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**CHEMICAL ENGINEERING REFRESHER REVIEW**

**ANALYTICAL CHEMISTRY PART 1**

1. A 750-mg sample of butter was analyzed by the Kjeldahl method. 50 mL of excess 0.16 M HCl were used and 7.67 mL back titration with 0.0500M NaOH was required to titrate the liberated ammonia. Calculate the percentage of protein in the sample. Use 6.38 for butter.
    - a. 75
    - b. 80
    - c. 85
    - d. 90
  2. A sample of impure salicylic acid,  $C_6H_4(OH)COOH$  (one titratable proton), is analyzed by titration. What size sample should be taken so that the percent purity is equal to five times the milliliters of 0.0500 M NaOH used to titrate it?
    - a. 140 mg
    - b. 142 mg
    - c. 138 mg
    - d. 136 mg
- For items 3-6, consider the titration of 40 mL, 0.2 M Acetic acid using 0.4 M NaOH as the titrant.
3. Solve for the initial pH (Before titration)
    - a. 2.72
    - b. 1.8
    - c. 7.22
    - d. 8.1
  4. Solve for the pH of the solution, after adding 10 mL of NaOH
    - a. 7.44
    - b. 4.74
    - c. 4.47
    - d. None of these
  5. Determine the volume of NaOH required to reach the equivalence point
    - a. 40 mL
    - b. 30 mL
    - c. 20 mL
    - d. 10 mL
  6. Calculate for the pH at the equivalence point
    - a. 3.98
    - b. 9.83
    - c. 9.38
    - d. 8.93
  7. The aluminum in a 759.08 mg of impure sulfate sample was precipitated as  $Al(OH)_3$  and ignited at  $1100^\circ C$  to yield a precipitate of  $Al_2O_3$  weighing 387.953 mg. Express the result of the analysis in terms of %Al (MW = 27).
    - a. 27.05
    - b. 13.53
    - c. 18.67
    - d. 23.29
  8. A 0.2356 g sample containing only NaCl and  $BaCl_2$  yielded 0.4637 of dried AgCl, upon reaction with excess  $AgNO_3$ . Calculate the %NaCl in the sample.
    - a. 55
    - b. 45
    - c. 37
    - d. 73

9. Which of the following salts give acidic aqueous solutions?

- |                                  |                              |                              |                    |
|----------------------------------|------------------------------|------------------------------|--------------------|
| (1) $\text{KNO}_3$               | (2) $\text{KCH}_3\text{COO}$ | (3) $\text{NH}_4\text{NO}_3$ | (4) $\text{RbI}$   |
| (5) $(\text{NH}_4)_2\text{SO}_4$ | (6) $\text{BaCl}_2$          | (7) $\text{NaCN}$            | (8) $\text{KNO}_2$ |
- a. 2, 7, 8  
 b. 3, 5  
 c. 2, 4, 6  
 d. 1, 4, 7, 6

For 10-12] A 500-mg sample containing  $\text{NaOH}$  (40),  $\text{Na}_2\text{CO}_3$  (106),  $\text{NaHCO}_3$  (84), either alone or in compatible combination is treated with 12.95 mL of 0.100 M  $\text{HCl}$  to reach the phenolphthalein endpoint and an additional of 18.76 mL to reach the methyl red endpoint.

10. Identify the compounds (aside from the inerts) present in the sample.

- |                                       |  |
|---------------------------------------|--|
| a. $\text{NaOH}$ and $\text{NaHCO}_3$ | c. $\text{Na}_2\text{CO}_3$ and $\text{NaHCO}_3$ |
| b. $\text{Na}_2\text{CO}_3$ only      | d. $\text{NaHCO}_3$ only                         |

11. Calculate the % Sodium Carbonate

- |          |          |
|----------|----------|
| a. 27.5% | c. 72.5% |
| b. 57.2% | d. 52.7% |

12. Calculate the percentage of inert in the sample.

- |          |          |
|----------|----------|
| a. 27.5% | c. 9.8%  |
| b. 62.8% | d. 15.2% |

13. An iron ore is analyzed for iron content by dissolving in acid and converting all iron species to  $\text{Fe}^{2+}$ .  $\text{Fe}^{2+}$  ions are then titrated with standard 0.0150 M  $\text{K}_2\text{Cr}_2\text{O}_7$  solution, converting them to  $\text{Fe}^{3+}$ . 35.6 mL is required to titrate the iron in a 1.68-g ore sample.

Calculate the %  $\text{Fe}_2\text{O}_3$   
 MW ( $\text{Fe} = 55.85$ ,  $\text{O} = 16$ )

- |          |          |
|----------|----------|
| a. 23.15 | c. 25.13 |
| b. 15.23 | d. 13.25 |

14. The pH of a household white vinegar solution is 2.45. The vinegar has a density of 1.09 g/mL. What is the mass percentage of acetic acid in the solution?

- |        |       |
|--------|-------|
| a. 1%  | c. 8% |
| b. 10% | d. 4% |

15. A 750.25-mg of alloy nickel was dissolved and treated to remove the impurities. The ammoniacal solution was treated with 50 mL of 0.1075 M  $\text{KCN}$  and the excess cyanide required 2.25 mL of 0.00925 M  $\text{AgNO}_3$ . Determine the %Ni (58.7) in the alloy.

- |           |          |
|-----------|----------|
| a. 20.86% | c. 10.43 |
| b. 37.69  | d. 41.27 |

16. The TI in a 9.76-g sample of rodenticide was oxidized to the trivalent state and treated with an unmeasured excess  $\text{Mg}/\text{EDTA}$  solution. The reaction is



Titration of the liberated  $\text{Mg}^{2+}$  required 13.34 mL of 0.03560 M  $\text{EDTA}$ . Calculate the percentage of  $\text{Ti}_2\text{SO}_4$  (504.8 g/mol) in the sample.

- |         |         |
|---------|---------|
| a. 3.21 | c. 1.23 |
| b. 2.45 | d. 4.25 |

17. Determine the number of grams of  $\text{C}_2\text{H}_5\text{N}$  that will heat with 81.81g of oxygen in the equation:  $\text{C}_2\text{H}_5\text{N} + \text{O}_2 \rightarrow \text{CO} + \text{H}_2\text{O} + \text{NO}$

- |                  |                              |
|------------------|------------------------------|
| a. 40.g          | c. Reaction will not proceed |
| b. None of these | d. 22.6g                     |

18. Determine the number of moles of an unknown base in a solution when titrated with 0.15M  $\text{HCl}$  and 22.01mL of the acid were needed to reach the end point of the titration.

- |                            |                            |
|----------------------------|----------------------------|
| a. $2.2 \times 10^{-3}$ mL | c. $1.1 \times 10^{-3}$ mL |
| b. $0.9 \times 10^{-3}$ mL | d. $3.3 \times 10^{-3}$ mL |

19. What is the Nujol Mull in organic chemical reactions?
- It is a mass spectrum technique and is obtained by grinding up a solid which is mixed with mineral oil to form a suspension for IR spectroscopy
  - It is the name of a type of paraffin oil from India and most often used in gas chromatography to enhance the mass transfer properties of compounds
  - It is a process applied for inorganic compounds to determine the effervescence of the compound under study
  - It is suspension in mineral oil which is placed in between HgCl, AgI and KCl or stainless steel plates to obtain a good spectrum
20. Define a salt in terms of acid and base.
- A salt is a compound that follows Le Chatelier's Principle in reactions with other compounds.
  - All of these
  - A salt is a compound formed when the nucleus of a hydrogen ion enters a quantity of water.
  - A salt is a compound (other than water) produced by the reaction of an acid and a base.

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