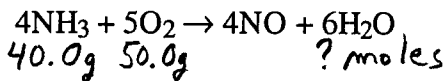




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1. Ammonia reacts with diatomic oxygen to form nitric oxide and water vapor:



What is the theoretical yield of water, in moles, when 40.0 g NH₃ and 50.0 g O₂ are mixed and allowed to react?

- Based on: $\frac{40.0\text{g NH}_3}{17.0\text{g}} \times \frac{6\text{ moles H}_2\text{O}}{4\text{ mol NH}_3} = 3.52\text{ mol H}_2\text{O}$
- Based on: $\frac{50.0\text{g O}_2}{32.0\text{g}} \times \frac{6\text{ moles H}_2\text{O}}{5\text{ moles O}_2} = 1.875\text{ mol H}_2\text{O}$
- A. 1.30 mol
 B. 1.57 mol
 C. 1.87 mol
 D. 3.53 mol
 E. None of the above.

2. Table salt (sodium chloride) is 39.1% sodium. How many grams of salt contains 72.0 g of sodium?

- A. 28.2 g salt
 B. 72.0 g salt
 C. 184 g salt
 D. 2,820 g salt
 E. 1.84×10^5 g salt
- $\frac{72.0\text{g Na}}{39.1\%} = 184\text{g NaCl}$
- $\frac{39.1\text{Na}}{100\text{NaCl}}$

3. When 22.0 g NaCl and 21.0 g H₂SO₄ are mixed and react according to the equation below, which is the limiting reagent? (Pick a product to work for)

- $$2\text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{HCl}$$
- 22.0g 21.0g
- A. NaCl
 B. H₂SO₄
 C. Na₂SO₄
 D. HCl
 E. Neither reagent is limiting.
- Based on: $\frac{22.0\text{g NaCl}}{58.45\text{g}} \times \frac{1\text{ mol Na}_2\text{SO}_4}{2\text{ mol NaCl}} = 0.188\text{ mol Na}_2\text{SO}_4$
- Based on: $\frac{21.0\text{g H}_2\text{SO}_4}{98.1\text{g}} \times \frac{1\text{ mol Na}_2\text{SO}_4}{1\text{ mol H}_2\text{SO}_4} = 0.214\text{ mol Na}_2\text{SO}_4$

4. The density of lead is 11.4 g/cm³ at 25°C. Calculate the volume occupied by 25.0 g of lead.

- A. 2.19 cm³
 B. 0.456 cm³
 C. 285 cm³
 D. 1.24 cm³
 E. 6.05 cm³
- $\frac{25.0\text{g}}{11.4\text{g/cm}^3} = 2.19\text{ cm}^3$

5. The diameter of an atom is approximately 1×10^{-8} cm. What is this diameter when expressed in nanometers?

- A. 1×10^{-19} nm
- B. 1×10^{-15} nm
- C. 1×10^1 nm
- D. 1×10^{-10} nm
- E. 1×10^{-1} nm**

$$\frac{1 \times 10^{-8} \text{ cm}}{10^{-2}} \times \frac{1 \text{ nm}}{10^{-9}} = 1 \times 10^{-1} \text{ nm}$$

6. What is the mass of 0.0250 mol of P_2O_5 ?

- A. 35.5 g
- B. 5676 g
- C. 0.0250 g
- D. 1.51×10^{22} g
- E. 3.55 g**

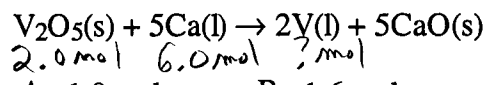
$$\begin{array}{l} 5 \times 16.0 = 80.0 \\ 2 \times 31.0 = 62.0 \\ \hline 142.0 \\ \text{mol} \end{array} \quad \frac{0.0250 \text{ mol} \times 142 \text{ g}}{1 \text{ mol}} = 3.55 \text{ g}$$

7. A barrel of oil contains 42.0 gallons. How many liters is this? Given 1L = 1.06 qt, 4 qts = 1 gallon).

- A. 9.9 L
- B. 11 L
- C. 142 L
- D. 158 L**
- E. 178 L

$$\frac{42.0 \text{ gal} \times 4 \text{ qt}}{1 \text{ gal}} \times \frac{1 \text{ L}}{1.06 \text{ qt}} = 158 \text{ L}$$

8. What is the theoretical yield of vanadium, in moles, that can be produced by the reaction of 2.0 mole of V_2O_5 with 6.0 mole of calcium based on the following chemical reaction?



