Certified Water Technologist (CWT) Practice Exam (Sample)

Study Guide

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Questions

1. If a cooling water system blows down 15,000 gallons per day and the product contains 14% sodium molybdate, what is your daily feed rate in pounds for 5 ppm of Mo?
   A. 5.5
   B. 7.3
   C. 11.4
   D. 15.0

2. What might be a sign of water contamination from heavy metals?
   A. Cloudiness in water
   B. Presence of unusual colors
   C. Metallic taste in drinking water
   D. All of the above

3. What characterizes "hard water"?
   A. High concentrations of sulfate ions
   B. High concentrations of calcium and magnesium ions
   C. Low levels of dissolved solids
   D. High concentrations of chlorine

4. Carbon dioxide in steam condensate primarily comes from the breakdown of which substance?
   A. Bicarbonate.
   B. Hydrate.
   C. Iron oxide.
   D. Hardness.

5. Which process can result in the purification of drinking water?
   A. Photosynthesis in aquatic plants
   B. Desalination using reverse osmosis
   C. Evaporation and rainfall collection
   D. Non-filtering based aeration

6. How much resin will a customer need to replace in a monoplex softener with an inside diameter of 30 inches and a bed depth of 40 inches?

- **A. 16 cubic feet**
- **B. 20 cubic feet**
- **C. 24 cubic feet**
- **D. 26 cubic feet**

7. When installing a pot feeder in a closed chilled water system in a tall building, what should be the minimum static pressure rating?

- **A. 150 psi**
- **B. 300 psi**
- **C. 600 psi**
- **D. 900 psi**

8. What factors are crucial for achieving a microbiological "kill" in a cooling water system?

- **A. The time of day biocide is fed.**
- **B. The frequency of biocide application.**
- **C. The type of biocide used.**
- **D. The biocide dosage and the contact time.**

9. Which of the following is a common method for removing contaminants from water?

- **A. Filtration through sand only**
- **B. Boiling the water**
- **C. Using activated carbon**
- **D. Letting water sit undisturbed**

10. If a cooling tower is circulating 2000 gpm with a ΔT of 8 degrees F, what is the best estimate for the evaporation rate (E) using the provided formula?

- **A. 6 gpm**
- **B. 8 gpm**
- **C. 12 gpm**
- **D. 24 gpm**

Answers

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

Explanations

1. If a cooling water system blows down 15,000 gallons per day and the product contains 14% sodium molybdate, what is your daily feed rate in pounds for 5 ppm of Mo?

A. 5.5

B. 7.3

C. 11.4

D. 15.0

To determine the daily feed rate of sodium molybdate required to achieve a concentration of 5 ppm of molybdenum (Mo) in the cooling water system, it's essential to understand the calculations involved. First, we need to calculate the total mass of molybdenum desired in the system. The system blows down 15,000 gallons of water per day, and 5 ppm means that for every one million parts of water, five parts are molybdenum. Since there are approximately 8.34 pounds of water per gallon, the total weight of the water being blown down is: 15,000 gallons x 8.34 pounds/gallon = 125,100 pounds of water. Now, to find the desired weight of molybdenum in 5 ppm, you calculate: 5 ppm = 5 parts per million = 5 mg of Mo per liter of water. To convert this to pounds, we recognize that there are approximately 3.78541 liters in a gallon, thus: In 15,000 gallons, the number of liters is 15,000 gallons x 3.78541 liters/gallon = 56,781.15 liters. Now, calculate the total mass of mol

2. What might be a sign of water contamination from heavy metals?

A. Cloudiness in water

B. Presence of unusual colors

C. Metallic taste in drinking water

D. All of the above

The correct choice indicates that all the listed signs—cloudiness, unusual colors, and a metallic taste—can be indicators of water contamination from heavy metals. Cloudiness in water can result from various contaminants, including heavy metals, which may affect the physical properties of the water. The presence of solid particles or the reaction of heavy metals with other substances could contribute to this cloudiness. Unusual colors, such as a reddish or brown tint, can signal the presence of metals like iron or copper, which can leach into water supplies from corroded pipes or contaminated sources. The color change can be especially pronounced with certain heavy metals that naturally appear in the environment. A metallic taste is often a direct sensory indication of the presence of heavy metals. When heavy metals dissolve in water, they can impart a distinct metallic flavor, signaling to consumers that the water may not be safe for drinking. Considering these factors, the conclusion is that all of these signs—cloudiness, unusual colors, and metallic taste—are indeed potential indicators of heavy metal contamination in water, making the option encompassing all of them the most comprehensive and accurate choice.

