Welcome to our CHEM 4 lecture

Review clicker question: Mole and molar mass

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1) A sample of iron has a volume of 3.5 in^3. How many iron atoms are in the cube? The density of iron is 7.86 g/cm^3.

A) 3.0×10^{23} Fe atoms

B) 4.86×10^{24} Fe atoms

C) 7.5×10^{23} Fe atoms

D) 7.57×10^{24} Fe atoms

E) 5.95×10^{25} Fe atoms

F) 4.9×10^{24} Fe atoms

26
Fe
55.85

Answer: *Flowchart:* $in^3 \rightarrow cm^3 \rightarrow$ g Fe $\rightarrow$ moles Fe $\rightarrow$ Fe atoms

Calculation:

$(2.54\ cm)^3$

$$3.5\ \cancel{in^3}\left(\frac{16.387\ \cancel{cm^3}}{1\ \cancel{in^3}}\right)\left(\frac{7.86\ \cancel{g\ Fe}}{1\ \cancel{cm^3}}\right)\left(\frac{1\ \cancel{mole\ Fe}}{55.85\ \cancel{g\ Fe}}\right)\left(\frac{6.022 \times 10^{23}\ Fe\ atoms}{1\ \cancel{mole\ Fe}}\right) = 4.8608 \times 10^{24}\ Fe\ atoms$$

2sf *∞ sf* *3sf* *4sf* *4sf*

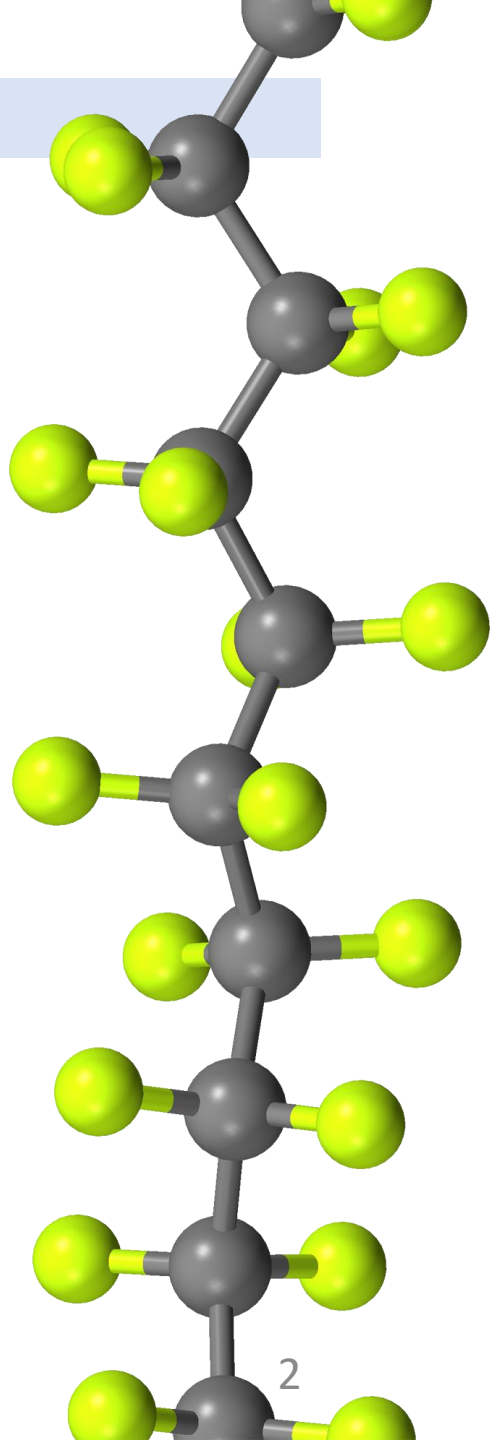
Keep 2sf

Exam #2 results

What to improve? Here's our checklist of key behaviors that lead to success in CHEM 4:

- ✓ Visit our CHEM 4 website regularly: tinyurl.com/SacStateChem4
- ✓ Study efficiently with a focus on the homework:
  - ✓ (1) do the assigned reading, then (2) attend lecture, then (3) review the lecture slides or video. You should then be ready to do the homework.
  - ✓ If you do (1) - (3) and start the required homework and have trouble, then put aside the homework and redo (1) and (3). Then try the optional homework.
  - ✓ If you still have trouble, put the homework aside and come to my office hours.
  - ✓ Remember is it okay if the homework is late, the most important thing is that you are really understanding the homework.
- ✓ Get help when needed:
  - ✓ Put together a weekly study group.
  - ✓ Jeff's office hours: MWF 9 – 9:30 am and 11 – 11:30 am; and by appointment.
  - ✓ PAL office hours: link is on our CHEM 4 website.
- ✓ Complete all of the practice exams.

