Stoichiometry Practice Problems

NChO 1999

9. Arsenic(III) sulfide reacts with oxygen to form arsenic(III) oxide and sulfur(IV) oxide as represented by this equation.

$$\_\_As_2S_3 + \_\_O_2 \rightarrow \_\_As_2O_3 + \_\_SO_2$$

What is the coefficient for O_2 when this equation is balanced using whole number coefficients?

(A) 5 (C) 9

(B) 7 (D) 11

10. How many grams of $MgCO_3$ contain 24.0 g of oxygen? (The molar mass of $MgCO_3$ is 84.3 g mol^{-1})

(A) 42.2 g (C) 126 g

(B) 84.3 g (D) 154 g

11. How many hydrogen atoms are present in one mole of ammonium benzoate, $NH_4C_7H_5O_2$?

(A) 6.0×10^{23} (C) 3.0×10^{24}

(B) 2.4×10^{24} (D) 5.4×10^{24}

12. Consider this balanced equation:

$$3\ H_2(g) + CO(g) \rightarrow CH_4(g) + H_2O(g)$$

How many moles of CH_4 can be obtained by reacting 2.0 mol of H_2 with 2.0 mol CO according to this equation?

(A) 0.33 mol (C) 2.0 mol

(B) 0.67 mol (D) 3.0 mol

13. What is the molarity of the chloride ion in 250 mL of a solution containing 1.90 g of $MgCl_2$? (The molar mass of $MgCl_2$ is 95.2 g mol^{-1})

(A) 0.020 M (C) 0.080 M

(B) 0.040 M (D) 0.16 M

14. Consider this equation.

$$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$$

What happens to the total volume when 3.0 L of SO_2 and 2.0 L of O_2 react to form the maximum amount of SO_3 possible from these volumes of reactants? Assume all gases are at the same constant temperature and pressure.

(A) It decreases by 1.5 L.

(B) It decreases by 1.0 L.

(C) It increases by 0.50 L.

(D) It remains constant.

15. What is the molarity of an H_2SO_4 solution if 25.00 mL is exactly neutralized by 32.63 mL of 0.164 M NaOH?

(A) 0.107 M (C) 0.214 M

(B) 0.126 M (D) 0.428 M

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7. A compound prepared as a model of hemoglobin is 4.6% iron by mass. If the compound is known to contain a single iron atom, which of these values will be closest to its molar mass?

(A) 1000 g mol^{-1} (C) 1400 g mol^{-1}

(B) 1200 g mol^{-1} (D) 1600 g mol^{-1}

8. How many hydrogen atoms are present in 0.046g of ethanol, C_2H_5OH? (Molar Mass of C_2H_5OH is 46 g mol^{-1})

(A) 6.0×10^{20} (C) 3.0×10^{21}

(B) 1.2×10^{21} (D) 3.6×10^{21}

9. Which of these hydrated salts contains the greatest percentage of water by mass?

(A) $BaCl_2 \cdot 2H_2O$ (C) $CaCl_2 \cdot 6H_2O$

(B) $CuSO_4 \cdot 5H_2O$ (D) $Ni(ClO_4)_2 \cdot 6H_2O$

10. Ammonium dichromate, $(NH_4)_2Cr_2O_7$, decomposes when heated to produce N_2, H_2O, and Cr_2O_3 as represented by this equation.

$\_\_(NH_4)_2Cr_2O_7(s) \rightarrow \_\_N_2(g) + \_\_H_2O(g) + \_\_Cr_2O_3(s)$

What is the coefficient for H_2O when this equation is correctly balanced using the smallest set of whole number coefficients?

(A) 1 (C) 4
(B) 2 (D) 8

11. What volume of 0.15 M HCl can be made from 7.5 mL of concentrated HCl (12M)?

(A) 0.060 L (C) 6.0 L
(B) 0.60 L (D) 6.0×10^2 L

12. Hematite, Fe_2O_3, is the most common iron ore. How many moles of hematite are in an ore sample that contains 355 g of iron? Assume hematite is the only source of iron in this ore.

(A) 1.11 mol (C) 3.18 mol
(B) 1059 mol (D) 6.36 mol

13. How many moles of $Mg(OH)_2$ can be precipitated when 15 mL of 0.20 M $MgCl_2$ solution is mixed with 25 mL of 0.18 M KOH?

