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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : THERMOFLUIDS
COURSE CODE : BNT 10403
PROGRAMME CODE : BNT
EXAMINATION DATE : JANUARY / FEBRUARY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER **ALL** QUESTIONS
OPEN BOOK EXAMINATION

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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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Q1 (a) One end of a U-tube manometer in a certain experiment is connected to a reservoir while the other end is connected to a flat zigzag pipe filled with corn cooking oil which has a density ($\rho_2 = 922 \text{ kg/m}^3$) as shown in **Figure Q1 (a)**. The zigzag pipe is connected to a round container filled with a liquid A which has a density of ($\rho_1 = 800 \text{ kg/m}^3$). On top of the reservoir, a channel filled with palm oil ($\rho_4 = 915 \text{ kg/m}^3$) was set to have an angle of 55° from the vertical line. The absolute pressure at point A is measured to be 102736 Pa and P atmosphere is 101325 Pa. Determine

(i) The density of the working fluid (ρ_3) in the U tube manometer. (14 marks)

(ii) Suggest the name of the working fluid based on your result in (i). (? marks)

(b) Briefly discuss the 1st and the 2nd Law of Thermodynamic. If heat is said to be transferred from a low temperature region to a high temperature region, does it violates any of the law mentioned above? Please give an explanation. (4 marks)

Q2 (a) Sketch P - v diagrams for steam and label the pressure, specific volume, temperature clearly, and then specify the phase of each state (on the diagrams) based on the following conditions:

(i) $P = 20 \text{ bar}$, $T = 250^\circ\text{C}$, (3 marks)

(ii) $T = 212.4^\circ\text{C}$, $v = 0.09957 \text{ m}^3/\text{kg}$, (3 marks)

(iii) $P = 10 \text{ bar}$, $h = 2650 \text{ kJ/kg}$, and (6 marks)

(iv) $P = 6 \text{ bar}$, $h = 3166 \text{ kJ/kg}$. (3 marks)

Note: You should sketch **FOUR (4)** diagrams based on the above conditions.

(b) Discuss and sketch from state 1 to state 2 in either T - v , or T - s diagram for the following processes:

(i) isentropic process, (1.25 marks)

(ii) isothermal process, (1.25 marks)

(iii) isobaric process, and (1.25 marks)

(iv) isochoric process. (1.25 marks)

Note: You should sketch **FOUR (4)** diagrams based on the above processes.



- Q3** A piston-cylinder device with a set of stops on the top, initially contains 5 kg of air at 300 kPa and 27°C as shown in **Figure Q3** (Process occurred at constant pressure and it's a closed system). Heat is now supplied to the air (inside cylinder) causing the volume to expand and rise the piston until it hits the stoppers at which the volume is twice the initial volume
- (i) Illustrate the process on a P - V diagram (show pressure and volume labels for each initial and final state on the diagram); (5 marks)
 - (ii) Determine the work done by the end of the process (in kJ), and (7 marks)
 - (iii) Find the amount of heat transfer into the system (Q_{in}), using internal energy values of air from the appropriate table. (8 marks)
- Q4**
- (a)
 - (i) Define the meaning of no-slip condition of a fluid flow. (7 marks)
 - (ii) Distinguish the difference between internal and external flow with example. (3 marks)
 - (b) The pressure in a balloon depends on the temperature of air in the balloon. The gage pressure reads 1.4 bar when the air temperature is at 25°C. If the volume of the balloon is 0.014 m³, find the pressure rise in the balloon if the temperature of air in the balloon is 36°C. Assume the atmospheric pressure to be 1.0 bar. Assume the air is an ideal gas and volume of the balloon remain constant. (5 marks)
 - (c) A round viewing window of diameter, $d = 0.8$ m is situated in a large tank of seawater (specific gravity, $SG=1.03$). The top of the window is 1.2 m below the water surface, and the window is gaged at 60° with respect to horizontal as shown in **Figure Q4 (c)**.
 - (i) Find the hydrostatic force acting on the window and the centroid, y_c . (8 marks)
 - (ii) Locate the center of pressure. (2 marks)

- Q5** (a) (i) Define metacenter and its effects on the stability of a submerged or floating
(3 marks)
- (ii) A metal part (object 2) is suspended by a thin cord from a floating wood block (object 1) as shown in **Figure Q5 (a) (ii)**. The wood block has a specific gravity, $SG = 0.3$ and dimension $60 \times 60 \times 10$ mm. The metal part has a volume 7100 mm^3 . Draw free body diagram and find the tension, T in the cord and mass, m_2 of the metal part. Given the water at 15°C specific weight, $\gamma = 9800 \text{ N/m}^3$. Compare the tension in the cord value and the weight of metal part.
(7 marks)
- (b) (i) U-tube manometer is a pressure measuring device, one of it is the inclined u-tube manometer. Define the specific use of it?
(2 marks)
- (ii) The tank is fill with oil has specific gravity, $SG = 0.8$ and the tank is pressurized with air. Evaluate the pressure of air in the tank if $h_1 = 40\text{cm}$, $h_2 = 100\text{cm}$, and $h_3 = 80\text{cm}$ as shown in **Figure Q5 (b) (ii)**. Given the specific weight, γ for mercury is $133,000 \text{ N/m}^3$ and for water is 9810 N/m^3 . Describe assumption used in the calculation?
(3 marks)
- (c) (i) Bernoulli's equation provides the relationship between pressure, velocity and elevation along a streamline. Outline **FOUR (4)** assumptions made in deriving the Bernoulli's equation.
(2 marks)
- (ii) State the Bernoulli equation in **THREE (3)** different ways using energies, pressures and heads
(3 marks)

