GCAP Industrial Ammonia Refrigeration Training Practice Test (Sample)

Study Guide

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Questions

1. **What is the tax gas/flash gas effect in an ammonia refrigeration system with an evaporator at 10°F and a condenser at 85°F?**
   - **A. 10%**
   - **B. 15%**
   - **C. 20%**
   - **D. 25%**

2. **A pressure gauge measures a force of 30 pounds on an area of 1 square inch. What is the pressure in PSI?**
   - **A. 15 PSI**
   - **B. 30 PSI**
   - **C. 45 PSI**
   - **D. 60 PSI**

3. **How much heat must be absorbed to convert 1 pound of saturated NH3 liquid to saturated NH3 gas?**
   - **A. 212 BTUs**
   - **B. 561 BTUs**
   - **C. 100 BTUs**
   - **D. 500 BTUs**

4. **What is a typical cause of liquid slop over in an ammonia refrigeration system?**
   - **A. Overfeeding the liquid to a DX evaporator**
   - **B. Insufficient insulation on piping**
   - **C. Underfeeding the liquid to an evaporator**
   - **D. Excessive refrigerant in the system**

5. **For each pound of water evaporated, how many BTUs does an evaporative condenser typically reject?**
   - **A. 500 to 700 BTUs**
   - **B. 800 to 900 BTUs**
   - **C. 970 to 1057 BTUs**
   - **D. 1100 to 1300 BTUs**

6. **Which component enhances the efficiency of the refrigeration cycle by removing heat?**
   - **A. Compressor**
   - **B. Evaporator**
   - **C. Condenser**
   - **D. Expansion device**

7. **To determine the boiling point of a refrigerant, which property must you consider?**
   - **A. Pressure**
   - **B. Temperature**
   - **C. Volume**
   - **D. Density**

8. **Which of the following is NOT considered a secondary coolant?**
   - **A. Sodium Chloride**
   - **B. Calcium Chloride**
   - **C. Glycol**
   - **D. R-134a**

9. **In a refrigeration cycle, what happens to refrigerant as it passes through the condenser?**
   - **A. It absorbs heat and vaporizes**
   - **B. It releases heat and condenses**
   - **C. It remains liquid throughout**
   - **D. It evaporates at high pressure**

10. **Where is the ideal location to manually purge noncondensibles from a refrigeration system?**
   - **A. At the lowest point of the condenser**
   - **B. From the highest point of the condenser, with the compressor off**
   - **C. At the compressor discharge line**
   - **D. Near the evaporator outlet**

Answers

1. B
2. B
3. B
4. A
5. C
6. C
7. A
8. D
9. B
10. B

Explanations

1. What is the tax gas/flash gas effect in an ammonia refrigeration system with an evaporator at 10°F and a condenser at 85°F?

- **A. 10%**
- **B. 15%**
- **C. 20%**
- **D. 25%**

The tax gas or flash gas effect in an ammonia refrigeration system refers to the phenomenon in which a portion of the refrigerant evaporates into a gas due to a drop in pressure or temperature, which can occur between the evaporator and the condensing process. In systems with high-efficiency demands, understanding the percentage of tax gas that can be generated from the refrigerant is crucial for maintaining optimal efficiency and performance. In this scenario, with an evaporator at 10°F and a condenser at 85°F, the calculated flash gas effect indicates that approximately 15% of the refrigerant can exist as gas in specific conditions. This figure is derived from thermodynamic properties and empirical data specific to ammonia, reflecting industry standards and efficiencies that are typical for such refrigeration systems. Recognizing this percentage is critical during the design and operation phases because it helps in selecting appropriate equipment, sizing compressors, and ensuring overall system reliability. The flash gas effect can influence pressures, temperatures, and, consequently, the overall efficiency of the refrigeration cycle. Understanding this concept helps mechanics and engineers in troubleshooting and optimizing ammonia refrigeration systems.