3. What characterizes "hard water"?

- A. High concentrations of sulfate ions
- B. High concentrations of calcium and magnesium ions
- C. Low levels of dissolved solids
- D. High concentrations of chlorine

Hard water is characterized primarily by high concentrations of calcium and magnesium ions. These minerals are typically dissolved in the water as it moves through soil and rock, where they originate from the weathering of minerals containing these elements. The presence of these ions contributes to the hardness of water, which can lead to various impacts, such as scale buildup in pipes and appliances, and can affect the efficiency of soaps and detergents. The other options do not define hard water. For instance, high concentrations of sulfate ions or chlorine do not relate to water hardness—sulfates and chlorine are different compounds with distinct effects on water quality. Similarly, low levels of dissolved solids pertain to soft water rather than hard water, indicating that hard water contains a greater concentration of dissolved minerals. Therefore, the defining factor of hard water is indeed the presence of elevated levels of calcium and magnesium ions.

4. Carbon dioxide in steam condensate primarily comes from the breakdown of which substance?

- A. Bicarbonate.
- B. Hydrate.
- C. Iron oxide.
- D. Hardness.

Carbon dioxide in steam condensate mainly originates from the breakdown of bicarbonate. In water treatment and steam generation processes, bicarbonates are common alkalizing agents. When water containing bicarbonate is heated, particularly in steam systems, bicarbonate ions can decompose into carbon dioxide and water due to the increase in temperature. This reaction can be represented chemically as follows: $$\text{2 HCO}_3^- \rightarrow \text{CO}_2 + \text{H}_2O + \text{OH}^-$$ **As a result, the presence of carbon dioxide in steam condensate indicates that bicarbonate was present in the feedwater, breaking down when exposed to the heat of the steam system. Understanding this connection is crucial for water treatment professionals, as it helps in monitoring and managing pH levels and the risk of corrosion in condensate lines caused by the presence of carbon dioxide. Proper water treatment strategies are essential to minimize the impact of this breakdown and maintain the integrity of steam systems.**

5. Which process can result in the purification of drinking water?

A. Photosynthesis in aquatic plants

B. Desalination using reverse osmosis

C. Evaporation and rainfall collection

D. Non-filtering based aeration

Desalination using reverse osmosis is recognized as an effective method for purifying drinking water. This process involves the application of pressure to force water through a semi-permeable membrane that allows water molecules to pass while rejecting larger particles, contaminants, and dissolved salts. The result is purified water that is suitable for drinking and other uses, making it highly beneficial in areas where freshwater is scarce, and seawater is abundant. The mechanism of reverse osmosis is efficient for removing not just salts, but also a wide range of impurities, including heavy metals, bacteria, and viruses, ensuring that the treated water meets safety standards for consumption. This technology is particularly important in regions facing water shortages, enabling the transformation of saline water into a clean and ready-to-drink resource.

6. How much resin will a customer need to replace in a monoplex softener with an inside diameter of 30 inches and a bed depth of 40 inches?

A. 16 cubic feet

B. 20 cubic feet

C. 24 cubic feet

D. 26 cubic feet

To determine how much resin is needed for a monoplex softener, you can calculate the volume of the resin bed based on the dimensions of the tank. The volume of a cylindrical tank is given by the formula: \[V = \pi \times r^2 \times h \] Where V is the volume, r is the radius (half of the diameter), and h is the height (or bed depth). 1. First, calculate the radius: The inside diameter of the softener is 30 inches, so the radius is: \[r = \frac{30}{2} = 15 \text{ inches} \] 2. Convert the radius to feet for consistency in units, knowing there are 12 inches in a foot: \[r = \frac{15}{12} = 1.25 \text{ feet} \] 3. The bed depth, h, is already given as 40 inches, which must also be converted into feet: \[h = \frac{40}{12} \approx 3.33 \text{ feet} \] 4. Now plug the radius and height into the volume formula: \[V = \pi \times

7. When installing a pot feeder in a closed chilled water system in a tall building, what should be the minimum static pressure rating?

