
Karl Fischer Titration

15 Advanced Multiple-Choice Questions

Includes calculation-based questions

Instructions
Circle the single best answer for each question. Read every option carefully before selecting your answer.

Based on: Electroanalytical Techniques - Karl Fischer Titration

Questions

Circle the correct answer.

1. During a Karl Fischer titration, exactly 0.400 mmol of iodine (I_2) is consumed. Considering the 1:1 molar ratio between iodine and water, what mass of water was present in the sample? (Molar mass of H_2O = 18.02 g/mol.)

- (A) 3.60 mg
- (B) 7.21 mg
- (C) 10.72 mg
- (D) 14.42 mg

2. In a coulometric Karl Fischer titration, a constant current of 75 mA passes through the cell for 144 seconds. What is the total electrical charge delivered?

- (A) 5.40 C
- (B) 10.80 C
- (C) 18.75 C
- (D) 108.00 C

3. A coulometric Karl Fischer instrument records a total charge of 42.88 C. Given that 1 mg of H_2O corresponds to 10.72 C, what mass of water was detected?

- (A) 0.25 mg
- (B) 2.00 mg
- (C) 4.00 mg
- (D) 8.00 mg

4. A Karl Fischer reagent is standardized using 230 mg of disodium tartrate dihydrate. The titration requires 7.20 mL of Karl Fischer reagent. Calculate the water equivalence factor using $f = 0.1566 \times W/V$.

- (A) 2.50 mg H₂O/mL
- (B) 4.00 mg H₂O/mL
- (C) 5.00 mg H₂O/mL
- (D) 7.20 mg H₂O/mL

5. A sample weighing 850 mg consumes 4.25 mL of Karl Fischer reagent with a water equivalence factor of 5.02 mg H₂O/mL. What is the percentage of water in the sample?

- (A) 0.50%
- (B) 1.26%
- (C) 2.51%
- (D) 5.02%

6. Which sequence most accurately describes the Karl Fischer reaction mechanism?

- (A) Iodine first oxidizes alcohol, followed by reduction of sulfur dioxide by water.
- (B) Alcohol, sulfur dioxide, and a base first form an alkylsulfite salt, which is then oxidized by iodine to an alkylsulfate salt.
- (C) Water first reacts with alcohol to form an aldehyde, which subsequently consumes iodine.
- (D) Sulfur dioxide reacts directly with iodine without requiring alcohol or a base.

7. Why does excess iodine indicate the endpoint of a Karl Fischer titration?

- (A) Excess iodine appears only after all sulfur dioxide has evaporated.
- (B) Iodine begins accumulating only after all available water has been consumed.
- (C) Excess iodine indicates that the alcohol has been completely oxidized.
- (D) Iodine accumulation occurs when the pH falls below 2.

8. Which pH condition is considered optimal for the Karl Fischer reaction?

- (A) Strongly acidic conditions, pH 1-2
- (B) Mildly acidic to neutral conditions, pH 5-7
- (C) Mildly alkaline conditions, pH 8-10
- (D) Strongly alkaline conditions, pH above 11

9. What is the principal difference between volumetric and coulometric Karl Fischer titration?

- (A) Volumetric titration generates iodine electrochemically, whereas coulometric titration adds iodine directly.
- (B) Volumetric titration measures reagent volume, whereas coulometric titration quantifies water from the electrical charge used to generate iodine.
- (C) Volumetric titration is limited to gases, whereas coulometric titration is limited to solids.
- (D) Coulometric titration requires disodium tartrate in every sample analysis.

10. A gaseous sample is expected to contain approximately 0.005% water. Which Karl Fischer method is most appropriate?

- (A) Volumetric titration because it is most suitable for extremely low water levels
- (B) Coulometric titration because its application range includes approximately 0.001-1% water
- (C) Volumetric titration because gases cannot be analyzed coulometrically
- (D) Neither method because Karl Fischer titration cannot analyze gases

11. Why should methanol generally be avoided when aldehydes or ketones are analyzed by Karl Fischer titration?

- (A) Methanol destroys iodine and produces a falsely low result.
- (B) Methanol reacts with aldehydes or ketones and may generate additional water, producing a falsely high result.
- (C) Methanol prevents sulfur dioxide from reacting with the base.
- (D) Methanol converts iodine into an electrochemically inactive compound.

12. Why must Karl Fischer reagent be standardized frequently, commonly once daily?

- (A) Its iodine concentration increases continuously because methanol absorbs iodine from the atmosphere.
- (B) Atmospheric air and moisture can degrade the reagent, including oxidation-related changes involving sulfur dioxide.
- (C) Disodium tartrate precipitates spontaneously inside the reagent bottle.
- (D) The water equivalence factor is independent of storage conditions but depends on sample color.

13. Which statement correctly compares the original Karl Fischer reagent with commonly used modern formulations?

- (A) The original reagent contained imidazole and trifluoroethanol, while modern reagents use only pyridine and water.
- (B) The original reagent used anhydrous pyridine and anhydrous methanol, while modern formulations may replace pyridine with imidazole or primary amines.
- (C) The original reagent was completely aqueous, while modern reagents are exclusively nonpolar.
- (D) Modern formulations remove sulfur dioxide because it interferes with iodine detection.

14. What is the major difficulty when determining water in foods such as chocolate using the Karl Fischer method?

- (A) Chocolate immediately releases excessive iodine into the titration vessel.
- (B) Water may be strongly retained and released slowly, making complete contact with the Karl Fischer reagent difficult.
- (C) Chocolate converts all alkylsulfate products back into alkylsulfite salts.
- (D) Chocolate always produces a strongly alkaline solution above pH 12.

15. Which pairing of Karl Fischer method and application range is correct?

- (A) Volumetric: 0.001-1%; Coulometric: 0.1-100%
- (B) Volumetric: 0.1-100%; Coulometric: 0.001-1%
- (C) Volumetric: 10-100%; Coulometric: 1-50%
- (D) Volumetric: below 0.001%; Coulometric: 50-100%

Model Answer Key

Check your responses only after completing all questions.

1 B	2 B	3 C	4 C	5 C
6 B	7 B	8 B	9 B	10 B
11 B	12 B	13 B	14 B	15 B

End of Quiz