Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	TECHNOLOGY OF REFRIGERATION AND AIR-CONDITIONING
COURSE CODE	:	BBA 20203
PROGRAMME CODE	:	BBG
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

SECTION A (40 marks)

Q1. Temperature is defined as:

A. How hot it is.
B. The level of heat.
C. How cold it is.
D. Why it is hot.

Q2. In which direction does heat flow?

A. From a cold substance to a cold substance.
B. Up.
C. Down.
D. From a warm substance to a cold substance.

Q3. How is heat transferred? What is principle of heat transfer?

I. Heat energy cannot be destroyed
II. Heat flow from lower temperature to higher temperature
III. Heat can be transferred from one substance to another
IV. Heat flow from higher temperature to lower temperature

A. I, and II,
B. I, II, and III
C. I, II, III and IV
D. I, III, and IV

Q4. An increase in sensible heat causes

A. A higher thermometer reading.
B. A lower thermometer reading.
C. No change of the thermometer reading.
D. Ice to melt.

Q5. Latent heat causes

A. A higher thermometer reading.
B. Temperature to rise.
C. A change of state.
D. Temperature to fall.

Q6. For a fixed amount of gas at a constant pressure, the volume of the gas increases as the temperature increases. This statement refers to;

A. Boyle's Law.
B. Charles Law.
C. Gay-Lussac's Law.
D. Combined Gas Law.

Q7. If you push down the plunger of a bicycle pump the chamber's volume is decreased. When that happens pressure in the chamber increases and 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. Newton's law.

Q8. A mass of an ideal gas occupies 0.75 m^3 at 20°C and is heated at constant pressure to 90°C. What is the final volume?

A. 3.38 m^3
B. 0.93 m^3
C. 0.17 m^3
D. 0.61 m^3

Q9. A sample of nitrogen occupies 5.50 liter under a pressure of 900 torr at 25°C. At what temperature will it occupy 10.0 liter at the same pressure?

A. -109°C
B. 154°C
C. 269°C
D. 370°C

Q10. Under conditions of fixed temperature and amount of gas, Boyle's law requires that

I. $P_1V_1 = P_2V_2$
II. PV = 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. Heat may be transferred from one body to another by

A. Radiation.
B. Conduction.
C. Convection.
D. All of the above.

Q12. Which of these flammability classifications of refrigerants is based on ASHRAE Standard 34-2001?

A. Class 1 non-flammable.
B. Class 2 moderately flammable.
C. Class 3 highly flammable.
D. All of these.

Q13. HCFC are the second group of refrigerants that have low ODP rates. HCFCs are formed as a result of the combination of the following atoms?

A. Hidrogen, Carbon, Florin, and Clorine.
B. Carbon, Fortane, Calcium and Clorine.
C. Hidrogen, Clorine, Florine and Carbon Dioxide.
D. Hidrogen, Carbotane, Florin and Clorine.

Q14. HFC does not destroy the ozone layer in the stratosphere because?

A. ODP is zero.
B. ODP is lower.
C. ODP is high.
D. GWP is zero.

Q15. Spit unit air conditioning consists refrigerant of type

A. R32 and R11.
B. R32 and R410A.
C. R11 and R141B.
D. R12 and R134a.

Q16. The ozone layer has thinned in the Antarctic and Arctic regions. The depletion of the ozone layer is especially noticeable during the spring where 50% of the ozone molecules will be destroyed. This phenomenon is known as

A. Ozone hole
B. Global warming
C. Open burning
D. None of the above

Q17. Superheating will be found in which of the following location?

A. Discharge line
B. Liquid line
C. Suction line
D. Expansion line

Q18. What is the metering device function?

A. Controls sub-cooling.
B. Cycles the compressor.
C. Stores refrigerant.
D. Meters refrigerant.

Q19. Which of the following will cause the compressor work harder?

A. High suction pressure.
B. Low suction pressure.
C. Low charge.
D. Low load.

Q20. What is the condition of the refrigerant when leaving the compressor?

A. 100 percent Low Pressure, low temperature, superheated vapour.
B. 100 percent High Pressure, high temperature, superheated vapour.
C. 100 percent Low Pressure, low temperature sub cooled Liquid.
D. 100 percent High Pressure, high temperature sub cooled Liquid.

Q21. What is the condition of the refrigerant when entering the compressor?

A. High pressure, high temperature, 100 percent superheated vapour.
B. High pressure, high temperature, 100 percent sub cooled liquid.
C. Low pressure, low temperature, 100 percent superheated vapour.
D. Low pressure, low temperature, 100 percent sub cooled liquid.

Q22. In a vapor-compression system, which of the following refrigerant condition has the lowest pressure and temperature?

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. Outdoor unit components include are

I. Condenser
II. Evaporator
III. Compressor
IV. Condenser fan

A. I, and II
B. I, II, and III
C. I, III, and IV
D. I, II, III, and IV

Q24. Refrigerant in the evaporator

A. changes from vapor to liquid.
B. changes from liquid to vapor.
C. stays in the vapor state.
D. stays in the liquid state.

