



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023**

COURSE NAME	:	AUTOMOTIVE HVAC SYSTEM
COURSE CODE	:	BNG 40503
PROGRAMME CODE	:	BNG
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER <b>ALL</b> QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA <b>CLOSED BOOK</b> 3. STUDENTS ARE <b>PROHIBITED</b> TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

**CONFIDENTIAL**

**TERBUKA**

- Q1** (a) Air conditioning comes standard in almost every car sold worldwide today. At the turn of the century, inventors started to look at the best way to develop a comfortable cooling system. Outline the development of automotive air-conditioning from the earliest invention to current technologies. (4 marks)
- (b) The automotive air conditioner must control four conditions within the vehicle interior to be effective. Classify those **FOUR (4)** factors for air conditioning to become effective. (8 marks)
- (c) A phase change is when matter changes from one state (solid, liquid, gas) to another. It is essential to note that phase change is a physical, not a chemical, change. The substance still has the same chemical characteristics. A refrigerant constantly changes its phases throughout the cycles in an air conditioning system. Analyze the phase changes in the air conditioning system and their significance to the system. (6 marks)
- (d) Based on question **Q1 (c)**, identify **TWO (2)** components in the air conditioning system involved in a phase change process. (2 marks)
- Q2** (a) There are two main types of air conditioning systems in use in the automobile industry today. The main difference between each system is the device used to lower the refrigerant pressure. Differentiate both systems of metering devices complete with a diagram. (10 marks)
- (b) Pressure-enthalpy diagram as in **Figure Q2 (b)** shows the relationship between the pressure and enthalpy of a selected refrigerant. One of the most critical skills needed for the professional engineer in the HVAC field is navigating the refrigeration cycle on a pressure-enthalpy diagram. Produce a depth explanation (with a diagram) of the pressure-enthalpy diagram with the air conditioning process and components. (10 marks)
- Q3** (a) An air conditioner compressor is a component in the system that raises the temperature and pressure of the vapour refrigerant that leaves the evaporator coil. The air conditioner's compressor compresses refrigerant vapour, increasing its pressure and turning it into a hot gas. Illustrate the working principle of a through vane type of automotive compressor with a simple diagram. (10 marks)
- (b) Dual-zone air-conditioning system is a system of two separate vehicle sections maintaining different preferred temperatures simultaneously. This feature is handy for families with other temperature preferences. Produce the working principle of the dual-zone air conditioning system with a simple diagram. (10 marks)

- Q4** (a) Early air conditioning systems used mechanical controls, which were often imprecise and difficult to adjust. The electronic controls replaced mechanical controls, leading to greater accuracy and control over the air conditioning system.
- (i) Construct a working flow for the manual air conditioning system with the aid of **Figure Q4 (a)**. (5 marks)
  - (ii) Construct a working flow for an automatic air conditioning system with the aid of **Figure Q4 (a)**. (5 marks)
- (b) The number of sensors in an air conditioning system can vary depending on the design and complexity. Using sensors in air conditioning systems helps improve energy efficiency and provide greater comfort for occupants, among many others, by ensuring that the system functions appropriately and adapts to environmental changes.
- (i) List **FIVE (5)** electronic sensors used in the air conditioning system. (5 marks)
  - (ii) Choose **ONE (1)** electronic sensor from **Q4 (b) (i)**. Explain the functions of that sensor in the air conditioning system with a simple diagram. (5 marks)
- Q5** (a) Troubleshooting problems in air conditioning systems can be a complex process that requires knowledge of the systems and components. Generalize **FIVE (5)** initial air conditioning inspection methods to kickstart troubleshooting. (10 marks)
- (b) The temperature difference refers to the difference in temperature between the air entering the air conditioning system and the air leaving the system. Monitoring and maintaining the temperature difference within the recommended range for the specific air conditioning system is vital.
- (i) State **TWO (2)** locations used to measure the temperature difference. (2 marks)
  - (ii) Produce an explanation for each of the answers in **Q5 (b) (i)**. (4 marks)
- (c) A sight glass is a transparent glass tube or window generally installed in a receiver drier. Sight glasses come in two basic styles: plain and with a moisture indicator. Describe **TWO (2)** functions of sight glass at the receiver drier. (4 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER / SESSION: II / 2022/2023

