

Name: _____ Date: _____

Answer Key: Stoichiometric Limiting Reagents: A 10th Grade Chemistry Ace

Students calculate theoretical yields and identify limiting reactants through complex, multi-step chemical scenarios requiring advanced dimensional analysis.

1. A sample of 25.0g of Silver Nitrate reacts with excess Copper to produce Silver and Copper (II) Nitrate. If the actual yield of Silver collected is 14.5g, what is the percent yield of this reaction?

Answer: B) 83.6%

Based on the stoichiometry of $2\text{AgNO}_3 + \text{Cu} \rightarrow 2\text{Ag} + \text{Cu}(\text{NO}_3)_2$, the theoretical yield of Ag is approximately 17.34g. Percent yield = (Actual/Theoretical) * 100.

2. When balancing the combustion of Octane (C₈H₁₈), the stoichiometric coefficient for Oxygen gas (O₂) in the simplest whole-number ratio is _____.

Answer: B) 25

The balanced equation is $2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$. Standard stoichiometry requires the lowest whole-number ratio, making the coefficient for O₂ 25.

3. In a reaction where 10.0g of Reactant A (molar mass 50g/mol) reacts with 10.0g of Reactant B (molar mass 100g/mol) in a 1:1 molar ratio, Reactant B is the limiting reagent.

Answer: A) True

10.0g of A is 0.2 moles, while 10.0g of B is only 0.1 moles. Since they react 1:1, B will be exhausted first.

4. Which of the following contains the greatest number of individual atoms?

Answer: D) 1.5 moles of Glucose (C₆H₁₂O₆)

1.5 moles of C₆H₁₂O₆ contains $1.5 * 24 = 36$ moles of atoms. NH₃ has $2 * 4 = 8$; Cl₂ has $3 * 2 = 6$; P₄ has $1 * 4 = 4$.

5. Determine the mass of Iron (III) Oxide formed when 28.0g of Iron reacts completely with excess Oxygen. The molar mass of Fe is 55.8g/mol and Fe₂O₃ is 159.7g/mol. (Use $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$)

Answer: A) 40.0 g

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28g Fe is 0.5 mol. The ratio is 4:2 (or 2:1), so 0.25 mol of Fe₂O₃ is produced. 0.25 mol * 159.7 g/mol = approximately 40.0g.

6. During the synthesis of Aspirin (C₉H₈O₄), a chemist calculates that 5.00g should be produced, but only 3.85g is recovered. What is the most likely reason the percentage yield is not 100%?

Answer: A) The reaction reached a state of dynamic equilibrium.

Equilibrium, side reactions, and physical loss during filtration are common reasons that experimental yields fall below theoretical predictions.

7. The molar volume of any gas at STP (Standard Temperature and Pressure) is approximately 22.4 Liters per mole, regardless of the chemical identity of the gas.

Answer: A) True

According to Avogadro's Hypothesis, equal volumes of gases at the same temperature and pressure contain equal numbers of particles.

8. An unknown hydrate Copper(II) Sulfate (CuSO₄ · nH₂O) has a mass of 2.50g. After heating to remove water, the anhydrous salt weighs 1.60g. Determine the value of 'n'.

Answer: C) 5

Mass of water lost = 0.90g (0.05 moles). Moles of CuSO₄ (159.6 g/mol) = 1.60/159.6 = 0.01 moles. The ratio of H₂O to CuSO₄ is 5:1.

9. What is the concentration (Molarity) of a solution prepared by dissolving 5.85g of Sodium Chloride (NaCl) in enough water to make 500 mL of solution?

Answer: B) 0.2 M

5.85g NaCl is 0.1 moles (5.85/58.5). Molarity = Moles / Liters = 0.1 / 0.5 = 0.2 M.

10. In the reaction 2Al + 3Cl₂ -> 2AlCl₃, the mass of Aluminum used must always equal the mass of Chlorine used to satisfy the Law of Conservation of Mass.

Answer: B) False

Conservation of mass states total mass of reactants equals total mass of products, but the individual masses of reactants relative to each other depend on their molar masses and stoichiometric ratios.