Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	THERMODYNAMIC
COURSE CODE	:	DAM 20503
PROGRAMME	:	2 DAM
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER (A) ANY **THREE (3)** IN SECTION A, (B) **ALL QUESTION ON** SECTION B

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A: ANSWER **ANY THREE (3)** QUESTIONS

Q1 (a) State the following definitions of:

(i) classical thermodynamics

(1 mark)

(ii) statistical thermodynamics

(1 mark)

(b) Equipped with example, explain the heat transfer mechanism as below:

(i) conduction

(2 marks)

(ii) convection

(2 marks)

(iii) radiation

(2 marks)

(c) The pilot of an airplane reads the altitude 3 km and the absolute pressure 58 kPa when flying over a city. Take the densities of air and mercury to be 1.15 kg/m^3 and 13,600 kg/m^3 respectively. Calculate,

(i) the local atmospheric pressure in that city in kPa.

(5 marks)

(ii) the local atmospheric pressure in that city in mmHg.

(3 marks)

(d) Why does a bicyclist pick up speed on a downhill road even when he is not pedaling? Does this violate the conservation of energy principle? Explain.

(4 marks)

Q2 (a) List two forms of energy that contribute to the internal energy of a system.

(2 marks)

(b) Explain briefly the meaning of terminology below,

(i) mechanical energy

(2 marks)

(ii) kinetic energy

(2 marks)

(iii) potential energy

(2 marks)

(c) A 2000 kg car required to climb 100 m long uphill road with a slope of 30° in 10 s as show by **Figure Q2(c)**. By disregard friction, air drag and rolling resistance, calculate power required for the car to climb:

(i) at a constant velocity

(2 marks)

(ii) from rest to a final velocity of 30 m/s

(3 marks)

(iii) from 35 m/s to a final velocity of 5 m/s

(3 marks)

(d) A room is heated by an iron that is left plugged in. Is this a heat or work interaction? Take the entire room, including the iron, as the system.

(4 marks)

Q3 (a) Explain the definition of saturated vapor and superheated vapor?

(2 marks)

(b) Determine the enthalpy (h) in kJ/kg of 1.5 kg of water contained in a volume of 1.2 m^3 at 200 kPa

(6 marks)

(c) Complete the following **Table 1** for **H_2O** (water) and write it into your answer papers.

Table 1: H_2O

Condition	***P*, kPa**	***T*, °C**	***x***	***v*, m^3/kg**	***u*, kJ/kg**	***h*, kJ/kg**	**Phase Description**
1	750	125	A	B	C	D	E
2	6000	450	F	G	H	I	J

(10 marks)

(d) How does the boiling process at supercritical pressures differ from the boiling process at subcritical pressures?

(2 marks)

Q4 (a) Define terms of "ideal gas".

(2 marks)

(b) Determine the weight of air inside a room whose dimensions are 5 m x 6 m x 8 m at pressure 2.5 bars and temperature 30 °C.

(6 marks)

(c) A 1 kg mass of air, have a complete thermodynamic cycle which consist of 3 states:

1-2: Cooled at constant pressure
2-3: Heated at constant volume until final temperature, T_3 equal to initial temperature, T_1
3-1: Volume expand at constant temperature

At state-1, the initial temperature, T_1 is 600 K and the pressure, P_1 is 220kPa. The volume for state-3 is 40% of state-1 volume. Assume R = 0.287 kJ/kg.K. Using ideal gas model, calculate:

(i) volume at State-1 and State-2

(4 marks)

(ii) temperature at state-2

(4 marks)

(iii) pressure at State-3

(4 marks)

Q5 (a) List **two (2)** physical quantities that are not conserved during a First Law of Thermodynamics process. (2 marks)

(b) Explain the function and application of equipment below,

(i) compressor

(2 marks)

(ii) turbine

(2 marks)

(iii) nozzle

(2 marks)

(c) Liquid water at 300 kPa and 20°C is heated in a chamber by mixing it with superheated steam at 300 kPa and 300°C. Cold water enters the chamber at a rate of 1.8 kg/s. If the mixture leaves the mixing chamber at 60°C, determine

(i) the phase description in inlet
(ii) the mass flow rate of the superheated steam.

(12 marks)

SECTION B: ANSWER **ALL** QUESTIONS

Q6 (a) List **two (2)** devices that apply the Second Law of Thermodynamics concept.
(2 marks)

(b) Discuss the Second Law of Thermodynamics'terminology below,

(i) reversible processes
(2 marks)

(ii) irreversible processes
(2 marks)

(c) A refrigerator discards 7.1 kW to the ambient surroundings with a power input of 2.5 kW. Calculate,

(i) the rate of cooling, Q_L
(2 marks)

(ii) the refrigerator's coefficient of performance, COP_R
(3 marks)

(d) A heat pump with 7.07 kW of electric power was provided the heat energy to a house at a rate of 64,400 kJ / hour. Calculate,

(i) the heat pump's coefficient of performance, COP_{HP}
(3 marks)

(ii) the rate of heat absorption from the outside air, Q_L
(3 marks)

(e) Why are today's refrigerators much more efficient than those built in the past?
(3 marks)

Q7 (a) State **two (2)** conclusions can be made based on the Clausius Inequality, $\oint \frac{\delta Q}{T} \leq 0$.

(2 marks)

(b) What is entropy? State the relevant formulas of entropy change to Q and T.

(5 marks)

(c) Steam enters an adiabatic turbine at 9 MPa and 550°C with a rate of 2 kg/s and leaves at 30 kPa. The isentropic efficiency of the turbine is 0.90. Neglecting the kinetic energy changes and potential energy of the steam, calculate,

(i) the exit temperature of the turbine,

(6 marks)

(ii) the output power of the turbine.

(3 marks)

(d) What do you think about the entropy of a hot baked potato decreases as it cools. Is this a violation of the increase of entropy principle? Explain.

(4 marks)

- END OF QUESTION –

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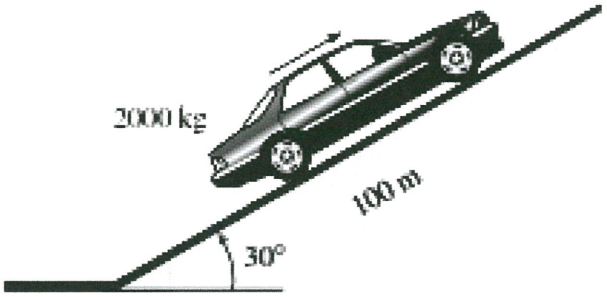

FIGURE Q2(c)