Menoufia University
Mech. Power Eng. Dept.
Subject:Cycles & Ref. systems
Total mark: 100 (mark)

Faculty of Engineering
Post-graduate (Diploma)
Final Exam: 2015/2016
Time allowed: 3 hours.

Answer the following questions:

Question (1) **[15 mark]**

A) Explain the differences between an absorption refrigeration system and a mechanical vapor compression system. (3 mark)

B) Draw a neat diagram of the simple ammonia-water absorption refrigeration system and explain its working. (3 mark)

C) With neat diagrams, explain the difference between the performance of flash sub-cooler, surface Sub-cooler and flash inter-cooler. (3 mark)

D) Explain the effect of variable suction and discharge pressures on the performance of the standard vapor compression system. (3 mark)

E) Explain the advantages and disadvantages of air refrigeration system. (3 mark)

Question (2) **[30 mark]**

Answer the following by true (√) or fulse (×)

1 – Superheating, always increases specific work of compression,

2 - Degree of superheating obtained using a LSHX is always equal to degree of sub-cooling,

3 - In actual VCRS, the system performance is affected mainly by, pressure drop and heat transfer in suction line,

4 - Compared to individual expansion valves, multiple expansion valves, decrease the quality of refrigerant at the inlet to low temperature evaporator

5 - Compared to multi-evaporator and single compressor systems, multi-evaporator systems with multiple compressors, decrease maximum cycle temperature,

6 - In multi-stage systems, there is a possibility of migration of lubricating oil from one compressor to other,

7 - Using a flash tank, quality of refrigerant at the evaporator inlet can be increased,

8 - Compared to compression systems, absorption systems offer the benefits of, possibility of using low-grade energy sources,

9 - Absorption of the refrigerant by the absorbent in a vapour absorption refrigeration system is accompanied by, absorption of heat,

10 - The conventional, continuously operating single stage vapour absorption refrigeration system, does not require a condenser,

11 - Which of the following statements are true, ammonia-water systems can be used for refrigeration applications below 0°C only,

12 - Vapour absorption refrigeration systems using water-lithium bromide, are used in large frozen food storage applications,

13 - For a required refrigeration capacity, the solution heat exchanger used in water lithium bromide systems, reduces heat rejection rate at condenser,

14 - In water-lithium bromide systems, crystallization of solution is likely to occur in absorber,

15 - In commercial water-lithium bromide systems, crystallization is avoided by adding additives,

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Question (3) **[25 mark]**

a) A refrigeration unit works with R-134a has a compressor of 1.6 m^3/min piston displacement. The evaporator and condenser pressure are respectively 2 and 11 bar. The liquid leaves the condenser is cooled to 22 °C in liquid/vapor heat exchanger. The vapor leaves the evaporator with 6°C superheating and leaves the compressor at 80 °C. The volumetric efficiency is 72 %.

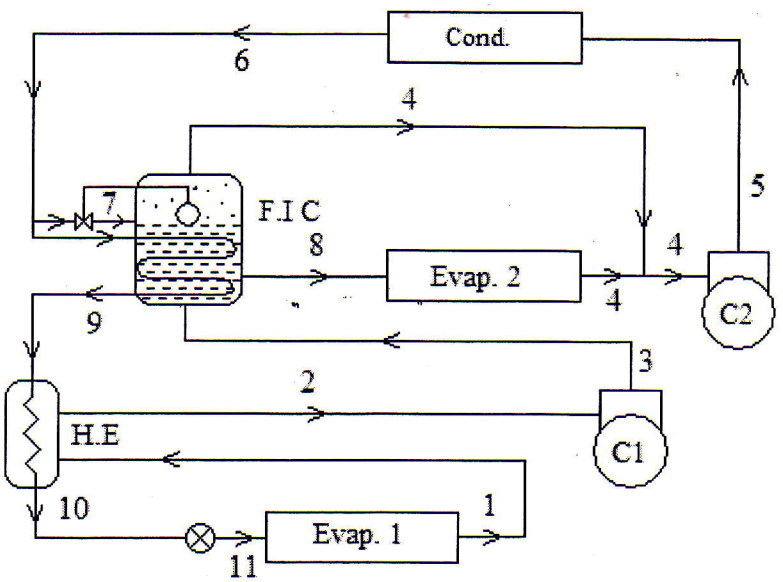
Find: i) The system R.C. ii) Required power
iii) Heat rejected in compressor iv) C.O.P. (15 mark)

b) An absorption refrigeration plant, having 150 T.R capacities, uses dry saturated steam at 2 bars to heat the aqua-solution in the generator. The condensate leaves at saturation temperature. The following data is obtained per one kg of liquid ammonia leaving the condenser:
Refrigeration effect is 1200 kJ,
Heat input to generator is 2250 kJ,
Heat rejected in condenser is 1200 kJ,
Heat rejected in absorber is 1670 kJ, and
Heat rejected in rectifier is 350 kJ.
Latent heat of steam at 2bar = 2250 kJ/kg
Calculate:
i – The C.O.P of the unit,
ii – The amount of ammonia leaving the condenser.
iii – The quantity of steam consumed and
iv – The power required to derive the aqua pump. (10 mark)

Question (4) **[30 mark]**

An ammonia refrigeration system consists of two stages compressors, two evaporators, flash intercooler and sub-cooler, heat exchanger and condenser as shown in the following figure. Ammonia vapor condenses in the condenser at 40 °C. The amount of liquid refrigerant goes to the low temperature evaporator is sub-cooled 10 °C in the liquid sub-cooler and another 10 °C in the liquid-vapor heat exchanger. Vapor leaves the low pressure evaporator saturated at (-30 °C), and then it is superheated in the heat exchanger at the same pressure. The vapor comes out the flash intercooler and high pressure evaporator saturated at 4 bars. The cooling capacities of the L.P. and H.P. evaporators are 15 T.R. and 35 T.R. respectively. Calculate;

(a) Refrigerant mass flow rates through each evaporator,
(b) Refrigerant mass flow rate though each compressor,
(c) The power required for each compressor,
(d) Heat rejected in the condenser, and
(e) The C.O.P. of the system.



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