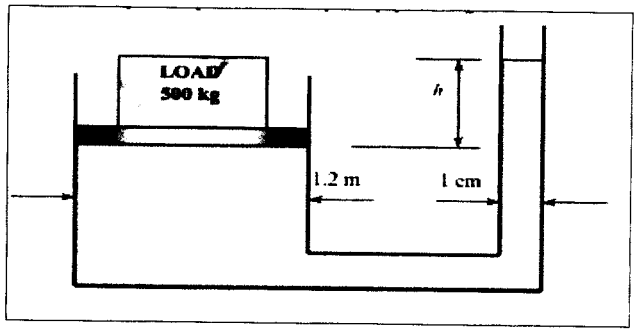

Figure 1 (b) / Rajah 2 (b)

[10 marks]
[*10 markah*]

QUESTION 3
SOALAN 3

CLO1
C1

a) From the **Figure 3(a),** the heat supply to boiler is 2100 kJ/kg. The plant produces 1800kJ/kg turbine work out. The steam then goes to condenser to change it phase to water by removing 1200kJ/kg heat. The water then pump in to the boiler. Define the work in by the water pump.

Dalam sebuah loji kuasa stim haba ***Rajah 3(a)*** *dibekalkan ke dandang, ialah 2100kJ/kg. Logi tersebut menghasilkan 1800 kJ/kg kerja keluaran turbin. Stim kemudiannya dijujuhkan ke pemeluwap untuk menukarkannya kepada air dengan mengeluarkan 1200kJ/kg haba. Air kemudiannya dipam masuk ke dandang. Tentukan kerja masuk oleh pam air.*

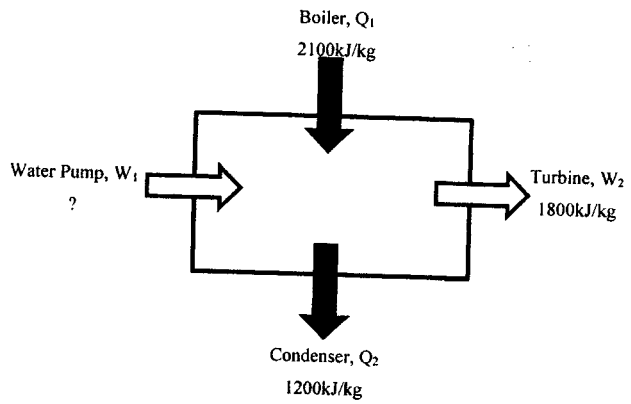

Figure 3 (a) / Rajah 3 (a)

[5 marks]
[*5 markah*]

CLO1
C2

b) 1kg of nitrogen (molecular weight 28) is compressed reversibly and isothermally from 1.01bar, 20^0C to 4.2 bar. Calculate the work done and the heat flow during the process. Assume nitrogen is a perfect gas.

1kg nitrogen (berat molekul 28) dimampatkan secara balikan dan isotherma dari 1.01 bar, 20^0C ke 4.2 bar. Kirakan kerja yang dilakukan dan aliran haba semasa proses berlaku. Anggap nitrogen adalah gas unggul.

[7 marks]
[*7 markah*]

CLO1
C3

c) A mass of 0.35kg gas is at a temperature of 35^0C, volume of $0.075m^3$/kg and pressure of 190 kN/m^2. If the gas has a value of C_v=720 J/kgK, calculate;

Sejenis gas mempunyai jisim 0.35kg, suhu 35^0C, isipadu $0.075m^3$/kg dan tekanan 190 kN/m^2. Jika gas tersebut mempunyai C_v=720 J/kgK, kirakan,

i. Gas constant
Pemalar gas

ii. Molecular weight
Berat molekul

iii. Specific heat at constant pressure
Haba tentu pada tekanan malar

iv. Specific heat ratio
Nisbah haba tentu

[13 marks]
[*13 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

(a) In a certain steam plant, the turbine produces 1000 kW. The heat supplied to the steam in the boiler is 2800 kJ/kg, the heat rejected by the steam to the cooling water in the condenser is 2100 kJ/kg and the required feed-pump work to pump the condensate back into the boiler is 5 kW. Determine the

