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Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2021/2022**

COURSE NAME : TECHNOLOGY OF REFRIGERATION  
AND AIR-CONDITIONING  
COURSE CODE : BBA 20203  
PROGRAMME CODE : BBG  
EXAMINATION DATE : JANUARY / FEBRUARY 2022  
DURATION : 3 HOURS  
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS

2. THIS FINAL EXAMINATION IS A  
**ONLINE ASSESSMENT AND  
CONDUCTED VIA CLOSE BOOK.**

THIS QUESTION PAPER CONSISTS OF **SIXTEEN (16)** PAGES

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**SECTION A (40 marks)**

- Q1.** The heat content of water is usually measured in:
- A. Btu
  - B. Kelvin
  - C. Celsius
  - D. Fahrenheit
- Q2.** The human body, as a surface, will either radiate it's \_\_\_\_\_ to cooler surrounding surfaces or absorb \_\_\_\_\_ from warmer surfaces.
- A. energy
  - B. heat
  - C. temperature
  - D. none of these
- Q3.** Which way is it possible to lower temperatures?
- A. Add heat to the object
  - B. Putting the object to be cooled in contact with another object which has a lower temperature
  - C. Putting the object to be cooled in contact with another object which has a higher temperature
  - D. By increasing the pressure on the object to be cooled
- Q4.** How is heat transferred?
- A. From low to high temperature
  - B. From a warm source to a cold object
  - C. From a cold source to a warm object
  - D. Between two objects with same temperatures
- Q5.** An increase in sensible heat causes
- A. Ice to Melt
  - B. A higher thermometer reading.
  - C. A lower thermometer reading.
  - D. No change of the thermometer reading.

- Q6.** The volume of the gas increases as the temperature increases for a fixed amount of gas at a constant pressure. This statement refers to;
- A. Charles Law
  - B. Boyle's Law
  - C. Gay-Lussac's Law
  - D. Combined Gas Law
- Q7.** The volume of a gas is increased from 150mL to 350mL by heating it. If the original temperature of the gas was 25°C, what will its final temperature (°C) be under constant pressure?
- A. 58.3
  - B. 146
  - C. 422
  - D. 695
- Q8.** A sample of oxygen occupies 47.2 litres under a pressure of 1240 torr at 25°C. What volume would it occupy at 25°C if the pressure were decreased to 730 torr?
- A. 29.3 L
  - B. 32.3 L
  - C. 47.8 L
  - D. 80.2 L
- Q9.** A sample of oxygen with a pressure of 900 torr at 25°C occupies 5.50 litres. At what temperature will it occupy 10.0 litres at the same pressure?
- A. -109°C
  - B. 154°C
  - C. 269°C
  - D. 370°C

- Q10.** What is Boyle's law in simple terms?
- I.  $P_1 V_1 = P_2 V_2$
  - II.  $PV = \text{constant}$
  - III.  $P_1/P_2 = V_2/V_1$
- A. I only
  - B. II only
  - C. III only
  - D. I, II, and III
- Q11.** If you push down the plunger of a bicycle pump the chamber's volume will decreased. When the pressure in the chamber increasing, the air then rushes out of the pump and into your flat tire. What gas law does this represent?
- A. Boyle's Law
  - B. Charles Law
  - C. Gay-Lussac's Law
  - D. Newtons laws
- Q12.** Based on ASHRAE Standard 34-2001, which of these flammability classification of refrigerants?
- A. Class 1 non-flammable
  - B. Class 2 moderately flammable
  - C. Class 3 highly flammable
  - D. All of these
- Q13.** Which refrigerant is used most frequently in large industrial plants?
- A. ammonia
  - B. sulfur dioxide
  - C. calcium chloride
  - D. carbon dioxide
- Q14.** What are three basic properties of lubricating oils?
- A. viscosity, lubricity, and economical
  - B. viscosity, density, and slickness
  - C. viscosity, open cells, and water
  - D. viscosity, lubricity, and chemical stability

- Q15.** Where do you commonly find R-134a refrigerant used today?
- A. in ice-cream freezers
  - B. in truck refrigeration systems
  - C. in commercial installations
  - D. in automobile A/C systems
- Q16.** What does the Montreal Protocol have to do with the future of refrigerants?
- A. little or nothing
  - B. stops production altogether
  - C. none of the above
  - D. changes in composition to eliminate chloride
- Q17.** Where will the superheating process take place?
- A. Discharge line
  - B. Liquid line
  - C. Suction line
  - D. Expansion line
- Q18.** To achieve a better Coefficient of Performance (COP) of a vapour compression system, the degree of sub-cooling after undergoing condensation should be \_\_\_\_\_.
- A. 0°C
  - B. as high as possible
  - C. as low as possible
  - D. Between 5°C to 10°C
- Q19.** What the factor cause the compressor to work hard?
- A. Low load
  - B. Low charge
  - C. High suction pressure
  - D. Low suction pressure