- ✓ Everyone deserves a second chance! C2S program allows you to drop lowest exam.



CHEM 4 lecture

Friday – November 6, 2020

Sec 6.4

Molar mass of compounds

Reading clicker question: Molar mass of compounds (Sec 6.4)
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2) Which of the following statements is false?

A) The molar mass of a compound is the mass of 1 mol of molecules or formula units of that compound.

B) The molar mass of a compound can be used to convert between the grams and moles of that compound.

C) Combined with Avogadro's number, the molar mass of CO_2 can be used to find the number of CO_2 molecules in a given mass of CO_2.

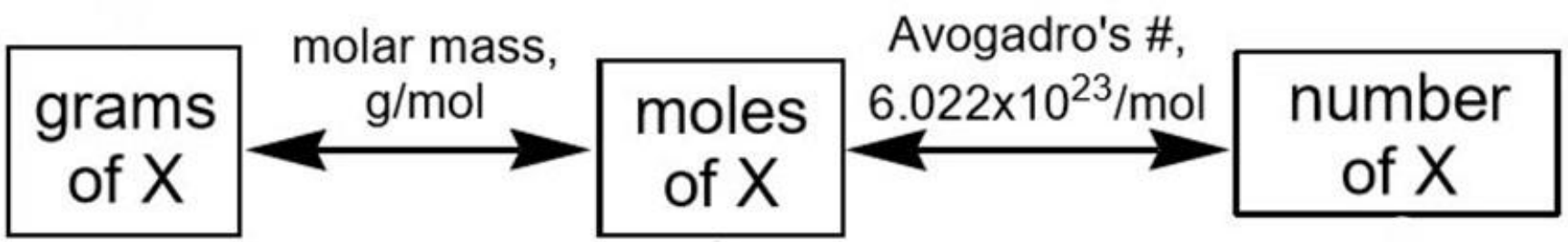
D) The typical units for the molar mass of a compound are $\frac{\text{X mol}}{\text{1 gram}}$.

E) The molar mass of water has the same numerical value as the formula mass of water (just the units are changed).

Background: Calculating and using molar masses for compounds (Sec 6.4)

What prior skills go into being able to do this?

- Need to know naming.
- Find the molar mass by adding up all of the molar masses for all of the elements in the compound. Watch decimal places when adding…like when we found formula mass (see sec. 5.11)
- Know material from last lecture about using molar mass and Avagadro's number.



Sample calculation: Finding the molar mass of a compound

Ex. What is the molar mass of iron(III) hydrogen carbonate?

Answer:

Formula: $Fe(HCO_3)_3$

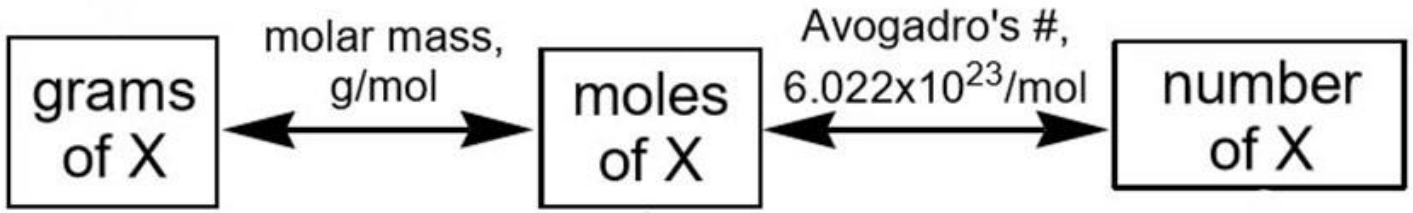
1 x Fe →	1 x 55.85 →	55.85
3 x H →	3 x 1.008 →	3.024
3 x C →	3 x 12.01 →	36.03
9 x O →	9 x 16.00 →	144.00
		238.904

Molar mass of $Fe(HCO_3)_3$ = $\frac{\mathbf{238.90\ g}}{\mathbf{1\ mole}}$ (or it can be written as 238.90 g/mol)

Meaning, if you have 6.022×10^{23} units of $Fe(HCO_3)_3$, it will have a mass of 238.90 g

Sample calculation: Using the molar mass of a compound

Ex. A sample of $Fe(HCO_3)_3$ has 3.9×10^{20} formula units. What is the mass of the sample in grams?



