

CONFIDENTIAL



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : THERMODYNAMICS
COURSE CODE : DAK 10603 / DAK 20703
PROGRAMME : DAK
EXAMINATION DATE : DECEMBER 2019/JANUARY 2020
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

TERBUKA

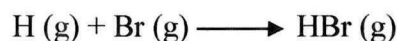
THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

CONFIDENTIAL

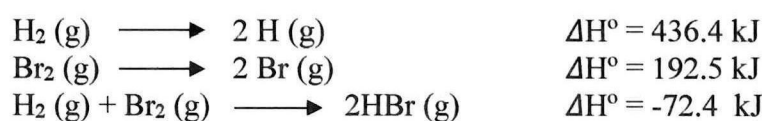
- Q1** (a) Thermodynamic is the science of energy that concerned with the ways in which energy is stored within a body.
- (i) State the Zeroth Law of Thermodynamics. (2 marks)
- (ii) List **three (3)** examples of various application of thermodynamic in real life. (3 marks)
- (b) Describe the phase change process of pure substances exist in many practical situations of thermodynamic application. (5 marks)
- (c) A 0.5 m^3 rigid tank containing H_2O at $20 \text{ }^\circ\text{C}$ and 150 kPa is connected by a valve to another 0.5 m^3 rigid tank that hold H_2O at $150 \text{ }^\circ\text{C}$ and 400 kPa . Now the valve is opened and the system is allowed to reach thermal equilibrium with the surrounding, which are at $15 \text{ }^\circ\text{C}$.
- (i) Determine the final pressure in the tank. (9 marks)
- (ii) Analyzed the phase of H_2O at final state. (1 mark)
- Q2** (a) Work is the energy transfer associated with a force acting through a distance.
- (i) Define the net work for a cycle process. (2 marks)
- (ii) List **two (2)** types of common process, which involve a work done. (2 marks)
- (b) Distinguish the function of mixing chamber and heat exchanger in terms of thermodynamic system. (6 marks)
- (c) Steam at 5 MPa and $400 \text{ }^\circ\text{C}$ enters a nozzle steadily with a velocity of 80 m/s , and it leaves at 2 MPa and $300 \text{ }^\circ\text{C}$. The inlet area of the nozzle is 50 cm^2 , and heat is being lost at a rate of 120 kJ/s . Calculate the exit area of the nozzle in m^2 . (10 marks)

TERBUKA

- Q3** (a) Define the terms of heat capacity and specific heat along with its unit. (4 marks)
- (b) Distinguish between standard heat of formation and standard heat of reaction. (4 marks)
- (c) One of the most studied chain reaction is that between hydrogen and bromine as the following equation:



Given the following information.



- (i) Calculate the ΔH° for the following reaction. (10 marks)
- (ii) Determine the heat evolve when 15 g of hydrogen react with bromine gas during the process. (2 marks)
- Q4** (a) The heat engine that operates on the reversible Carnot cycle is called the Carnot Heat Engine.
- (i) List **four (4)** reversible processes that makeup the Carnot cycle. (4 marks)
- (ii) Explain each reversible process mentioned in **Q4 (a) (i)**. (4 marks)
- (b) A refrigerator is to remove heat from the cooled space at a rate of 300 kJ/min to maintain its temperature at -8°C . If the air surrounding the refrigerator is at 25°C , determine the minimum power input required for this refrigerator in kW. (7 marks)
- (c) Carnot heat engine receives 650 kJ of heat from a source of unknown temperature and rejects 250 kJ of it to a sink at 24°C . Calculate the thermal efficiency of the heat engine. (5 marks)

TERBUKA

- Q5** (a) List the purpose of the Second Law of Thermodynamics, which commonly used in engineering systems. (3 marks)
- (b) A rigid tank consist of a steam heating system has a volume of 20 L and is filled with superheated water vapor at 200 kPa and 150 °C. At this moment both the inlet and the exit valves to the tank are closed. After a while the temperature of the steam drops to 40 °C as a result of heat transfer to the room air. Determine the entropy change (kJ/K) of the steam during this process. (7 marks)
- (c) Air enters an adiabatic turbine at 800 °C and 1.5 MPa at a rate of 1.34 kg/s and exhausts at 200 kPa. If the power output of the turbine is 700 kW, calculate the isentropic efficiency (in percent) of the turbine. Given $k = 1.667$. (10 marks)

-END OF QUESTIONS-

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION : I/2019/2020

PROGRAMME : DAK

COURSE NAME : THERMODYNAMICS

COURSE CODE : DAK 10603 / DAK 20703

List of formulas and equations

$$\left(\frac{Q_H}{Q_L}\right)_{\text{rev}} = \frac{T_H}{T_L}$$

$$\eta_{th} = \frac{W_{net, out}}{Q_{in}}$$

$$\left(\frac{T_2}{T_1}\right)_{s=const.} = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

$$E_{in} - E_{out} = \Delta E_{system}$$

$$\dot{m} = \frac{1}{v} (\mathcal{V}A)$$

$$PV = mRT$$

$$COP_{HP} = \frac{Q_H}{W_{net, in}} = \frac{Q_H}{Q_H - Q_L}$$

$$Q - W = \Delta U + \Delta KE + \Delta PE$$

$$\Delta U = U_2 - U_1 = C_v (T_2 - T_1)$$

$$\dot{W}_{in} = \dot{m} (h_2 - h_1)$$

$$q_{net} - w_{net} = \left(u_2 - u_1 + \frac{V_2^2 - V_1^2}{2} + \frac{g(z_2 - z_1)}{1} \right)$$

$$\eta_{th \text{ rev}} = 1 - \frac{T_H}{T_L}$$

$$\left(\frac{T_2}{T_1}\right)_{s=const.} = \left(\frac{v_1}{v_2}\right)^{k-1}$$

$$COP_R = \frac{Q_L}{W_{net, in}} = \frac{Q_L}{Q_H - Q_L}$$

$$Q - W = \Delta U$$

$$W = \dot{W} \Delta t$$

$$COP_R = \frac{1}{(T_H / T_L) - 1}$$

$$W = VI \Delta t$$

$$W = P_1 V_1 \ln \frac{V_2}{V_1}$$

$$\Delta H = H_2 - H_1 = C_p (T_2 - T_1)$$

$$\dot{W}_{out} = \dot{m} (h_1 - h_2)$$

$$\left(h_1 + \frac{V_1^2}{2} \right) = \left(h_2 + \frac{V_2^2}{2} \right)$$

TERBUKA