- Q20.** What is the state of the refrigerant when leaving the compressor ?
- A. 100 percent Low Pressure, low temperature, superheated vapor
  - B. 100 percent High Pressure, high temperature, superheated vapor
  - C. 100 percent Low Pressure, low temperature subcooled Liquid
  - D. 100 percent High Pressure, high temperature subcooled Liquid
- Q21.** When entering the compressor, what is the state of the refrigerant?
- A. High pressure, high temperature, 100 percent superheated vapor
  - B. High pressure, high temperature, 100 percent subcooled liquid
  - C. Low pressure, low temperature, 100 percent superheated vapor
  - D. Low pressure, low temperature, 100 percent subcooled liquid
- Q22.** Which of the following refrigerant condition has the lowest pressure and temperature when in a vapor-compression system?
- A. Sub-cooled liquid after condensation process
  - B. Gas/liquid mixture after expansion process
  - C. Super-heated gas before compression process
  - D. Super-heated gas after compression process
- Q23.** What is the temperature of the suction line if you touch it?
- A. Warm
  - B. Cool
  - C. Cold
  - D. Very Warm/Hot
- Q24.** Condensers are heat \_\_\_\_\_ designed to condense the high-pressure, high-temperature refrigerant discharged by the compressor.
- A. absorbers
  - B. spreaders
  - C. collectors
  - D. exchangers

- Q25.** Where is the sensing bulb of a TXV located?
- A. Liquid Line, close to the evaporator inlet
  - B. Suction Line, close to the evaporator outlet
  - C. Suction Line, close to the evaporator inlet
  - D. Liquid Line, close to the evaporator outlet
- Q26.** Why do the evaporator and condenser in a refrigeration cycle consist of coils and fins?
- A. To increase pressure
  - B. To restrict flow rate of refrigerant
  - C. To enhance heat transfer
  - D. To facilitate maintenance
- Q27.** What are the role(s) of a compressor in a refrigeration system?
- I. to compress the refrigerant
  - II. maintain low pressure & low temperature in evaporator
  - III. maintain low pressure & low temperature in condenser
  - IV. maintain high pressure & high temperature in evaporator
  - V. maintain high pressure & high temperature in condenser
- A. I & II
  - B. I, II, & III
  - C. I, II, & V
  - D. I, III, & IV
- Q28.** The key function of an expansion device are...
- I. Reducing condensing pressure to evaporating pressure
  - II. Controlling refrigerants mass flow
  - III. Generates cooling
  - IV. Filling the evaporator with the required amount of liquid
- A. I, II, & III
  - B. I, III, & IV
  - C. I, II, & IV
  - D. I, & IV

- Q29.** Which of the following is **NOT** the advantage of having secondary refrigerant compare to direct cooling system?
- A. The risk of loss of leakage is more readily controlled
  - B. The pipeline diameter used is considerably larger.
  - C. More easily controlled to give accurate temperature control
  - D. Greater flexibility
- Q30.** Centrifugal compressors are used in:
- A. Large refrigerant capacity systems
  - B. In small refrigerant capacity systems
  - C. Domestic refrigeration and air conditioning
  - D. All of the above
- Q31.** Which of these statements about capillary tubes are true?
- I. Capillaries are inexpensive and allow for the equalization of system pressure.
  - II. Capillaries are inexpensive and do not allow for the equalization of pressure.
  - III. Must only be applied to systems with a 1:1 configuration between compressor and evaporator.
  - IV. They are capable of optimal superheat control regardless of fluctuating system pressures and loads.
- A. I, & III
  - B. II, & III
  - C. III, & IV
  - D. II, & IV
- Q32.** The secondary refrigerant in central air conditioning plant is...
- A. Air
  - B. Water
  - C. Freon-22
  - D. None



Q33. The secondary refrigerant in an ice plant is..

- A. Mercury
- B. Brine solution
- C. Freon-22
- D. None

Q34. Entropy can be described as ...

