

9. The number of items contained in one mole of any substance is called the _____.
10. There are 6.02×10^{23} paper clips in a _____ of paper clips.
11. The mass in atomic mass units of one formula unit of a compound is the _____ of the compound.
12. The _____ of a compound expresses the smallest whole number ratio of the atoms in the compound.
13. The amount of product of a chemical reaction can be predicted by _____.
14. The compounds CH_2O and $\text{C}_6\text{H}_{12}\text{O}_6$ have the same _____.
15. A unit of measure used to count the number of atoms, molecules, or formula units of a substance is the _____.

Matching

Match each item with the correct item below.

- a. formula mass
- b. ideal gas law
- c. study that relates mass to number of particles
- d. percent yield
- e. one molecule or one mole
- f. 6.02×10^{23}
- g. 0.10 mole
- h. molar mass
- i. molar volume
- j. 0.25 mole
- k. $8.31 \text{ kPa} \cdot \text{L/mol} \cdot \text{K}$
- l. atomic mass unit
- m. empirical formula

- ___ 16. R
- ___ 17. 2 g of H_2
- ___ 18. CO_2
- ___ 19. 58.5 u of NaCl
- ___ 20. stoichiometry
- ___ 21. ratio of mass of product obtained to mass expected
- ___ 22. Avogadro constant
- ___ 23. 2.24 L of a gas at STP
- ___ 24. u
- ___ 25. $PV = nRT$
- ___ 26. NaCl
- ___ 27. 22.4 L
- ___ 28. 24.5 g of H_2SO_4

Short Answer

A chemical plant is being designed to manufacture ethanol (ethyl alcohol; $\text{C}_2\text{H}_5\text{OH}$) by treating ethylene (ethene; C_2H_4) gas with water, using phosphoric acid as a catalyst. Answer the following questions about this process.

- 29. Suppose that ethylene is to be supplied to the reaction chamber at the rate of 100.0 L per minute at 300.0°C and $7.00 \times 10^3 \text{ kPa}$. At what rate in moles per minute is ethylene being supplied to the reaction chamber?
A. 127 mol/min B. 147 mol/min C. 167 mol/min D. 187 mol/min
- 30. In the first pass of ethene through the reaction chamber, the actual rate of production of ethanol is 271 g/min. What is the percent yield for the reaction?
A. 2.00 percent B. 4.00 percent C. 6.00 percent D. 8.00 percent
- 31. If the unused ethene is passed through the reaction chamber again, 12.8 moles of ethanol are produced, compared to a theoretical yield of 13.2 moles. What is the percent yield?
A. 91.0 percent B. 93.0 percent C. 95.0 percent D. 97.0 percent

32. What is the anticipated rate in grams per minute at which ethanol will be formed under the conditions described above?
- A. 6.77×10^3 g/min B. 8.77×10^3 g/min C. 10.77×10^3 g/min D. 12.77×10^3 g/min
33. What is the mass in grams of 0.30 mol of NaHCO_3 ?
- A. 21.2 g B. 23.2 g C. 25.2 g D. 27.2 g
34. What is the volume of 0.625 mol of nitrogen at 74.2 kPa and 85°C?
- A. 25.1 L B. 27.1 L C. 29.1 L D. 315.1 L
35. Determine the percent fluorine in the following fluoride of chromium.
chromium(II) fluoride, CrF_2
- A. 36.2% B. 38.2% C. 40.2% D. 42.2%
36. What volume of hydrogen gas can be produced by reacting 3.86 g of aluminum in excess hydrochloric acid at 21.0°C and 102 kPa? The reaction is $2\text{Al(s)} + 6\text{HCl(aq)} \rightarrow 2\text{AlCl}_3\text{(aq)} + 3\text{H}_2\text{(g)}$.
- A. 4.14 L B. 5.14 L C. 6.14 L D. 7.14 L
37. Calcium oxide can be prepared by heating calcium metal in oxygen according to the reaction: $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$. How much calcium would be needed to make 15.0 g of calcium oxide?
- A. 10.7 g B. 110.7 g C. 12.7 g D. 13.7 g
38. Methylal is a compound that is used in perfumery. Methylal is 47.3 percent C, 10.6 percent H, and 42.1 percent O. The molar mass is approximately 76 g/mol. What is the molecular formula of methylal?
- A. $\text{C}_3\text{H}_8\text{O}$ B. $\text{C}_3\text{H}_6\text{O}_2$ C. $\text{C}_3\text{H}_8\text{O}_2$ D. CH_8O_2
39. Hydrogen gas reacts with copper(II) oxide to form copper metal and water vapor according to the reaction: $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$. What mass of copper is produced if 255 L of hydrogen at STP are used up in this reaction?
- A. 723 g B. 823 g C. 911 g D. 923 g
40. How many atoms are there in 106.2 g of potassium?
- A. 14.4×10^{23} atoms B. 16.4×10^{23} atoms
C. 18.4×10^{23} atoms D. 20.4×10^{23} atoms

Problem

Nitrogen and oxygen combine with each other to form a series of compounds. This chart summarizes laboratory research done on this series of compounds. From the data supplied, calculate the empirical and molecular formulas for each oxide listed.

Compound	Percentage Nitrogen	Percentage Oxygen	Molecular Mass
A	63.6	36.4	44.01 u
B	30.4	69.6	46.00 u
C	36.9	63.1	76.01 u
D	25.9	74.1	108.01 u
E	46.7	53.3	30.01 u

A. N_2O_3

B. N_2O_5

C. N_2O

D. NO

41. Compound D is _____

42. Compound C is _____

43. Compound A is _____

44. In a reaction, 82.00 g of sodium reacts with 74.00 g of ferric oxide to form sodium oxide and iron metal. Calculate the mass of solid iron produced. 51.36 g

A. 51.36 g

B. 61.36 g

C. 71.36 g

D. 81.36 g

45. In a reaction, 10.76 g of CaCO_3 , 10.51 g of HCl, and excess water produced 10.26 g of $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$. Calculate the theoretical yield of calcium chloride hexahydrate. 23.56 g

A. 17.56 g

B. 19.56 g

C. 21.56 g

D. 23.56 g

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