Q25. 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

Q26. The sensing bulb of a TXV located at…

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

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 and II
B. I, II, and III
C. I, II, and V
D. I, III, and IV

Q28. The key function of an expansion device is…

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, and III
B. I, III, and IV
C. I, II, and IV
D. I, and IV

Q29. 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

Q30. Which of these statements about screw compressor are true?

I. Positive displacement compressor
II. Refrigerant flow is mainly in the axial direction.
III. Also known as a Turbo compressor.
IV. Suction and compression take place as the rotors unmeshed and mesh.

A. I, III, & IV
B. II, III, & IV
C. I, II, & IV
D. I, II, & III

Q31. 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.

Q32. Which is the secondary refrigerant in central air conditioning plant?

A. Air.
B. Water.
C. Freon-22.
D. None.

Q33. Which is the secondary refrigerant in an ice plant?

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

Q34. Enthalpy can be described as …

A. Degree of disorder.
B. Loss of energy over time.
C. property of a thermodynamic system.
D. Temperature decrease.

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

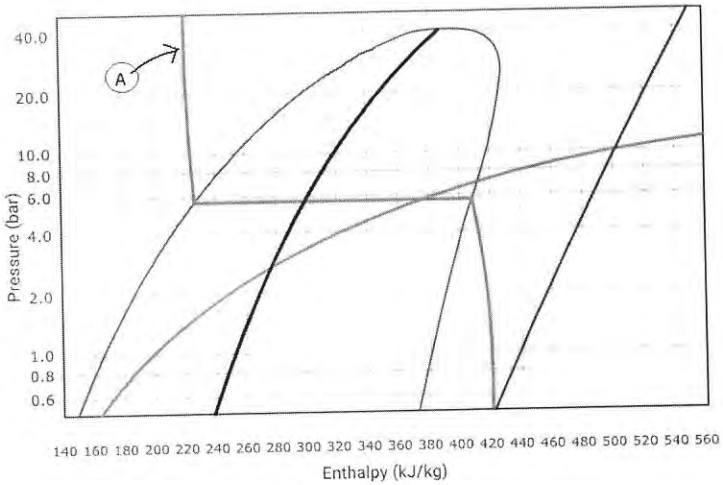

Figure Q35

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

Q36. Line B in the figure below represents;

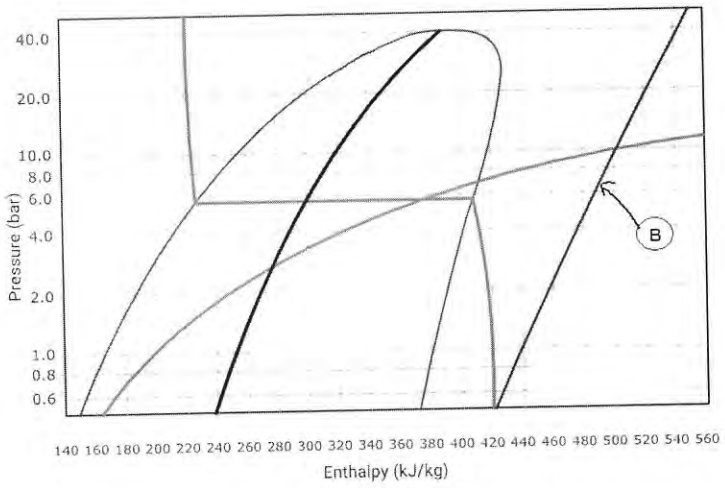

Figure Q36

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

Q37. Psychrometry is the science and practice of air _____ and their control.

A. Pressures.
B. Mixtures.
C. Distributions.
D. Diffusions.

Q38. What determines the amount of water vapour that air can hold?

A. Pressure.
B. Vacuum.
C. Temperature.
D. Sunshine.

Q39. A wet-bulb temperature reflects the cooling effect of _____ water.

A. Evaporating.
B. Boiling.
C. Frozen.
D. Condensing.

Q40. The temperature at which the air cannot hold all the water vapour mixed in it and some vapour starts condensing is called as

A. humidification temperature.
B. dehumidification temperature.
C. dew point temperature.
D. none of the above.

SECTION B (60 marks)

Q41 The following measurements were taken on an Air Conditioning system using R134a.

- Evaporator pressure at 0.35 MPa,
- Condenser pressure at 1.75 MPa
- Compressor inlet at 20°C, Compressor outlet at 100°C,
- Condenser outlet at 30°C

(a) Draw the cycle on the P-h diagram (**Figure Q41**) and identify the evaporating and condensing temperatures. What are the degrees of superheat and sub-cool?

(10 marks)

(b) Based on your answer in Q41(a), explaining what happen to the refrigerant in the cycle by considering the process, temperature, pressure, and state of phase at each point.