- A. Degree of disorder
- B. Loss of energy over time
- C. Heat increase
- D. Temperature decrease

Q35. Line A in the **Figure Q35** below represents;

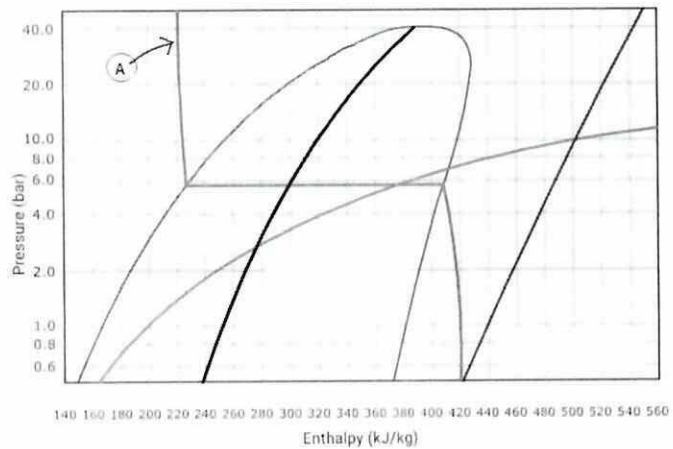


Figure Q35

- A. Constant temperature
- B. Constant density
- C. Constant title
- D. Constant specific entropy

Q36. Line B in the figure below represents;

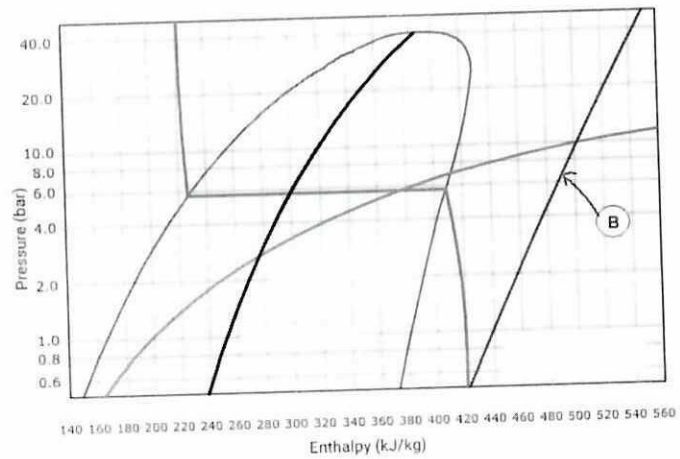


Figure Q36

- A. Constant temperature
  - B. Constant density
  - C. Constant title
  - D. Constant specific entropy
- Q37. \_\_\_\_\_ temperature measurement is an indication of moisture content of the air.
- A. Wet bulb
  - B. Dry bulb
  - C. Dew point
  - D. Dew bulb
- Q38. What is the comfort range of relative humidity (RH) for dry bulb temperatures?
- A. 20 - 50%
  - B. RH 60 - 80%
  - C. RH 45 - 65%
  - D. RH 70 - 80%

- Q39.** In Psychrometric chart, Y-axis indicates which of the following,
- A. Dry bulb temperature
  - B. Enthalpy
  - C. Humidity Ratio
  - D. Wet Bulb temperature
- Q40.** In Psychrometric chart, lines of \_\_\_\_\_ run diagonally downward from left to right across the chart.
- A. Latent heat
  - B. Constant enthalpy
  - C. Dry bulb temperature
  - D. Relative humidity

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**SECTION B (60 marks)**

**Q41** An air conditioning process are uses refrigerant R410a with the outlet of condenser at 20°C. The pressure at the evaporator is 0.30 MPa and the pressure of condenser is 2.0 MPa. Meanwhile the temperature at compressor inlet is -10°C.

(a) By using suitable P-h diagram (**Figure Q41**), draw the cycle and what is the evaporating and condensing temperatures?

(10 marks)

(b) Explain in detail in what are the process, temperature, pressure and phase at each point of the refrigerant based on your cycle drawing in **Q41 (a)**

(10 marks)

(c) Based on the data from **Q41(a)**, what is;

- i) Degree of Subcool and Degree of Superheat
- ii) Compression ratio
- iii) Total heat rejection at condensor
- iv) Heat of compression
- v) Refrigeration effect

(10 marks)

