POSTAL Book Package 2023

Mechanical Engineering

Objective Practice Sets

Refrigeration and Air-conditioning

Contents

MADE EASY Publications

3 CHAPTER
Vapour Absorption Refrigeration System

MCQ and NAT Questions

Q.1 Choose the wrong statement to increase the COP of vapour absorption system
(a) Generator Temperature should be high
(b) Sink temperature should be high
(c) Evaporator temperature should be high
(d) None of these

Q.2 Electrolux refrigerator is
(a) Vapour Absorption refrigeration with one aqua pump
(b) Vapour compression refrigerator
(c) Vapour Absorption refrigerator with two pump
(d) None of these

Q.3 Choose the correct statement
(a) In NH_3 - Water system NH_3 is the refrigerant and in lithium Bromide - water system water is the refrigerant
(b) In NH_3 - water system water is the refrigerant and in Lithium Bromide - water system Lithium Bromide is the refrigerant.
(c) In NH_3 - water system water is the refrigerant and in Lithium Bromide system water is refrigerant
(d) In NH_3 - water system NH_3 is the refrigerant and in Lithium Bromide water system Lithium Bromide is the refrigerant

Q.4 Consider the statements and select the correct alternative
(i) Heat pump is more economical than electric heater
(ii) Vapour absorption system are more suitable for utilising solar energy for refrigeration
(iii) Steam ejector system are suitable for utilizing waste energy
(a) All are correct
(b) (ii) and (iii) are correct
(c) (i) and (iii) are correct
(d) (i) and (ii) are correct

Q.5 In vapour absorption system heating in generator is done at 100°C, evaporator temperature is 10°C and cooling by cooling water in condenser at 30°C. The maximum COP is
(a) 0.5 (b) 0.35
(c) 2 (d) 2.65

Q.6 Receiver is installed in _____ to _____
(a) liquid line, dry the refrigerant
(b) liquid line, collect the refrigerant
(c) expansion line, dry the refrigerant
(d) expansion line, collect the refrigerant

Q.7 Consider the following statements regarding electrolux refrigerator:
1. A pump is used for the circulation of solution.
2. In an $NH_3 - H_2O$ system, H_2 is chosen as the third fluid because it is non-corrosive and insoluble in water.
3. Partial pressure of H_2 provides the pressure difference of NH_3 between the condenser and the evaporator.

The correct statements is/are
(a) 1 only (b) 1 and 2
(c) 2 and 3 (d) all are correct

Q.8 Consider the following statements related to vapour absorption system:
1. The reaction occurring in the absorber is exothermic so cooling is required.
2. Pump is used to pump the rich solution to the condenser pressure.
3. In H_2O-LiBr system, LiBr is used as the refrigerant.
4. There should be a large difference in the normal boiling point of the refrigerant and the absorbent.

The correct statements are
(a) 1 and 2 (b) 2 and 3
(c) 1, 2 and 4 (d) 2 and 4

Q.17 Which of the following is not a desirable characteristic of ideal refrigerant in a vapour absorption system
(a) High critical temperature
(b) high specific heat
(c) Stability
(d) high Latent heat of vapourisation

Q.18 Which of the following cannot be considered as a desirable characteristic for a refrigerant absorbent combination
(a) high solubility in absorbent
(b) low viscosity
(c) small difference in boiling point of refrigerant and absorbent
(d) low specific heat

Q.19 Which of the following is not a desirable characteristic of ideal absorbent in vapour absorption system
(a) High affinity for the refrigerant
(b) Low boiling point
(c) Low specific heat
(d) Chemical stability

Direction (Q.21 to Q.22): The following questions consist of two statements, one labelled as '**Assertion (A)**' and the other labelled as '**Reason (R)**'. You are to examine these two statements carefully and select the answers to these items using the codes given below.

Codes:
(a) Both **A** and **R** are individually true and **R** is the correct explanation of **A**
(b) Both **A** and **R** are individually true but **R** is not the correct explanation of **A**
(c) **A** is true but **R** is false
(d) **A** is false but **R** is true

Q.20 **Assertion (A):** In a Lithium Bromide-water absorbent refrigeration system, water is the absorbent.
Reason (R): It operates at lower pressures than ammonia system as the evaporation temperature at atmospheric pressure is 0°C.

Q.21 **Assertion (A):** Hydrogen is chosen in electrolux refrigerator
Reason (R): It is non-corrosive & insoluble in water

Q.22 In a vapour-absorption refrigeration system, the refrigeration temperature is –15°C. The generator is operated by solar heat where the temperature reached is 110°C. The temperature of the heat sink is 55°C. The possible COP of the system is_____.

