Moles

Chapter 3, clicker 1
Dr. Stone

Eggs

- If you have a dozen eggs, how many do you have?

- If you have 36 eggs, how many dozen is that?

- What are you doing to convert between the number of eggs and the amount in a dozen?

- 36 eggs x $\frac{1 \text{ dozen}}{12 \text{ eggs}}$ = 3 dozen

Mole

- We measure atoms, ions and molecules in **moles**

- There are 6.02 x 10^{23} atoms of Carbon in a mole of carbon atoms

- 1 **mole** of Carbon-12 atoms weighs exactly 12 grams (unlimited decimal places)

- 6.02 x 10^{23} carbon-12 atoms weighs exactly 12 grams.

- What does a **mole** of carbon atoms weigh?

- 12.011 grams (weighted average of masses of all isotopes)

Avogadro's number

- 6.02 x 10^{23} is a very large number.

- A mole of M&Ms candy would cover the lower 48 united states at a depth of 52 miles.   https://pubs.acs.org/doi/pdf/10.1021/ed070p453

- There are 6.6 billion people on the planet, if you had a mole of pennies and you gave an even amount to each person, how many dollars would each person get?

  - 6.02 x 10^{23} pennies x $\dfrac{\$1.00}{100\ \text{pennies}}$ = $6.02 x 10^{21}

  - $\dfrac{\$6.02 \times 10^{21}}{6.6 \times 10^{9}\ \text{people}}$ = $9.12 x 10^{11} /person

Atoms

How many atoms are in a 2 moles of carbon?

$\underline{6.02 \times 10^{23} \text{ atoms}}$ x 2 moles carbon = 12.04×10^{23}
   mole

= 1.204×10^{24} atoms

How many moles of iron atoms are present, if there are 3.40×10^{21} atoms of iron?

3.4×10^{21} atoms of iron x $\dfrac{1 \text{ mole of iron}}{6.02 \times 10^{23}}$ = 5.64×10^{-3} moles

How many moles of sodium atoms are present, if there are 9.40×10^{22} atoms of sodium?

A. 6.4   B. 1.56×10^{-1} C. 3.01×10^{3} D. 3.33×10^{-3} E. None of these

Ionic Compounds

- There is always a cation and an anion present

- NaCl, $KHCO_3$, ammonium chloride, calcium chloride

- NaCl = 2 moles of ions per mole of sodium chloride (1 mole of Na^+ and 1 mole of Cl^-)

- $KHCO_3$ = 2 moles of ions per mole of potassium hydrogen carbonate

- NH_4Cl = 2 moles of ions per mole of ammonium chloride

- $CaCl_2$ = 3 moles of ions per mole of calcium chloride

Ionic compounds

How many sodium ions are present if there are 2.5×10^{-1} moles of sodium phosphate?

2.5×10^{-1} moles Na_3PO_4 x $\underline{3 \text{ moles } Na^+}$ x $\underline{6.02 \times 10^{23} \text{ ions}}$ = 4.5×10^{23} ions

$\qquad\qquad\qquad\qquad\qquad$ 1 mole Na_3PO_4 $\qquad$ mole

How many chloride ions are present if there are 4.5×10^{-2} moles of iron(II) chloride?

A. 1.9×10^{-23} B. 7.5×10^{-26} C. 5.4×10^{22} D. 8.1×10^{22} E. None of these

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Molecules

How many atoms of chlorine are present in 2.1×10^{-3} moles of phosphorous pentachloride?

A. 5.   B. 1.0×10^{-2} C. 6.3×10^{21} D. 1.3×10^{21} E. None of these

Molecules

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Molar mass

The molar mass is the sum of the weighted average mass of the atoms or ions in the compound

The molar mass of sodium chloride is:

Na= 22.9898

Cl = 35.453

NaCl = 58.443

The molar mass of sodium chloride is 58.443 grams

Or: there are 58.443 grams of sodium chloride per mole of NaCl

Methane is also known as natural gas. Most homes heat water by combusting natural gas. What is the molar mass of methane (CH_4)?

C = 12.011 x 1. = 12.011

H = 1.0079 x 4 = 4.0316

Total = 16.043 grams of methane per mole of methane

Molar mass of methane is 16.043 g/mole

Propane is used for grilling. What is the molar mass of propane (C_3H_8)?

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