(10 marks)

(c) Based on the data from Q41(a), calculate;

i) Heat of compression
ii) Refrigeration effect
iii) Total heat rejection at condenser
iv) Compression ratio
v) Volume of gas entering compressor

(10 marks)

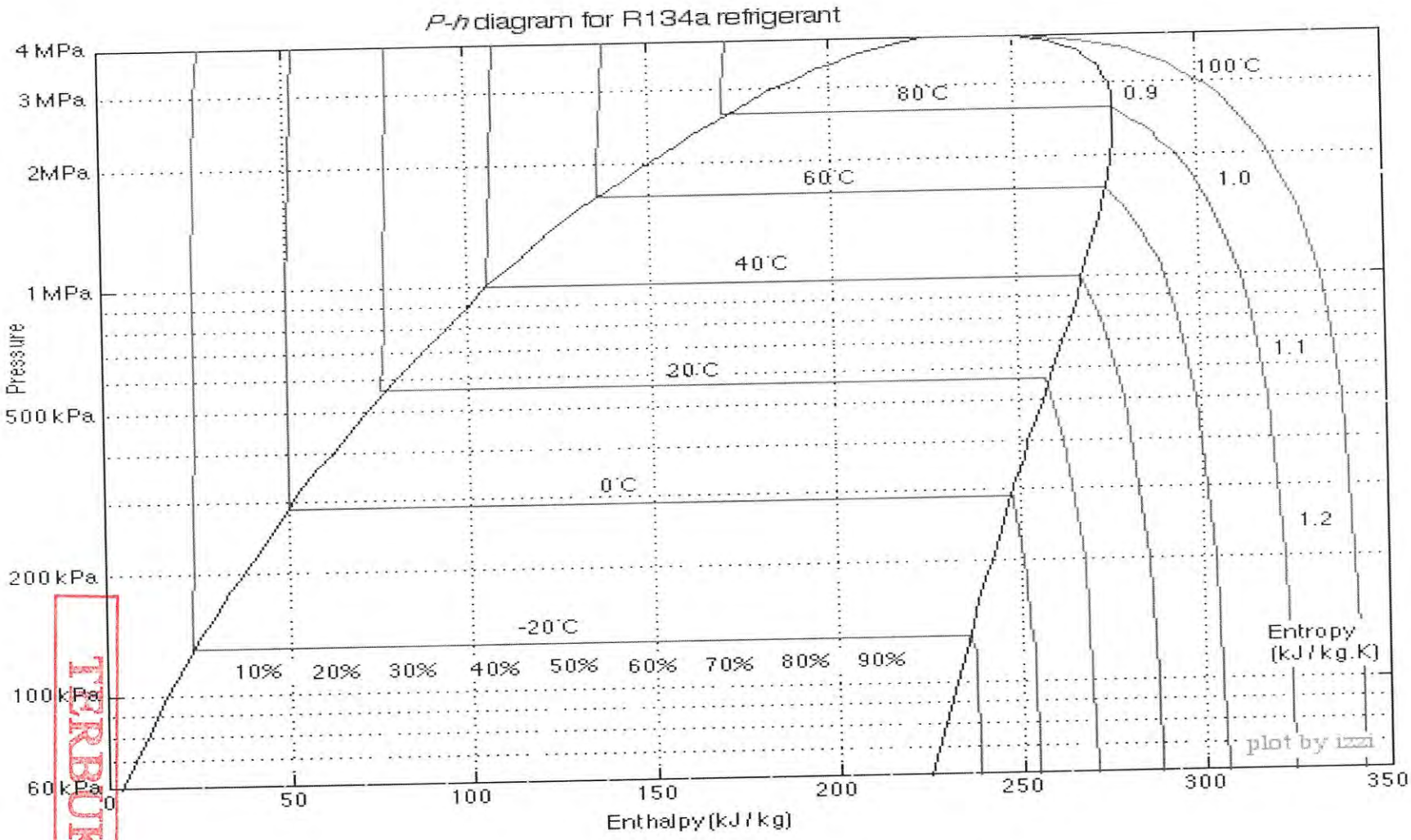

Figure Q41: Simplified lg(p)-h diagram according to Mollier

Q42 (a) Explain the Psychrometric method in refrigeration and air conditioning systems

(2 marks)

(b) After a few hours the air conditioning unit is turned on, the room temperature change to 27°C dry bulb temperature and 50% relative humidity. How much have air moisture remove from the room?

(3 marks)

(c) Using a psychrometric chart, find the required values in the space below;

Table Q42(b)

	Dry bulb temperature	Wet bulb temperature	Relative humidity	Dew point temperature	Humidity Ratio (g/Kg)
A	30	18			
B	24		50		
C	35				14
D		18		15	
E		20	100		

(10 marks)

Q43 (a) Sketch a P-h (Mollier) chart and details the processes that take place for refrigeration and air conditioning systems.

(5 marks)

(b) A cooling system has the following characteristics;

- Condenser Release (condenser) t=43°C, h=163kJ/kg, P=1mPa
- Evaporator Input (evaporator) t=8°C, h=163kJ/kg, P=0.1mPa
- Evaporator Release (evaporator) t=21.5°C, h=314kJ/kg, P=0.1mPa
- Condenser Input (condenser) t=81°C, h=364.4kJ/kg, P=2mPa

Based on P-h (Mollier) chart in Figure Q4, sketch the points of each condition for the following cooling system and determine:

i. Coefficient of Performance

ii. Refrigeration Work Efficiency

(10 marks)

- **END OF QUESTIONS** -