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# Answer Key: Stellar Synthesis Quest: stoichiometry for 7th Grade Chemists

Calculate cosmic chemical yields and balance planetary fuel ratios as you synthesize the relationship between Avogadro's number and mass conservation.

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**1. An environmental engineer is analyzing a water sample where 2.0 moles of Silver Nitrate ($AgNO_3$) reacts with excess Sodium Hydroxide (NaOH). If the reaction theoretical yield is 1.0 mole of Silver Oxide ($Ag_2O$), which stoichiometric ratio represents the connection between the reactant and this specific product?**

**Answer:** B) 2:1 ratio

If 2.0 moles of reactant ($AgNO_3$) produce 1.0 mole of product ($Ag_2O$), the molar ratio is 2:1, reflecting the Law of Definite Proportions in the balanced chemical equation.

**2. A space station's life support system uses Lithium Hydroxide to scrub $CO_2$. If the molar mass of Lithium is 7 g/mol, Oxygen is 16 g/mol, and Hydrogen is 1 g/mol, the molar mass of the compound LiOH is exactly ____ g/mol.**

**Answer:** B) 24

Summing the individual atomic masses (7 + 16 + 1) equals 24 g/mol for the compound LiOH.

**3. True or False: In a closed system, if you react 1 mole of Iron (Fe) with 1 mole of Sulfur (S) to form Iron(II) sulfide (FeS), the total mass of the system remains identical before and after the reaction.**

**Answer:** A) True

The Law of Conservation of Mass dictates that mass is neither created nor destroyed, regardless of the chemical transformation taking place.

**4. A chemist has $3.011 \times 10^{23}$ molecules of a mystery gas. Which of the following best describes this quantity relative to a standard mole?**

**Answer:** B) Exactly 0.5 moles

Avogadro's number is $6.022 \times 10^{23}$. Dividing $3.011 \times 10^{23}$ by $6.022 \times 10^{23}$ yields 0.5 moles.

**5. In the reaction $2Al + 3Cl_2$ ’ $2AlCl_3$, if you want to produce 10 moles of Aluminum Chloride ($AlCl_3$), you would need to start with ____ moles of Chlorine gas ($Cl_2$).**

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**Answer:** B) 15

Using the stoichiometric ratio from the equation (3 $Cl_2$ / 2 $AlCl_3$), we multiply 10 moles by 1.5 to get 15 moles of Chlorine.

**6. If you have 1 mole of Glucose ($C_6H_{12}O_6$), how many total moles of 'atoms' are contained within that single mole of the compound?**

**Answer:** C) 24 moles of atoms

One molecule of glucose has 6 Carbon + 12 Hydrogen + 6 Oxygen = 24 atoms. Therefore, 1 mole of the substance contains 24 moles of individual atoms.

**7. True or False: The molar mass of a substance is numerically equal to its atomic or molecular mass, but the units change from atomic mass units (amu) to grams per mole (g/mol).**

**Answer:** A) True

The mole is defined specifically to bridge the gap between microscopic atomic mass units and macroscopic grams used in laboratories.

**8. Imagine you are synthesizing ammonia: $N_2 + 3H_2$ ’$2NH_3$. If you have 4 moles of Nitrogen and 9 moles of Hydrogen, which reactant will run out first (the limiting reactant)?**

**Answer:** B) Hydrogen ($H_2$)

To use up 4 moles of $N_2$, you need 12 moles of $H_2$ (4 x 3). Since you only have 9 moles, the Hydrogen will be consumed before the Nitrogen is finished.

**9. A balloon is filled with 4.0 grams of Helium (He). Given that the molar mass of Helium is roughly 4 g/mol, the balloon contains approximately ____ atoms.**

**Answer:** B) $6.022 \times 10^{23}$

4.0 grams of Helium is exactly 1 mole. 1 mole of any element contains Avogadro's number ($6.022 \times 10^{23}$) of atoms.

**10. True or False: Stoichiometry allows scientists to predict the exact amount of product that will form, even if the reaction temperature and pressure change constantly in an open environment.**

**Answer:** B) False

While stoichiometry predicts 'theoretical yield,' real-world factors like temperature, pressure, and side reactions often lead to a lower 'actual yield.'

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