2. A pressure gauge measures a force of 30 pounds on an area of 1 square inch. What is the pressure in PSI?

- **A. 15 PSI**
- **B. 30 PSI**
- **C. 45 PSI**
- **D. 60 PSI**

To determine the pressure in pounds per square inch (PSI), you can use the basic formula for pressure, which is defined as force divided by area. In this scenario, the gauge measures a force of 30 pounds acting on an area of 1 square inch. The calculation involves dividing the total force (30 pounds) by the area (1 square inch): Pressure = Force / Area Pressure = 30 pounds / 1 square inch = 30 PSI This result of 30 PSI accurately reflects the pressure exerted as described in the question. The direct relationship between the force applied and the area over which it is applied is fundamental to understanding pressure, making this calculation straightforward and leading to the correct answer.

3. How much heat must be absorbed to convert 1 pound of saturated NH3 liquid to saturated NH3 gas?

A. 212 BTUs

B. 561 BTUs

C. 100 BTUs

D. 500 BTUs

To convert 1 pound of saturated NH3 (ammonia) liquid to saturated NH3 gas, a specific amount of heat, known as the latent heat of vaporization, must be absorbed. For ammonia, this value is approximately 561 BTUs per pound at saturation temperature and pressure conditions. Latent heat refers to the energy required to change phase from liquid to gas without changing temperature. In this case, as ammonia transitions from liquid to gas, it absorbs this significant amount of energy to overcome the forces holding the liquid molecules together. This phase change occurs at the boiling point of ammonia, where it can exist in equilibrium between liquid and gas. Understanding the latent heat of vaporization for ammonia is crucial for applications in industrial refrigeration systems, as it directly influences the efficiency and operation of the systems.

4. What is a typical cause of liquid slop over in an ammonia refrigeration system?

A. Overfeeding the liquid to a DX evaporator

B. Insufficient insulation on piping

C. Underfeeding the liquid to an evaporator

D. Excessive refrigerant in the system

A typical cause of liquid slop over in an ammonia refrigeration system is overfeeding the liquid to a direct expansion (DX) evaporator. In a DX evaporator, the refrigerant absorbs heat from the surrounding area, causing it to evaporate. If too much liquid refrigerant is fed into the evaporator, it can cause the liquid to flood the evaporator coil rather than allowing it to completely vaporize. This flooding leads to a buildup of liquid refrigerant in the evaporator, resulting in liquid slop over into the suction line, impairing the system's efficiency and potentially damaging the compressor. Proper feed rates and control of liquid refrigerant are crucial to ensuring that the evaporator operates correctly, allowing for optimal heat exchange and preventing issues such as slop over. The other options involve factors that can affect system performance but do not directly cause liquid slop over in the way that overfeeding does.

5. For each pound of water evaporated, how many BTUs does an evaporative condenser typically reject?

A. 500 to 700 BTUs

B. 800 to 900 BTUs

C. 970 to 1057 BTUs

D. 1100 to 1300 BTUs

In an evaporative condenser, the amount of heat rejected per pound of water that evaporates is primarily related to the latent heat of vaporization of water, which is the energy required to convert water from a liquid to a vapor without changing its temperature. This value is typically around 970 to 1057 BTUs per pound of water evaporated. The correct range of 970 to 1057 BTUs encompasses the energy transfer that occurs during the evaporation process, making it the appropriate answer. Understanding this principle is critical in industrial applications, as it informs system efficiency, energy consumption, and the design of cooling systems. Other ranges presented do not accurately represent the heat rejection involved in this process. The figures below this correct range do not take into account the full energy required for changing water from liquid to vapor, while the higher figures exceed the typical values for this process, reflecting a misunderstanding of the thermodynamic properties of water's phase changes.

6. Which component enhances the efficiency of the refrigeration cycle by removing heat?

A. Compressor

B. Evaporator

C. Condenser

D. Expansion device

The condenser is a key component in the refrigeration cycle that enhances efficiency by removing heat from the refrigerant. In this stage of the cycle, the refrigerant, which has absorbed heat from the environment during its passage through the evaporator, enters the condenser as a high-pressure gas. As the refrigerant moves through the condenser coils, it releases the absorbed heat to the surrounding environment, typically air or water. This heat removal process leads to the condensation of the refrigerant back into a liquid state. By efficiently transferring heat away from the refrigerant, the condenser not only ensures that the refrigerant can cycle back into the evaporator appropriately but also improves the overall performance of the refrigeration system. The efficiency of the entire refrigeration cycle is heavily reliant on the heat exchange that occurs in the condenser, enabling continuous operation and effective temperature control in the areas needing refrigeration.

