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Multiple Choice Questions

Circle the letter for the choice that best completes the statement or answers the question.

- Which one of the following substances is an Arrhenius acid?
 - $\text{C}_6\text{H}_{12}(\text{l})$
 - $\text{NH}_3(\text{aq})$
 - $\text{HClO}_4(\text{aq})$
 - $\text{CO}_3^{2-}(\text{aq})$
- Which one of the following is an Arrhenius base?
 - $\text{NH}_3(\text{aq})$
 - $\text{CO}_3^{2-}(\text{aq})$
 - $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$
 - $\text{Ca}(\text{OH})_2(\text{aq})$
- According to the (modified) Arrhenius definition, an acid is a substance that
 - loses hydrogen ions
 - generates hydronium ions in solution
 - gains hydrogen ions
 - generates hydroxide ions in solution
- Which solution will turn litmus blue and is a strong electrolyte?
 - $\text{HCl}(\text{aq})$
 - $\text{KOH}(\text{aq})$
 - $\text{NH}_3(\text{aq})$
 - $\text{NaCl}(\text{aq})$
- A student places a magnesium strip into an unknown solution. Bubbles slowly start to appear where the strip is immersed in the solution. The student infers that the unknown solution is most likely:
 - a strong acid
 - a strong base
 - a weak acid
 - a weak base
- Which one of the following examples is not matched by its approximate pH?
 - ocean water, $\text{pH} \approx 5.5$
 - vinegar, $\text{pH} \approx 3.0$
 - household ammonia, $\text{pH} \approx 11.9$
 - blood, $\text{pH} \approx 7.4$

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7. Which solution has the greatest concentration of hydronium ion, $\text{H}_3\text{O}^+(\text{aq})$?
- $\text{pH} = 0.00$
 - $\text{pOH} = 13.00$
 - 0.10 mol/L HCl
 - 0.90 mol/L HCl
8. Considering $\text{H}_2\text{SO}_4(\text{aq})$ and $\text{HSO}_4^-(\text{aq})$, which one of the following statements is true?
- They are both strong acids.
 - They are both diprotic.
 - Given the same volume and concentration, both neutralize the equivalent moles of NaOH .
 - $\text{H}_2\text{SO}_4(\text{aq})$ acts only as an acid; $\text{HSO}_4^-(\text{aq})$ can act as an acid or a base.
9. Which one of the following is a polyprotic base?
- $\text{OH}^-(\text{aq})$
 - $\text{PO}_4^{3-}(\text{aq})$
 - $\text{HCO}_3^-(\text{aq})$
 - $\text{NH}_3(\text{aq})$
10. A solution has a $\text{pH} = 2.8$. Which one of the following solutions is approximately twice as concentrated with respect to $\text{H}_3\text{O}^+(\text{aq})$?
- a solution of $\text{pH} = 1.4$
 - 0.02 mol/L HCl
 - a solution of $\text{pH} = 2.5$
 - 0.0008 mol/L HCl
11. Identify the solution with the highest pOH .
- $0.10 \text{ mol/L Ca(OH)}_2(\text{aq})$
 - $0.10 \text{ mol/L Na}_2\text{SO}_4(\text{aq})$
 - $0.10 \text{ mol/L NaCl}(\text{aq})$
 - $0.10 \text{ mol/L HCl}(\text{aq})$
12. Calculate the pH of $0.045 \text{ mol/L HClO}_4(\text{aq})$.
- -1.35
 - 1.35
 - 12.65
 - 0.35
13. Calculate the pOH of $0.075 \text{ mol/L Sr(OH)}_2(\text{aq})$.
- -0.82
 - 1.12
 - 0.82
 - 0.71

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14. 50.0 mL of 1.00 mol/L NaOH is diluted by adding 150 mL of distilled water. By how many units will the pH change?
- a) 0.6
 - b) 1.2
 - c) 4.0
 - d) 0.25
15. A student wants to choose an indicator to determine whether a solution of sodium hydroxide has a pH of 12. What would an appropriate indicator be?
- a) bromothymol blue
 - b) phenolphthalein
 - c) phenol red
 - d) methyl orange

Numerical Response Questions

For each numerical response question, record the answer in the following response box.

16.
17.
18.
19.
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23.
24.
25.

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16. To prepare 1.25 L of a solution of $\text{pH} = 10.50$, what mass of calcium hydroxide, $\text{Ca}(\text{OH})_2$, is required?
17. What is the pH when 2.21 g of nitric acid, HNO_3 , is dissolved in 100 mL of solution?
18. What is the concentration of hydroxide ion, $\text{OH}^-(\text{aq})$ in a $3.5 \times 10^{-6} \text{ mol/L HClO}_4(\text{aq})$?
19. What is the pH of $2.00 \times 10^{-1} \text{ mol/L H}_2\text{SO}_4$?
20. Compare the pH of solutions A and B. Solution A: 3.65 g of HCl in 500 mL of solution; Solution B: 0.727 g HCl per litre of solution.
21. Equal volumes of two solutions, both of $\text{pH} = 3.00$, are mixed. What is the molar concentration of hydronium ions in the resulting solution?
22. What is the molar concentration of hydroxide ion, $\text{OH}^-(\text{aq})$ when 1.0 L of solution of $\text{pOH} = 2.00$ is mixed with 2.0 L of solution of $\text{pOH} = 3.00$?
23. The pOH of a solution is 9.910. What mass of HCl must be dissolved in 500 mL of this solution?

24. What is the pH of solution if there are 4.52×10^{-3} mole of hydroxide ion in 6.0 L of solution?

25. What is the hydroxide ion concentration, $\text{OH}^-(\text{aq})$, in a solution of shampoo that has pH = 8.842?

Written Response Questions

Answer each question in the space provided. Use complete sentences and diagrams when necessary.

26. Why is the concentration of hydronium ion, $\text{H}_3\text{O}^+(\text{aq})$, in 0.400 mol/L phosphoric acid, H_3PO_4 , not 1.20 mol/L?

27. A 0.140 mol/L solution of a monoprotic acid has a pH of 2.418. What can be concluded about the nature of this acid?