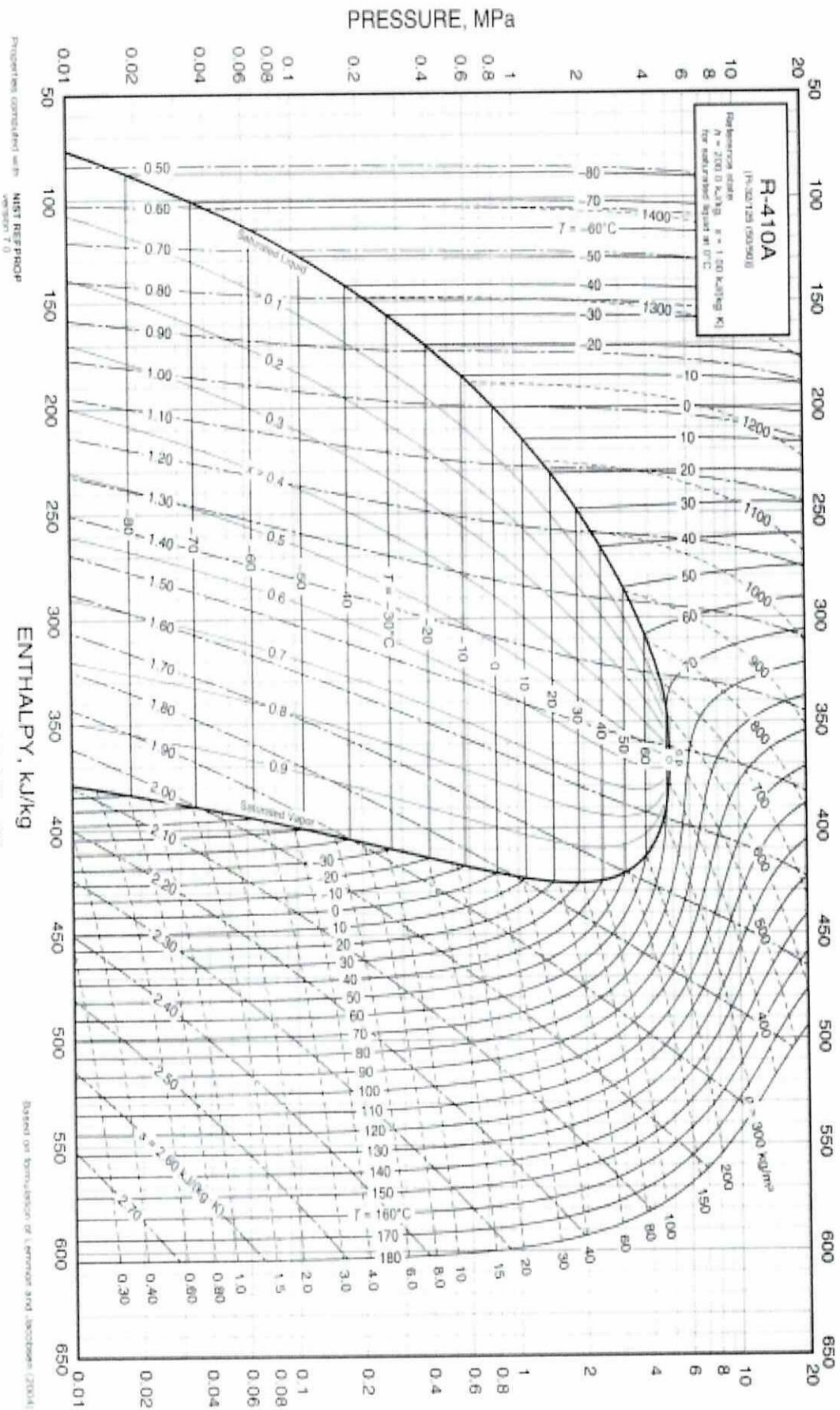


Figure Q41: Mohler Chart





**Q42** (a) A new split air conditioning unit are installed in a room. When it is turned on, the room temperature is 34 °C dry bulb and 80% relative humidity.

(i) By using psychrometric chart (**Figure Q42**), what is the moisture in the room. (2 marks)

(ii) Using with the same psychrometric chart, what is the air moisture remove from the room after a few hours when the air conditioning unit is turned on, with the room temperature change to 26°C dry bulb temperature and 60% relative humidity. (3 marks)

(b) What are the values in the space below by using a psychrometric chart.

Table Q42(b)

	Dry bulb temperature	Wet bulb temperature	Relative humidity	Dewpoint temperature	Humidity Ratio (g/Kg)
A	33	19			
B	20		50		
C	44				10.5
D		5		-5	
E		10	90		

(10 marks)





- Q3** (a) State briefly the impact of Freons (CFCs) on refrigeration and air conditioning. (5 marks)
- (b) What are the important issues to be considered in the design of refrigeration systems? (10 marks)

- **END OF QUESTIONS** -