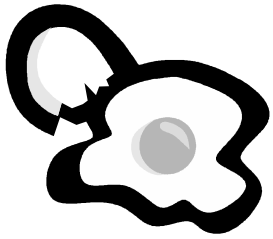
Basic Skills Supplement 1

The Mole Concept

INFORMATION



1 dozen items = 12 items
12 dozen items = 1 gross of items
1 egg sandwich = 3 eggs and 2 slices of bread
1 mole = 6.02×10^{23} items (Avogadro's number)

Key Questions

Use dimensional analysis ONLY for all calculations. Show all of your work and units. Be prepared to explain the process you used to find you answer.

1. How many dozen are 60 eggs?
2. How many dozen are in 34 gross?
3. How many eggs are in 14 gross?
4. How many eggs are there in 2 egg sandwiches?
5. How many slices of bread are there in 7 egg sandwiches?
6. How many egg sandwiches are there in 9 dozen?
7. How many eggs are there in 9 dozen egg sandwiches?
8. How many egg sandwiches can be made with 9 dozen eggs?
9. How many eggs are in 1 mole of eggs?
10. How many eggs are in 1 mole of egg sandwiches?
11. In grammatically correct English, explain the purpose of having different ways to describe different quantities of eggs.

INFORMATION

One **mole** of a substance is quantified by the following means:

1 mole = the molecular or atomic weight of the substance in grams
6.02×10^{23} atoms (or molecules)
22.4 liters (only gases at standard temperature [273 K] and pressure [1 atm])

A **mole** is a way to quantify atoms and molecules. The mole is a critical component when working with chemical reactions. The purpose of the mole is to normalize quantities of atoms and molecules when working with them in chemical reactions.

In a molecule of water (H_2O), for example, there are two hydrogen atoms and one oxygen atom. When combining these two elements to make water, 2 hydrogen atoms and 1 atom of oxygen must be used from each element. One *mole* of each element includes a specific number of atoms (see above), but because of the different numbers of protons and neutrons in each atom, one mole of different elements have different masses. For this reason, combining two *grams* of hydrogen with 1 *gram* of oxygen is not the same as combining 2 moles of hydrogen with 1 mole of oxygen. (See **Stoichiometry 3 – So *This* is What the Mole is For…** for more information about the mole in chemical reactions.)

The **molar mass** of a substance is the sum of the atomic weights of all of its constituent atoms, expressed in **grams/mole**.

A common compound, calcium chloride ($CaCl_2$), has a molecular weight of 110.98 g/mole. This is arrived at by summing the atomic weight of one atom of calcium (40.08 g/mole) and the atomic weight of two atoms of chlorine (35.45 g/mole).

Key Questions

Use dimensional analysis ONLY for all calculations. Show all of your work and units. Be prepared to explain the process you used to find you answer.

1. How many atoms in are 1 mole of aluminum?
2. How many molecules are in 1 mole of aluminum hydroxide?
3. How many hydrogen atoms are in 1 mole of aluminum hydroxide?
4. What is the mass of 1 mole of aluminum hydroxide?
5. What is the mass of 2 moles of aluminum hydroxide?
6. What is the mass of the hydroxide ions in 1 mole of aluminum hydroxide?
7. How many moles are contained in 56 liters of H_2 gas?
8. What is the mass of 56 liters of H_2 gas?
9. How many molecules are found in 56 liters of H_2 gas?
10. How many hydrogen atoms are found in 56 liters of H_2 gas?
11. If you have a 1 gram sample of several different compounds, which would contain the fewest number of molecules? Explain.

Student Name: _____ Pd. ____ Date: _____

Supplementary Exercises
The Mole Concept

Indicate whether the each of the following statements is true or false. Explain your reasoning for each answer.

1. One mole of NH_3 weighs more than one mole of H_2O.

2. There are more carbon atoms in 48 grams of CO_2 than in 12 grams of diamond (a pure form of carbon).

3. There are an equal number of nitrogen atoms in one mole of NH_3 and one mole of N_2.

4. The number of Cu atoms in 100 grams of pure copper metal is the same as the number of atoms in 100 grams of cupric oxide.

5. The number of Ni atoms in 100 moles of pure nickel metal is the same as the number of Ni atoms in 100 moles of nickel(II) chloride.

6. There are more hydrogen atoms in 2 moles of NH_3 than in 2 moles of CH_4.

Use dimensional analysis for all calculations below. Show all of your work and units. Be prepared to explain the process you used to find you answer.

7. What is the mass of 1 molecule of dextrose ($C_6H_{14}O_7$)?

8. How many footballs are there in 15.0 dozen footballs?

9. How many dozens are there in 960 eggs?

10. If 1 dozen apples weigh 1805 grams, how much will 30 apples weigh?

11. How many silver atoms are there in 2.00 moles of silver?

12. How many moles of sodium atoms are there in 46.0 grams of sodium?

13. How much will 1.8×10^{24} atoms of iron weigh?

14. How many hot dog buns would you need for 5.00 moles of hot dogs?

15. How many molecules are there in 6.00 grams of H_2O?

16. How much will 7.00 moles of aluminum weigh?

17. How many moles of oxygen atoms are there in 128 grams of oxygen?

18. How many atoms are there in 95 grams of fluorine atoms?

19. How many moles of H_2O molecules are there in 126 grams of water?

20. How many moles of lithium are there in 56 grams of lithium?

21. How many moles of sodium atoms are there in 1.8×10^{20} sodium atoms?

22. How many nitrogen atoms are there in eight moles of nitrogen atoms?

23. How many six-packs of soda are there in 48 cans of soda?

24. How many tennis balls are there in 15 cans of tennis balls (each can holds three balls)?

25. How many worms are there in a seven mole can of worms?

26. How much will 1.2×10^{46} atoms of carbon weigh?

27. If one dozen peas weigh 11.5 grams, how much will 200.0 peas weigh?