(A) 0.0015 mol (C) 0.0030 mol
(B) 0.0022 mol (D) 0.0045 mol

14. A 2.0 mL sample of HCl(g) is mixed with a 1.5 mL of NH_3(g). What is the volume if the resulting mixture after the reaction is complete? (Assume all measurements are carried out at the same pressure and temperature and that the volume of the solid is negligible)

$HCl(g) + NH_3(g) \rightarrow NH_4Cl(s)$

(A) 0.5 mL (C) 2.0 mL
(B) 1.5 mL (D) 3.5 mL

15. A student wants to prepare 250. mL of 0.10 M NaCl solution. Which procedure is most appropriate? (The molar mass of NaCl is 58.4 g mol^{-1})

(A) Add 5.84 g of NaCl to 250. mL of H_2O
(B) Add 1.46 g of NaCl to 250. mL of H_2O
(C) Dissolve 5.84 g of NaCl in 50 mL of H_2O and dilute to 250. mL.
(D) Dissolve 1.46 g of NaCl in 50 mL of H_2O and dilute to 250. mL.

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6. Calculate the density of a gold coin from the given data.

Table of Data	
Mass of the gold coin	13.5243 g
Volume of the coin and water	22.9 mL
volume of the water alone	22.2 mL

(A) 19.32 g mL^{-1} (C) 19 g mL^{-1}
(B) 19.3 g mL^{-1} (D) 2×10^1 g mL^{-1}

7. A typical silicon chip such as those in electronic calculators weighs 2.3×10^{-4} g. How many silicon atoms are in such a chip?

(A) 4.9×10^{18} (C) 3.9×10^{21}
(B) 1.4×10^{20} (D) 2.6×10^{27}

8. What is the coefficient for oxygen when this equation is balanced?

$\_\_\_H_2S(g) + \_\_\_O_2(g) \rightarrow \_\_\_SO_3(g) + \_\_\_H_2O(l)$

(A) 2 (C) 4
(B) 3 (D) 5

9. The first step in the Ostwald process for producing nitric acid, HNO_3, from ammonia is represented by this equation.

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

What volume of oxygen is needed to produce each liter of NO?

(A) 0.80 L (C) 5.00 L
(B) 1.20 L (D) 22.4 L

10. Antimony reacts with sulfur according to this equation.

$$2Sb(s) + 3S(s) \rightarrow Sb_2S_3(s)$$

The molar mass of Sb_2S_3 is 339.7 g mol^{-1}
What is the percentage yield for a reaction in which 1.40 g of Sb_2S_3 is obtained from 1.73 g of antimony and a slight excess of sulfur?
(A) 80.9% (C) 40.5%
(B) 58.0% (D) 29.0%

11. The limiting reagent in a particular reaction can be recognized because it is the reagent.
(A) with the smallest coefficient in the balanced equation.
(B) that has the lowest mass in the reaction mixture.
(C) that is present in the smallest molar quantity.
(D) that would be used up first.

12. What mass of oxygen is present in 50.0 g of copper(II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$?
The molar mass of $CuSO_4 \cdot 5H_2O$ is 249.68 g mol^{-1}
(A) 12.8 g (C) 20.0 g
(B) 16.0 g (D) 28.8 g

13. What mass of calcium chloride hexahydrate must be dissolved in sufficient water to prepare 200 mL of a solution with a chloride ion concentration of 0.50M? The molar mass of $CaCl_2 \cdot 6H_2O$ is 219 g mol^{-1}
(A) 5.6 g (C) 22 g
(B) 11 g (D) 44 g

14. The major commercial source for bromine is deep brine wells in Arkansas where the concentration of bromide ion can be as high as 5000 parts per million by mass. What is this concentration when expressed as a mass percentage?
(A) 0.005% (C) 0.5%
(B) 0.05% (D) 5%

1996 NChO

9. How many moles of ozone, O_3, could be formed from 48.0 g of oxygen gas, O_2?
(A) 1.00 mol (C) 1.50 mol
(B) 1.30 mol (D) 2.00 mol

10. How many grams of carbon are present in 0.50 mol of sucrose ($C_{12}H_{22}O_{11}$)?

Substance	Molar Mass
$C_{12}H_{22}O_{11}$	342 g mol^{-1}

(A) 60 g (C) 90 g
(B) 72 g (D) 120 g

11. If excess $Ca(OH)_2$ is treated with 0.160 mol of dry HCl gas, what is the maximum number of grams of $CaCl_2$ that could be formed?

Substance	Molar Mass
$Ca(OH)_2$	74.1 g mol^{-1}
HCl	36.5 g mol^{-1}
$CaCl_2$	111.0 g mol^{-1}

(A) 35.5 g (C) 8.88 g
(B) 17.8 g (D) 4.44 g

12. What volume of 0.500 M $CaCl_2$ solution is needed to prepare 250 mL of solution that has a chloride concentration of 0.100 M?
(A) 12.5 mL (C) 50.0 mL
(B) 25.0 mL (D) 100 mL