7. To determine the boiling point of a refrigerant, which property must you consider?

A. Pressure

B. Temperature

C. Volume

D. Density

To determine the boiling point of a refrigerant, the key property to consider is pressure. The boiling point of a substance is dependent on the pressure surrounding it; as pressure increases, the boiling point also increases, and conversely, a decrease in pressure leads to a lower boiling point. This relationship is captured in phase diagrams and is fundamental to understanding how refrigerants behave in refrigeration cycles. For instance, in many refrigeration systems, the refrigerant evaporates at a specific pressure which corresponds to its boiling point at that pressure. Therefore, to manage the efficiency and effectiveness of the refrigeration process, it's crucial to monitor and control the pressure to keep the refrigerant within its desired phase change regime. While temperature, volume, and density are important properties of refrigerants, they are not the primary factors that determine the boiling point. Thus, it is essential to focus on pressure when discussing the boiling point of a refrigerant.

8. Which of the following is NOT considered a secondary coolant?

A. Sodium Chloride

B. Calcium Chloride

C. Glycol

D. R-134a

In industrial ammonia refrigeration systems, secondary coolants are fluids that absorb heat from a primary coolant (like ammonia) and then transfer that heat elsewhere. They are typically used to lower the temperature of substances or environments without exposing them directly to the primary refrigerant. Sodium Chloride, Calcium Chloride, and Glycol are all examples of secondary coolants. They can absorb and transport heat effectively, allowing for efficient operation in refrigeration systems. These substances are chosen for their properties, which facilitate heat transfer and cooling. R-134a, however, is not classified as a secondary coolant in this context. R-134a is a refrigerant, which serves as a primary cooling agent. It participates directly in the refrigeration cycle by undergoing phase changes to absorb and release heat. As a refrigerant, R-134a operates in a closed system, while secondary coolants work to enhance the efficiency of heat transfer within or outside the system. Understanding the distinction between refrigerants and secondary coolants is vital in industrial refrigeration applications, particularly when considering system design and operational efficiency.

9. In a refrigeration cycle, what happens to refrigerant as it passes through the condenser?

A. It absorbs heat and vaporizes

B. It releases heat and condenses

C. It remains liquid throughout

D. It evaporates at high pressure

During the refrigeration cycle, the refrigerant undergoes significant changes as it moves through various components, including the condenser. As the refrigerant enters the condenser in a vapor state, it is under high pressure and cools down as it releases heat to the surrounding environment. This heat rejection occurs because the refrigerant is passing through a series of coils or fins that enable efficient heat transfer. As the refrigerant releases heat, it transitions from a vapor to a liquid state, completing the condensation process. This phase change is essential for the overall efficiency of the refrigeration cycle, allowing the refrigerant to be ready for the next stage, which is to expand and evaporate in the evaporator, absorbing heat from the area being cooled. The process of the refrigerant releasing heat and condensing is critical for maintaining the cycle's effectiveness, and this is why the choice indicating that it releases heat and condenses is the correct response.

10. Where is the ideal location to manually purge noncondensibles from a refrigeration system?

A. At the lowest point of the condenser

B. From the highest point of the condenser, with the compressor off

C. At the compressor discharge line

D. Near the evaporator outlet

The ideal location to manually purge noncondensibles from a refrigeration system is from the highest point of the condenser, with the compressor off. This is because noncondensibles, such as air or other gases, tend to accumulate at high points in the system due to their lower density compared to the refrigerant. When noncondensibles are present, they can lead to reduced efficiency in the system and can cause issues like high head pressure. By purging from the highest point, the noncondensibles can be removed effectively without disrupting the operation of the compressor. Turning off the compressor during this process is crucial; it prevents the compressor from drawing in any air or noncondensibles while the purge is taking place. This approach ensures that the refrigeration system maintains optimal performance and efficiency. Purging noncondensibles from other locations, such as the lowest point of the condenser or near the evaporator outlet, would not be effective, as those areas are less likely to have accumulated noncondensibles and may not facilitate proper purging. The compressor discharge line is also not ideal because it can create additional pressure and strain on the system, potentially leading to inefficient operation or equipment damage.