-END OF QUESTION-

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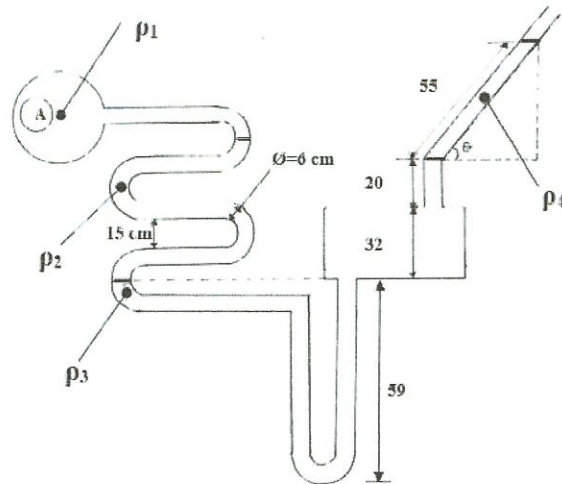


Figure Q1 (a)

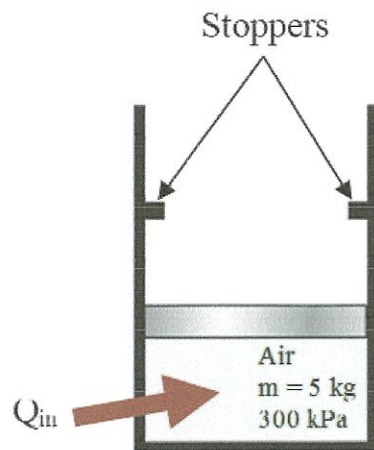


Figure Q3

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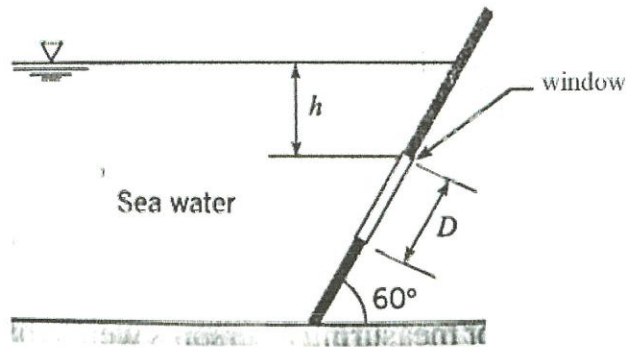


Figure Q4 (c)

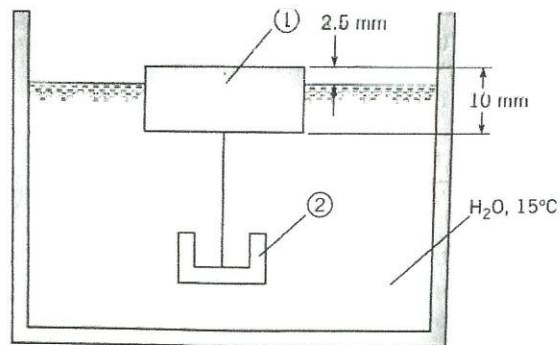


Figure Q5 (a) (ii)

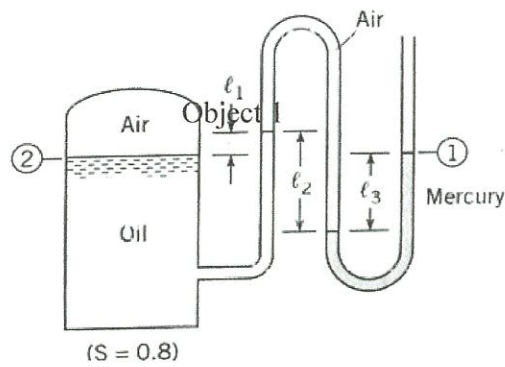


Figure Q5 (b) (ii)

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**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : AUTOMOTIVE HVAC SYSTEMS
COURSE CODE : BNG 40503
PROGRAMME CODE : BNG
EXAMINATION DATE : JANUARY / FEBRUARY 2021
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER ALL QUESTIONS