Answer:

Flowchart: # of $Fe(HCO_3)_3$ units $\rightarrow$ moles $Fe(HCO_3)_3$ $\rightarrow$ grams $Fe(HCO_3)_3$

Calculation:

Keep 2sf

$$(3.9 \times 10^{20}\ \cancel{Fe(HCO_3)_3}) \left(\frac{1\ \cancel{mole\ Fe(HCO_3)_3}}{6.022 \times 10^{23}\ \cancel{Fe(HCO_3)_3}}\right) \left(\frac{238.90\ g\ Fe(HCO_3)_3}{1\ \cancel{mole\ Fe(HCO_3)_3}}\right) = 0.1547177\ g$$

2sf *4sf* *5sf*

$= \mathbf{0.15\ g\ Fe(HCO_3)_3}$

Clicker question: Finding the molar mass of a compound
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3) What is the molar mass of tin(II) permanganate?

A) 339.3 g/mol
B) 356.58 g/mol
C) 189.64 g/mol
D) 356.6 g/mol
E) 237.64 g/mol
F) 237.6 g/mol

Answer: $Sn(MnO_4)_2$

1 x Sn →	1 x 118.7 →	118.7
2 x Mn →	2 x 54.94 →	109.88
8 x O →	8 x 16.00 →	128.00
		356.58

Molar mass of $Sn(MnO_4)_2$ = 356.6 g/mol

Clicker question: Using the molar mass of a compound
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4) How many formula units are in 5.85×10^{-2} µg of $Sn(MnO_4)_2$? Remember, in the last question we saw that the molar mass of $Sn(MnO_4)_2$ = 356.6 g/mol.

A) 9.88×10^{16} units
B) 3.52×10^{16} units
C) 9.9×10^{13} units
D) 9.9×10^{16} units
E) 1.26×10^{19} units
F) 9.88×10^{13} units

Answer: µg $Sn(MnO_4)_2$ → g $Sn(MnO_4)_2$ → moles $Sn(MnO_4)_2$ → # $Sn(MnO_4)_2$ units

3sf *∞sf* *4sf* *4sf*

$$\left(5.85 \times 10^{-2}\ \mu g\ Sn\right)\left(\frac{10^{-6}\ g\ Sn}{1\ \mu g\ Sn}\right)\left(\frac{1\ mole\ Sn}{356.6\ g\ Sn}\right)\left(\frac{6.022 \times 10^{23}\ units\ Sn}{1\ mole\ Sn}\right)$$

$$= 9.879052 \times 10^{13}\ Sn(MnO_4)_2\ units$$

Keep 3sf

Clicker question: Multi-step calculation with Avogadro's # and molar mass
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5) How many water molecules are in a 1.00-L bottle of water? The density of water = 1.00 g/mL

A) 3.34×10^{25} H_2O molecules
B) 1.09×10^{28} H_2O molecules
C) 9.22×10^{-23} H_2O molecules
D) 2.99×10^{-20} H_2O molecules
E) 9.22×10^{23} H_2O molecules
F) 3.34×10^{19} H_2O molecules

Answer:

Flowchart: L H_2O → mL H_2O → g H_2O → moles H_2O → # H_2O molecules

3sf *∞sf* *3sf* *4sf* *4sf*

$$(1.00 \cancel{\text{ L } H_2O}) \left(\frac{1 \cancel{\text{ mL } H_2O}}{10^{-3} \cancel{\text{ L } H_2O}}\right) \left(\frac{1.00 \cancel{\text{ g } H_2O}}{1 \cancel{\text{ mL } H_2O}}\right) \left(\frac{1 \text{ mole } \cancel{H_2O}}{18.02 \cancel{\text{ g } H_2O}}\right) \left(\frac{6.022 \times 10^{23} \text{ } H_2O}{1 \text{ mole } \cancel{H_2O}}\right)$$

$= 3.34184 \times 10^{25}$ H_2O molecules

Keep 3sf

Clicker question: Multi-step calculation with Avogadro's # and molar mass
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6) If 3.10 grams of phosphorous acid can be dissolved per mL of water, how many molecules of phosphorous acid can be dissolved in 5.5 mL of water?

A) 6.7×10^{22} molecules
B) 1.0×10^{23} molecules
C) 1.3×10^{23} molecules
D) 8.4×10^{26} molecules
E) 5.6×10^{22} molecules
F) 3.5×10^{-25} molecules

Answer: Formula = H_3PO_3 Molar mass = $\frac{81.99\ g\ H_3PO_3}{1\ mol\ H_3PO_3}$

Flowchart: mL H_2O → g H_3PO_3 → mol H_3PO_3 → # H_3PO_3 molecules

2sf *3sf* *4sf* *4sf*

$$5.5\ mL\ H_2O \left(\frac{3.10\ g\ H_3PO_3}{1\ mL\ H_2O}\right)\left(\frac{1\ mol\ H_3PO_3}{81.99\ g\ H_3PO_3}\right)\left(\frac{6.022 \times 10^{23}\ H_3PO_3\ molecules}{1\ mol\ H_3PO_3}\right)$$

$= 1.252288 \times 10^{23}\ H_3PO_3$ molecules

Keep 2sf