- A. 1.0 mol
- B. 1.6 mol
- C. 2.0 mol
- D. 2.4 mol**
- E. 4.0 mol

9. Which one of the following represents a physical change?

- A. water, when heated, forms steam**
- B. bleach turns hair yellow
- C. sugar, when heated, becomes brown
- D. milk turns sour
- E. apples, when exposed to air, turn brown

Based on V_2O_5 : $\frac{2 \text{ mol } V_2O_5}{2 \text{ mol } V_2O_5} \times \frac{2 \text{ mol } V}{1 \text{ mol } V_2O_5} = 4.0 \text{ mol } V$

Based on Ca: $\frac{6 \text{ mol } Ca}{5 \text{ mol } Ca} \times \frac{2 \text{ mol } V}{1 \text{ mol } V_2O_5} = 2.4 \text{ mol } V$

10. Which of the following pairs of elements would be most likely to form an ionic compound?

- A. P and Br
- B. Cu and K
- C. C and O
- D. O and Zn
- E. Al and Rb

nonmetal + metal

11. Radio waves travel at the speed of light, which is 3.00×10^8 m/s. How many minutes does it take for a radio message to reach Earth from Mars if Mars is 9.9×10^7 km from Earth?

- A. 5.5×10^{-3} min
- B. 0.33 min
- C. 5.5 min
- D. 19.8 min
- E. 1.8×10^{21} min

$$\frac{9.9 \times 10^7 \times 10^3 \text{ m}}{3.00 \times 10^8 \text{ m/s}} \times \frac{1 \text{ min}}{60 \text{ s}} = 5.5 \text{ min}$$

12. How many neutrons are there in an atom of lead whose mass number is 208?

- A. 82
- B. 126
- C. 208
- D. 290
- E. none of them

$$208 - 82 = 126$$

↑
Atomic #

13. How many significant figures are there in 1.3070 g?

- A. 6
- B. 5
- C. 4
- D. 3
- E. 2

14. Which of the following is an example of a physical property?

- A. corrosiveness of sulfuric acid
- B. lead becomes a liquid when heated to 601°C
- C. flammability of gasoline
- D. neutralization of stomach acid with an antacid
- E. toxicity of cyanide

15. If 0.274 moles of a substance weighs 62.5 g, what is the molar mass of the substance, in units of g/mol?

- A. 2.28×10^2 g/mol
- B. 1.71×10^1 g/mol
- C. 4.38×10^{-3} g/mol
- D. 2.17×10^2 g/mol
- E. none of these

$$\frac{62.5 \text{ g}}{0.274 \text{ mol}} = \frac{228 \text{ g}}{\text{mol}}$$

$$6.0 \text{ g Fe}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol}}{399.88 \text{ g}} \times \frac{3 \text{ mol S}}{1 \text{ mol Fe}_2(\text{SO}_4)_3} \times 32.07 \text{ g S/mol} = 1.44 \text{ g S}$$

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16. How many grams of sulfur are there in 6.0 g of $\text{Fe}_2(\text{SO}_4)_3$? molar mass = 399.88 g/mol

- A. 2.40 g B. 0.48 g C. 6.00 g D. 0.92 g E. 1.44 g

17. A piece of metal with a mass of 125 g is placed into a graduated cylinder that contains 25.00 mL of water, raising the water level to 56.00 mL. What is the density of the metal?