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- Q1** (a) Sketch the T-s diagram of reversed Carnot cycle and ideal-vapor compression refrigeration cycle with clear identification of heat rejection, heat absorption and work in process. (3 marks)
- (b) In moderately and very low temperature application, there are four innovative vapor compression refrigeration systems that successfully developed. List and sketch **TWO (2)** systems out of four that successfully developed. (2 marks)
- (c) A commercial refrigerator with refrigerant-134a as the working fluid is used to keep the refrigerated space at 230°C by rejecting its waste heat to cooling water that enters the condenser at 18°C at a rate of 0.25 kg/s and leaves at 26°C as per shown in **Figure Q1 (c)**. The refrigerant enters the condenser at 1.2 MPa and 65°C and leaves at 42°C . The inlet state of the compressor is 60 kPa and 234°C and the compressor is estimated to gain a net heat of 450 W from the surroundings. Determine
- the quality of the refrigerant at the evaporator inlet,
 - the refrigeration load, Q_L ,
 - the COP of the refrigerator,
 - the theoretical maximum refrigeration load for the same power input to the compressor, Q_L .
- (15 marks)
- Q2** (a) In the basic theory of heating, there are **TWO (2)** types of heat which are sensible heat and latent heat. Explain the different between these **TWO (2)** types of heat. (3 marks)
- (b) In certain automotive air conditioning filtration system, pollen filter and photo catalytic filter were used as part of filter components. Explain the function of these **TWO (2)** filter components. (3 marks)
- (c) Classify **THREE (3)** types of HVAC system by zones in automotive systems with the aided of simple drawing. (6 marks)
- (d) R12 and R134a are the two type of refrigerant that widely used in automotive air conditioning system. List **FOUR (4)** similarities of these refrigerant properties. (4 marks)
- (e) Categorize **FOUR (4)** principles of an HVAC system. (4 marks)

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- Q3** (a) Accumulator and receiver-drier are the additional component in HVAC system that may improve the HVAC system lifetime and efficiency.
- (i) Illustrate the location of both accumulator and receiver-drier with the aided of simple air conditioning system drawing.
 - (ii) Identify when the accumulator and receiver-drier will be used.
 - (iii) Investigate **FOUR (4)** conditions that require accumulator or receiver-drier shall be replace.
 - (iv) Analyze **THREE (3)** main functions of accumulator and receiver-drier. (11 marks)
- (b) Compressor is the main component in HVAC system and varies in design, size, weight, rotational speed and direction and displacement.
- (i) Define the function of compressor.
 - (ii) Illustrate **FOUR (4)** advantages of variable capacity compressor as compare to other types of compressor. (6 marks)
- (c) Give **THREE (3)** examples of commonly used anti-frosting device in automotive HVAC system. (3 marks)
- Q4** (a) Explain the term of duty cycle and give an example of duty cycle ratio signal. (3 marks)
- (b) Air conditioning temperature sensor may be divided into two types that are NTC and PTC temperature sensor. Illustrate the relation of resistance and temperature of both temperature sensors. (3 marks)
- (c) (i) Explain clearly the basic function of relay.
(ii) Based on your understanding, outline the operation of relay. (4 marks)
- (d) Discuss **THREE (3)** main advantages of stepper motor over the electric motor permanent magnet. (6 marks)
- (e) Outline **FOUR (4)** types of bus system that has been used in HVAC multiplex wiring system. (4 marks)

- Q5** (a) There are five testings that commonly used in HVAC system for leak test. List **TWO (2)** leak test out of five tests. (2 marks)
- (b) Name **SIX (6)** performance diagnostic tests that generally carried out on the automotive HVAC operation. (3 marks)
- (c) List **TWO (2)** reasons that lead to perform flushing on the automotive HVAC system. (2 marks)
- (d) Vacuum testing is one of the methods to identify the leakage in automotive HVAC system after the refrigerant has been recovered. Prepare the procedure to conduct the test clearly. (7 marks)
- (e) Investigate **THREE (3)** major sources of refrigerant contamination and the effects to the automotive HVAC system. (6 marks)

-END OF QUESTION-

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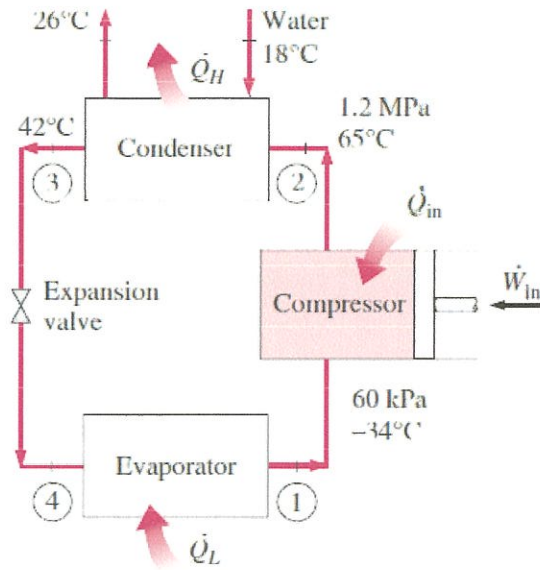


Figure Q1 (c)

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