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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017**

COURSE NAME : AUTOMOTIVE HVAC SYSTEMS
COURSE CODE : BNG 40503
PROGRAMME CODE : BNG
EXAMINATION DATE : DECEMBER 2016 / JANUARY 2017
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWERS ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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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 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 counterflow 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 certain automotive air conditioning filtration system, carbon filter and germicidal lamp were used as part of filter components. Analyze the function of these two filter components. (3 marks)
- (b) Classify **THREE (3)** types of HVAC system by zones in automotive systems with the aided of simple drawing. (6 marks)
- (c) Explain **FIVE (5)** principles of an HVAC system. (5 marks)
- (d) R12 and R134a are the two type of refrigerant that widely used in automotive air conditioning system. Analyze **TWO (2)** main different and **FOUR (4)** similarities of these refrigerant properties. (6 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) List **SIX (6)** types of sensor that generally used in automotive HVAC system.
- (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 the basic function of relay clearly.
(ii) Multimeter is one of the relay tester for fault diagnosis. Analyze **FOUR (4)** types of tester that may be conducted using multimeter.
- (4 marks)
- (d) Outline **FOUR (4)** variables that influence the performance of solenoid during its operation
- (4 marks)
- (e) Discuss **THREE (3)** main advantages of stepper motor over the electric motor permanent magnet.
- (6 marks)

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- Q5** (a) Name **SIX (6)** performance diagnostic tests that generally carried out on the automotive HVAC operation. (3 marks)
- (b) List **TWO (2)** reasons that lead to perform flushing on the automotive HVAC system. (2 marks)
- (c) 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)
- (d) Investigate **FOUR (4)** major sources of refrigerant contamination and the effects to the automotive HVAC system. (8 marks)

- END OF QUESTION -

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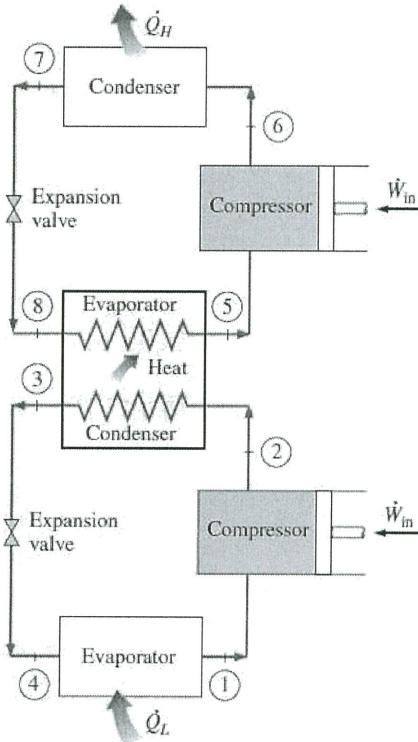


Figure Q1 (c)

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