i. change in heat
ii. change in work
iii. steam flow rate

Dalam loji turbin stim menghasilkan 1000 kW. Haba yang dibekalkan kepada stim di dalam dandang ialah 2800 kJ / kg, haba yang ditolak oleh stim pada air penyejuk di dalam pemeluwap ialah 2100 kJ / kg dan kerja pam suapan yang diperlukan untuk mengepam pemeluwapan kembali ke dalam dandang adalah 5 kW. Cari

i. perubahan dalam haba

ii. perubahan dalam kerja

iii. kadar aliran stim

[8 marks]
[*8 markah*]

CLO1
C2

(b) In a Carnot cycle operating between 307.2°C and 99.6°C, the maximum and minimum pressures are 95 bar and 1 bar. Determine:

i. cycle efficiency

ii. net work

iii. gross work

Assume steam as the working fluid.

Dalam kitar Carnot yang beroperasi antara 307.2 dan 99.6 ° C, tekanan maksimum dan tekanan minimum adalah 95 bar dan 1 bar. Tentukan:

i. kecekapan kitaran

ii. kerja bersih

iii. kerja kasar

Anggap wap sebagai bendalir kerja.

[10 marks]
[*10 markah*]

CLO1
C3

(c) The reversed Carnot heat engine receives heat at a temperature of 10°C and produce 7.213kW of power. Determine the heat transferred from the system at temperature of 32°C.

Enjin Haba Carnot balikan menerima haba pada suhu 10°C dan menghasilkan kuasa sebanyak 7.213kW. Kirakan jumlah haba yang dipindahkan daripada sistem pada suhu 32°C.

[7 marks]
[*7 markah*]

SOALAN TAMAT

FIRST LAW OF THERMODYNAMICS

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

FLOW PROCESS

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

$$Q_T - W_T = \left[(h_2 - h_1) + \left(\frac{C_2^{\,2} - C_1^{\,2}}{2}\right) + (Z_2 - Z_1)g\right] \qquad h = u + pv$$

PROPERTIES OF PURE SUBSTANCE

Steam

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

Ideal Gas

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

Non-Flow Process

1. **Isothermal Process** ($PV = C$)

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

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

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

2. Adiabatic Process ($PV^{\gamma} = C$)

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

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

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

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

SECOND LAW OF THERMODYNAMICS

Heat Engine

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

Heat Pump

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

STEAM

a) Isobaric process

$W = P(V_2 - V_1)$ *atau* $W = Q - (u_2 - u_1)$
$Q = h_2 - h_1$

b) Isometric Process

$W = 0$
$Q = u_2 - u_1$

c) Isothermal Process

$Q = T(s_2 - s_1)$
$W = Q - (u_2 - u_1)$

d) Adiabatic/Isentropic Process

$s_1 = s_2$
$Q = 0$
$W = u_1 - u_2$

e) **Politropic Process**

$$W = \frac{P_1V_1 - P_2V_2}{n-1}$$
$$Q = (u_2 - u_1) + W$$

PERFECT GAS

a) Isobaric process

$$s_2 - s_1 = mC_p \ln\left(\frac{T_2}{T_1}\right)$$

b) Isometric Process

$$s_2 - s_1 = mC_v \ln\left(\frac{T_2}{T_1}\right)$$

c) Isothermal Process

$$s_2 - s_1 = mR \ln\left(\frac{v_2}{v_1}\right) = mR \ln\left(\frac{p_1}{p_2}\right)$$

d) Politropic Process

$$s_2 - s_1 = mR \ln\left(\frac{v_2}{v_1}\right) - mC_v \ln\left(\frac{T_1}{T_2}\right) \quad \text{atau} \quad s_2 - s_1 = mR \ln\left(\frac{p_1}{p_2}\right) - mC_p \ln\left(\frac{T_1}{T_2}\right)$$