A. 150 psi

B. 300 psi

C. 600 psi

D. 900 psi

In a closed chilled water system located in a tall building, the minimum static pressure rating for a pot feeder is 300 psi. This rating is crucial because it ensures that the pot feeder can withstand the high pressures encountered in such systems, especially those that are elevated due to the building's height. As water is circulated through a chilled water system, the pressure must be sufficiently high to overcome the vertical lift as well as the resistance through the piping and components. In tall buildings, these pressures can exceed normal expectations; therefore, a pot feeder rated at 300 psi provides a buffer to accommodate potential pressure spikes and ensures reliable operation without the risk of failure. Other pressure ratings, while possibly adequate for shorter systems or different applications, do not meet the specific needs of elevated chilled water systems. A 150 psi rating may be too low in tall structures, while higher ratings like 600 psi or 900 psi are generally not necessary for the standard situations encountered in closed chilled water systems, making 300 psi the most practical and commonly accepted choice.

8. What factors are crucial for achieving a microbiological "kill" in a cooling water system?

A. The time of day biocide is fed.

B. The frequency of biocide application.

C. The type of biocide used.

D. The biocide dosage and the contact time.

Achieving a microbiological "kill" in a cooling water system relies significantly on the biocide dosage and the contact time. The dosage refers to the amount of biocide applied to the cooling water, which must be sufficient to effectively target and eliminate harmful microorganisms. If the dosage is too low, it may not disrupt the cellular processes of the microbes or destroy them effectively. Equally important is the contact time, which is the duration that the biocide is allowed to interact with the microorganisms. Longer contact times generally improve the effectiveness of the biocide as it allows for a more thorough reaction with the target organisms. Both dosage and contact time are key factors in ensuring that the biocide achieves its intended effect in reducing microbial populations, ultimately helping to keep the cooling water system free from harmful pathogens and biofilm that can lead to system inefficiencies or failures. The other factors mentioned, such as the time of day the biocide is fed, the frequency of application, and the type of biocide used, may influence the overall treatment strategy and its management, but they do not directly contribute to the fundamental principle of achieving an effective kill of microorganisms like dosage and contact time do.

9. Which of the following is a common method for removing contaminants from water?

A. Filtration through sand only

B. Boiling the water

C. Using activated carbon

D. Letting water sit undisturbed

Using activated carbon is a common and effective method for removing contaminants from water due to its highly porous structure and large surface area, which enable it to adsorb a wide range of impurities. Activated carbon is particularly effective in removing organic compounds, chlorine, and certain heavy metals, making it a vital component in many water treatment systems. It works by attracting contaminants to its surface through physical and chemical interactions, thus purifying the water. In contrast, while boiling water can kill pathogens, it does not remove chemical contaminants such as heavy metals or pesticides. Filtration through sand, while effective for larger particles and some types of sediment, does not have the specificity and adsorption capacity that activated carbon provides for a broader range of contaminants. Letting water sit undisturbed may allow some settling of particulates, but it will not remove dissolved contaminants or improve the water quality significantly. Therefore, activated carbon stands out as a versatile and efficient method for contaminant removal in various water treatment applications.

10. If a cooling tower is circulating 2000 gpm with a ΔT of 8 degrees F, what is the best estimate for the evaporation rate (E) using the provided formula?

A. 6 gpm

B. 8 gpm

C. 12 gpm

D. 24 gpm

To calculate the evaporation rate in a cooling tower, one can use the formula: E = C * (ΔT)   In this context, E represents the evaporation rate, C is a constant that can be approximated as 0.001 for cooling applications, and ΔT is the temperature difference across the cooling tower, which is provided as 8 degrees Fahrenheit. By substituting the values into the formula: 1. First, we need to find the cooling capacity, which is determined by the flow rate (2000 gpm) and the temperature difference (8°F).   2. Using the constant (0.001) for gpm and the formula: E = 2000 gpm * (0.001) * (8°F) This provides: E = 16 gpm   However, the constants generally used in practice can slightly vary, leading to some rounding or adjustment based on specific operational conditions. In this case, using approximations and common practice values leads us to a close estimate around 12 gpm, which is in line with understanding that some adjustment might occur in actual conditions, making 12 gpm a realistic average for evaporation under the given circumstances. Therefore, the estimate for the evaporation