PROGRAMME CODE : BNG

COURSE NAME : AUTOMOTIVE HVAC SYSTEM

COURSE CODE : BNG 40503

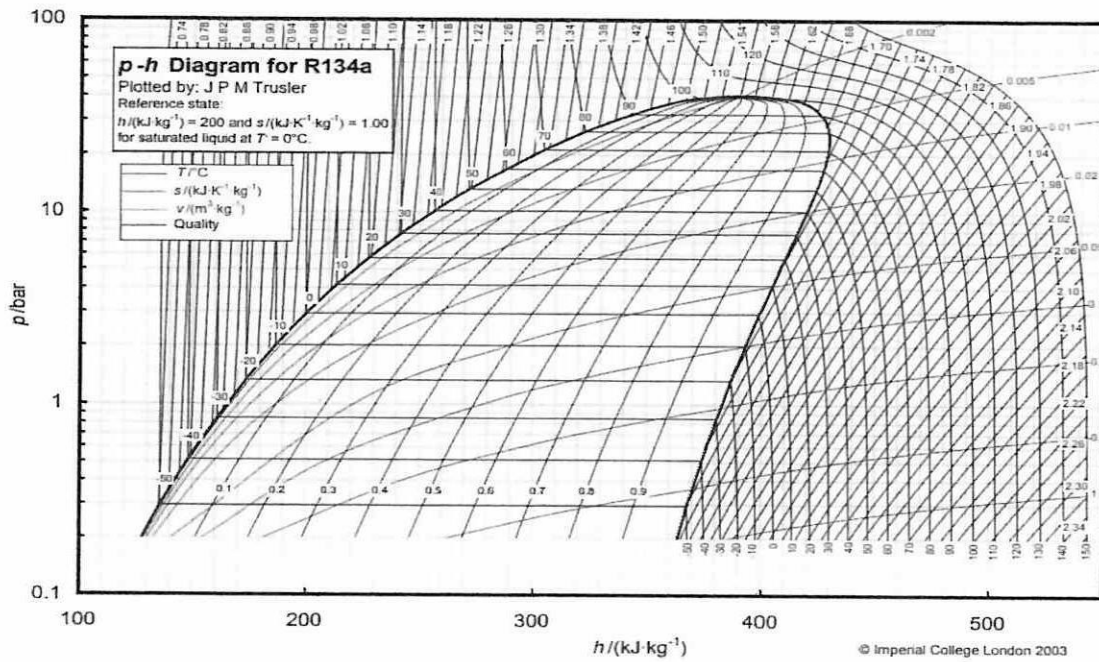


Figure Q2 (b)

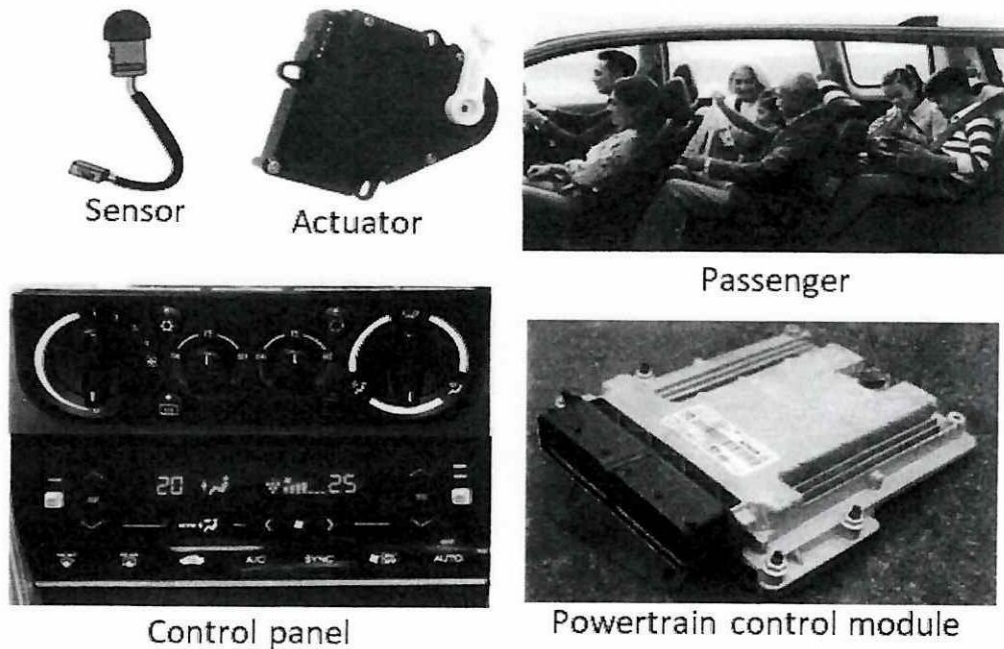


Figure Q4 (a)

TERBUKA