A. 5.00 g/cm³
 B. 4.03 g/cm³
 C. 2.23 g/cm³
 D. 1.51 g/cm³
 E. 0.25 g/cm³

$$\frac{125 \text{ g}}{(56.00 - 25.00) \text{ mL}} = \frac{125 \text{ g}}{31.00 \text{ mL}} = 4.03 \text{ g/cm}^3$$

18. How many significant figures does the sum of the following contain? $8.5201 + 1.93$

- A. 1 B. 2 C. 3 D. 4 E. 5

$$\begin{array}{r} 8.5201 \\ + 1.93 \\ \hline 10.4501 \end{array}$$

↓ places

19. After carrying out the following operations, how many significant figures are appropriate to show in the result?

$$\frac{13.7 + 0.027}{8.221}$$

$$\frac{13.727}{8.221} = 1.670$$

3 s.f. 4 s.f.

- A. 1 B. 2 C. 3 D. 4 E. 5

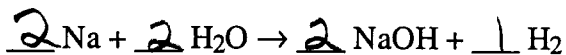
20. The elements in a column of the periodic table are known as

- A. metalloids.
 B. a period.
 C. noble gases.
 D. a group.
 E. nonmetals.

21. A magnesium ion, Mg^{2+} , has

- A. 12 protons and 13 electrons.
 B. 24 protons and 26 electrons.
 C. 12 protons and 10 electrons.
 D. 24 protons and 22 electrons.
 E. 12 protons and 14 electrons.

22. What is the coefficient of H₂O when the following equation is properly balanced with the smallest set of whole numbers?

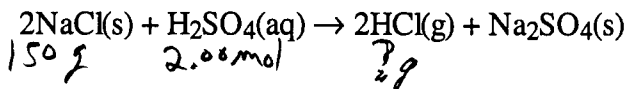


- A. 1 **B. 2** C. 3 D. 4 E. 5

23. The percent composition by mass of a compound is 76.0% C, 12.8% H, and 11.2% O. The molar mass of this compound is 284.5 g/mol. What is the molecular formula of the compound?

- A. C₁₀H₆O B. C₉H₁₈O C. C₁₆H₂₈O₄ D. C₂₀H₁₂O₂ **E. C₁₈H₃₆O₂**

24. Hydrochloric acid can be prepared by the following reaction:



How many grams of HCl can be prepared from 2.00 mol H₂SO₄ and 150 g NaCl?

- A. 7.30 g **B. 93.5 g** C. 146 g D. 150 g E. 196 g

25. What is the mass of 7.80×10^{18} carbon atoms?

- A. 1.30×10^{-5} g
B. 6.43×10^3 g
C. 7.80×10^{18} g
D. 1.56×10^{-4} g
E. 12.01 g

$$\frac{7.80 \times 10^{18} \text{ C atoms}}{6.02 \times 10^{23} \text{ atoms/mol}} \times \frac{12.01 \text{ g}}{\text{mol}} = 1.56 \times 10^{-4} \text{ g}$$

23 Assume 100g

| | | |
|----|--|---|
| C: | $\frac{76.0 \text{ g}}{12.01 \text{ g/mol}} = 6.33 \div 0.7 = 9.0$ | Empirical formula C ₉ H ₁₈ O ₁ Emp mass = 142.2 284.5 ÷ 142.2 = 2 so: C ₁₈ H ₃₆ O ₂ |
| H: | $\frac{12.8 \text{ g}}{1.008 \text{ g/mol}} = 12.70 \div 0.7 = 18.1$ | |
| O: | $\frac{11.2 \text{ g}}{16.00 \text{ g/mol}} = 0.7 \div 0.7 = 1$ | |

24 Based on NaCl: $\frac{150 \text{ g NaCl}}{58.45 \text{ g/mol}} \times \frac{2 \text{ mol HCl}}{2 \text{ mol NaCl}} \times \frac{36.46 \text{ g}}{\text{mol}} = 93.5 \text{ g HCl}$

Based on H₂SO₄: $\frac{2.00 \text{ mol H}_2\text{SO}_4}{1 \text{ mol H}_2\text{SO}_4} \times \frac{2 \text{ mol HCl}}{2 \text{ mol H}_2\text{SO}_4} \times \frac{36.46 \text{ g}}{\text{mol}} = 145.8 \text{ g HCl}$