

1. What weight of KClO_3 (molar mass 122.6) is needed to make 200 mL of a 0.150 M solution of this salt?
(A) 2.73 g (B) 3.68g (C) 27.3 g (D) 164g (E) 3.69 kg
2. In an experiment 35.0 mL of 0.345 M HNO_3 is titrated with 0.130 M NaOH . What volume of NaOH will have been used when the indicator changes color?
(A) 35.0 mL (B) 13.2 mL (C) 26.4 mL (D) 50.0 mL (E) 92.9 mL
3. Molarity units are most appropriate in calculating which of the following?
(A) freezing-point depression
(B) vapor pressure
(C) boiling-point elevation
(D) surface tension
(E) osmotic pressure
4. All of the following may be used to determine molar masses. Which one requires an ideal solution for accurate results?
(A) freezing-point depression
(B) boiling-point elevation
(C) osmotic pressure
(D) vapor pressure
(E) gas density
5. To make a solution, 3.45 mol of $\text{C}_6\text{H}_{13}\text{Cl}$ and 1.26 mol of C_5H_{12} are mixed. Which of the following is needed, but not readily available, to calculate the molarity of this solution?
(A) the density of the solution
(B) the densities of $\text{C}_6\text{H}_{13}\text{Cl}$ and C_5H_{12}
(C) the temperature
(D) the molar masses of $\text{C}_6\text{H}_{13}\text{Cl}$ and C_5H_{12}
(E) the volumes of $\text{C}_6\text{H}_{13}\text{Cl}$ and C_5H_{12}
6. Which of the following when added to 1.00 kg H_2O is expected to give the greatest increase in the boiling point of water? ($k_b = 0.052^\circ\text{C m}^{-1}$)
(A) 1.25 mol sucrose
(B) 0.25 mol iron(III) nitrate
(C) 0.50 mol ammonium chloride
(D) 0.66 mol calcium sulfate
(E) 1.00 mol acetic acid
7. Ethyl alcohol, $\text{C}_2\text{H}_5\text{OH}$, and water become noticeably warmer when mixed. This is due to
(A) the decrease in volume when they are mixed
(B) smaller attractive forces in the mixture than in the
(C) the hydrogen bonding of the two liquids
(D) the change in vapor pressure observed
(E) stronger attractive forces in the mixture than in the pure liquids

8. Which is the most appropriate method for determining the molar mass of a newly discovered enzyme?

- (A) freezing-point depression
- (B) osmotic pressure
- (C) boiling-point depression
- (D) gas density
- (E) vapor pressure

9. If equal numbers of moles of each of the following are dissolved in 1 kg of distilled water, the one with the lowest boiling point will be

- (A) NaI (B) AlCl₃ (C) Mg(C₂H₃O₂)₂ (D) CH₃CH₂COOH (E) glucose

10. If the following equation is balanced in acid solution, what is the sum of the coefficients?



- (A) 13 (B) 26 (C) 15 (D) 23 (E) 21

11. Which of the following ions contains an element with an oxidation number of +5?

- (A) ClO₄⁻ (B) MnO₄⁻ (C) NO₂⁻ (D) SO₃⁻² (E) NO₃⁻

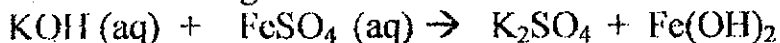
12. If 20.0 g of ethanol (molar mass = 46) and 30.0 g of water (molar mass 18) are mixed together, the mole fraction of ethanol in this mixture is

- (A) 0.207 (B) 0.261 (C) 0.739 (D) 0.793 (E) 4.83

13. How many milligrams of Na₂SO₄ (molar mass = 142) are needed to prepare 100 mL of a solution that is 0.00100 M in Na⁺ ions?

- (A) 28.4 (B) 14,200 (C) 1.00 (D) 7.1 (E) 14.2

14. In the following unbalanced reaction:



35.4 mL of 0.125 M KOH is used with excess FeSO₄. How much of the precipitate is made?

- (A) 0.3363 g FeSO₄ (D) 398 mg Fe(OH)₂
- (B) 38.5 mg K₂SO₄ (E) 384.9 g K₂SO₄
- (C) 199 g Fe(OH)₂

15. The solubility of cadmium chloride, CdCl_2 is 110 g per 100 g of water. What is the molal solubility (molarity) of a saturated solution of CdCl_2 ?
(A) 6.00 m (B) 1.31 m (C) 7.65 m (D) 12.61 m (E) 0.131 m
16. Calculate the mass % for the solution of CdCl_2 in the previous question.
(A) 36.5% (B) 58.4% (C) 19.5% (D) 67.2% (E) 52.4 %
17. The Ostwald process of making nitric acid involves three reactions, one of which is
 $4 \text{NH}_3 (\text{g}) + 5 \text{O}_2 (\text{g}) \rightarrow 4 \text{NO} (\text{g}) + 6 \text{H}_2\text{O} (\text{g})$
What is the reduced substance in this reaction?
(A) NO (B) H_2O (C) O_2 (D) NH_3 (E) not a redox reaction
18. Which of the following is expected to be the most soluble in water?
(A) KCl (B) $\text{C}_2\text{H}_5\text{OH}$ (C) C_6H_6 (D) N_2O (E) $\text{HC}_2\text{H}_3\text{O}_2$
19. How much water needs to be added to 5 L of 1.5 M HNO_3 in order to make it 0.5 M?
(A) 1.5 L (B) 2.5 L (C) 3.5 L (D) 4.0 L (E) 10.0 L
20. The triiodide ion is made in the following reaction
 $18 \text{H}^+ + 3 \text{KIO}_3 + 21 \text{I}^- \rightarrow 8 \text{KI}_3 + 9 \text{H}_2\text{O}$
If 29.87 mL of iodate is required to titrate 0.1058 L of 0.04 M iodide, what is the molarity of the iodate?
(A) .0162 M (B) .0202 M (C) .01754 M (D) .162 M (E) 1.75 M
21. Which of the following compounds dissociates into 4 particles?
(A) Na_3N (B) H_3PO_4 (C) $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$ (D) $\text{CH}_5\text{CH}_2\text{COOH}$ (E) glucose
22. What is the vapor pressure at 100°C of a solution of 2.0 M glucose if normal vapor pressure is 760.0 torr? Assume density of 1.1 g/mL.
(A) 751.6 torr (B) 624.6 torr (C) 1.20 torr (D) 724.8 torr (E) 0.563 atm