Multiple Select Questions (MSQ)

Q.23 In an absorption type refrigerator, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90% dry (h_{fg} = 2202 kJ/kg). The temperature in the refrigerator is to be maintained at –5°C. The refrigeration load is 20 tonnes and actual COP is 70% of the maximum COP and temperature of the atmosphere is 30°C. Which of the following statements is/are correct? Saturation temperature of steam at a pressure of 2 bar is 120.2°C.
(a) Maximum possible COP is 1.7565.
(b) Actual heat supplied in the cycle is 3415.9 kJ/min.
(c) Actual mass flow rate of steam required is 1.548 kg/min
(d) Actual heat supplied in the cycle is 5159.5 kJ/min.

■■■■

Answers Vapour Absorption Refrigeration System

1. (b)	**2.** (d)	**3.** (a)	**4.** (d)	**5.** (d)	**6.** (b)	**7.** (c)	**8.** (c)	**9.** (d)
10. (c)	**11.** (b)	**12.** (b)	**13.** (a)	**14.** (d)	**15.** (a)	**16.** (c)	**17.** (b)	**18.** (c)
19. (b)	**20.** (d)	**21.** (a)	**22.** (0.529)	**23.** (a, b)				

Explanations Vapour Absorption Refrigeration System

1. (b)

$$COP_{VARS} = \frac{T_E(T_G - T_0)}{T_G(T_0 - T_E)}$$

Here, for VARS COP will increase if temperature at evaporator and generator will increase and sink temperature decreases.

2. (d)

In case of electrolux refrigeration, no pump is installed.

3. (a)

In ammonia-water system, NH_3 acts as refrigerant and water act as absorbent, whereas in case of LiBr-H_2O system, H_2O acts as refrigerant and LiBr act as absorbent.

4. (d)

Steam jet ejectors offers a simple, reliable, low-cost way to produce vacuum. They are especially effective in the chemical industry where an on-site supply of the high-pressure motive gas is available. They are applied in processes such as crystallization, deaeration, drying, cooling, high vacuum distillation and deodorization.

5. (d)

$$COP = \left(\frac{100-30}{273+100}\right)\left(\frac{273+10}{30-10}\right) = 2.65$$

6. (b)

Receiver is installed in liquid line to collect the refrigerant.

7. (c)

The circulation takes place due to density difference and no pump is installed in electrolux refrigeration.

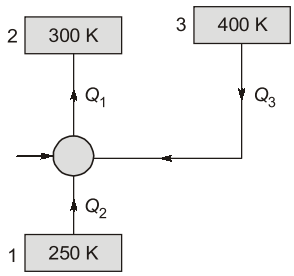
8. (c)

- In H_2O-LiBr system, H_2O is used as the refrigerant and LiBr is used as the absorbent.
- There should be a large difference in the normal boiling point of the two substances, atleast 200°C, so that the absorbent exerts negligible vapour pressure at the generator temperature. Thus almost absorbent-free refrigerant is boiled off from the generator and the absorbent alone returns to the absorber.

9. (d)

- Generator in VARS, is used for the removal vapour from strong aqua-ammonia solution.
- Analyser acts as dehydrator
- Receiver is used for storage of high pressure ammonia.
- Rectifier is used for producing dry ammonia by removing traces of water particles completely.

10. (c)



$$COP = \frac{\text{Refrigeration effect}}{\text{Work done}} = \frac{T_1}{T_2 - T_1}$$

$$\Rightarrow \quad \frac{100}{\text{Work}} = \frac{250}{300-250}$$

$$\therefore \quad \text{Work} = \frac{100 \times 50}{250} = 20 \text{ W}$$

To supply this work, heat is taken from reservoir '3' and rejected to sink '2'.

Efficiency,

$$\eta = \frac{W}{Q_3} = 1 - \frac{T_2}{T_3} = 1 - \frac{300}{400} = \frac{1}{4}$$

$$\eta = \frac{1}{4} = \frac{20}{Q_3}$$

$$\therefore \quad Q_3 = 4 \times 20 = 80 \text{ W}$$

11. (b)

In electrolux refrigerator, there is no circulation pump and the third fluid remains mainly in the evaporator.

12. (b)

$$(COP)_{max} = \frac{T_E}{T_C - T_E} \times \frac{T_G - T_C}{T_G} \qquad ...(1)$$

T_E = Evaporator temperature

T_C = Condenser temperature

T_G = Generator temperature

from equation (1),