Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	AUTOMOTIVE HVAC SYSTEMS
COURSE CODE	:	BNG 40503
PROGRAMME CODE	:	BNG
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

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 all the **FOUR (4)** systems.

(2 marks)

(c) Consider a two-stage cascade refrigeration system operating between the pressure limits of 1.2 MPa and 200 kPa with refrigerant-134a as the working fluid as per shown in **Figure Q1 (c)**. Heat rejection from the lower cycle to the upper cycle takes place in an adiabatic counter flow heat exchanger where the pressure in the upper and lower cycles are 0.4 and 0.5 MPa, respectively. In both cycles, the refrigerant is a saturated liquid at the condenser exit and a saturated vapor at the compressor inlet, and the isentropic efficiency of the compressor is 80 percent. If the mass flow rate of the refrigerant through the lower cycle is 0.15 kg/s, calculate

(i) the mass flow rate of the refrigerant through the upper cycle,
(ii) the rate of heat removal from the refrigerated space, and
(iii) the COP of this refrigerator.

(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)

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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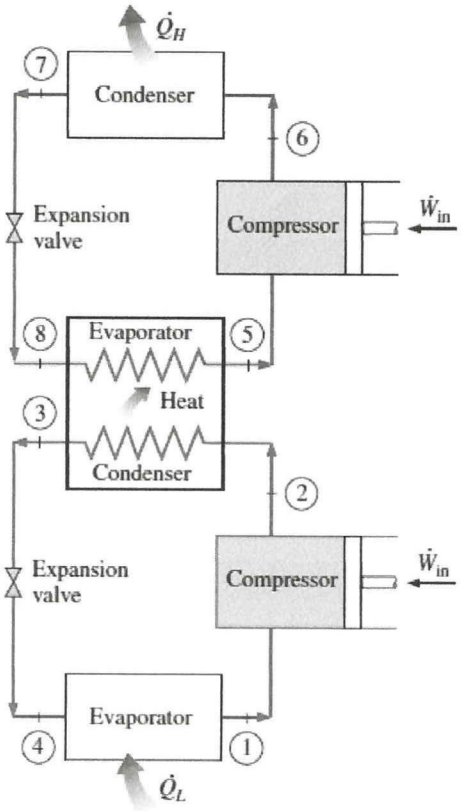

Figure Q1 (c)