

Name: _____

Chemistry

Date: ____/____/____

Mole Conversions

When converting between moles and mass or volume or representative particles (atoms, ions or molecules) you will use the mole chart to the right (it is also on the back of your periodic table).

Since I have this extra space here...due to that chart over there, I thought I would fill this space with bad mole jokes.

Q: What was Avogadro's favorite element?

A: Mole-lybdenum

Q: What kind of car would Avogadro drive (if he was around today...and could drive)?

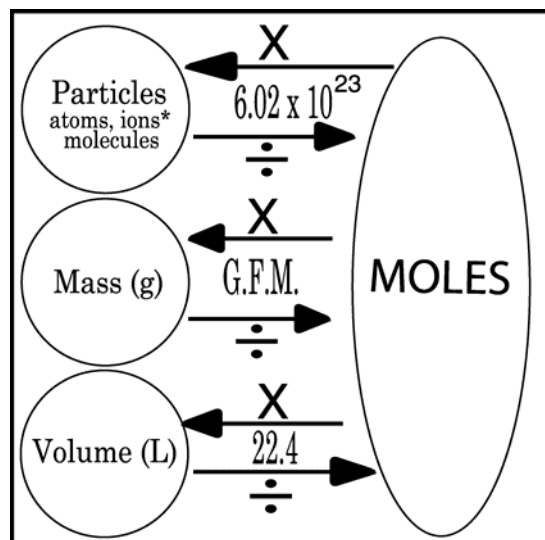
A: An Olds-mole-bile

Q: Which tooth did Avogadro have to have pulled?

A: His mole-r.

Q: Why did Avogadro stop going to a chiropractor on October 24th?

A: He was only tense to the 23rd.



Part I: Moles to Particles

Example: How many fluoride ions are there in 1.8 moles of aluminum fluoride?

Description of Action	Action
1. Determine what you are given. This will always be a number, unit and formula. Write your given over 1.	1. $\frac{1.8 \text{ moles of AlF}_3}{1}$
2. According to our chart, when going from moles to particles we must multiply our given number and 6.02×10^{23} particles of the given substance over 1 mole of the substance. Hint: When multiplying by 6.02×10^{23} , multiply your given and 6.02, then put $\times 10^{23}$ on the end. Your problem should be set up such that the units in your numerator in one step are the same as the units used in the denominator in the next step.	2. $\frac{1.8 \text{ moles of AlF}_3}{1} \times \frac{6.02 \times 10^{23} \text{ particles AlF}_3}{1 \text{ mole of AlF}_3} = 10.836 \times 10^{23} \text{ particles AlF}_3$ Notice how moles of AlF₃ cancel out. This leaves you with particles of AlF₃ , your unit in your answer.
3. Convert your answer to scientific notation. You should have one number before the decimal. When converting to proper scientific notation, if you move your decimal to the left , the power of 10 increases , if you move your decimal to the right , the power of 10 decreases .	3. $10.836 \times 10^{23} = 1.0836 \times 10^{24}$ Since I moved my decimal 1 place to the left, my power of 10 increased by 1.
4. Put your answer in significant figures. When multiplying, your answer must have the same amount of significant figures as the number with the fewest amount of significant figures in your problem.	4. Since 1.8 has 2 significant figures and 6.02×10^{23} has 3 significant digits and we multiplied, our answer can only have 2 significant figures. Alas, we have to change 1.0836×10^{24} to 1.1×10^{24}
5. Because we are solving for ions , we have one more step. This step is only necessary when solving for ions. In this step, we take our result and multiply it by the number of that specific ion or atom as indicated by the subscript following the symbol.	5. In our example we are solving for fluoride ions. There are 3 fluoride ions in the formula, AlF ₃ . $1.1 \times 10^{24} \times 3 = 3.3 \times 10^{24}$ Answer: 3.3×10^{24} fluoride ions

Practice Problems:

1. How many molecules are there in 4.35 moles of calcium sulfate?

2. How many atoms are in 0.75 mol of tungsten?

Part II: Particles to Moles

Example: Convert 2.408×10^{24} molecules of sodium chloride to moles.

Description of Action	Action
1. Determine what you are given and write it down over 1.	1. $\frac{2.408 \times 10^{24} \text{ molecules of NaCl}}{1}$
2. Convert the given value to 10^{23} . When converting in scientific notation, if you move your decimal to the left , the power of 10 increases , if you move your decimal to the right , the power of 10 decreases .	2. Convert: $2.408 \times 10^{24} = 24.08 \times 10^{23}$ Since I moved my decimal 1 place to the right, my power of 10 decreased by 1.
3. According to our chart, when going from particles to moles , we divide by 6.02×10^{23} molecules of the substance. Because we had set our given value to 10^{23} , both 10^{23} will cancel out.	3. $\frac{24.08 \times 10^{23} \text{ molecules NaCl}}{1} \times \frac{1 \text{ mole of NaCl}}{6.02 \times 10^{23} \text{ molecules NaCl}} = 4 \text{ moles NaCl}$
4. Put your answer in significant figures.	4. Since 24.08 has 4 significant figures and 6.02 has 3 significant figures, our answer must have 3 significant figures. So we must change 4 to 4.00 moles of NaCl

Practice Problems:

1. How many moles are in 1.204×10^{24} molecules of barium chloride?

2. How many moles are 1.2×10^{21} atoms of francium?

Part III: Moles to Grams

Example: Calculate how many grams are in 0.700 moles of magnesium oxide?

Description of Action	Action
1. Determine what you are given and write it down over 1.	1. $\frac{0.700 \text{ moles of MgO}}{1}$
2. Calculate the gram formula mass of the compound.	2. Mg: $1 \times 24.3 = 24.3$ O: $1 \times 16.0 = 16.0$ $24.3 + 16.0 = 40.3 \text{ g/mol}$
3. According to our chart, when going from moles to grams , we must multiply the given and the gram formula mass of the substance (in grams) over 1 mole of the substance.	3. $\frac{0.700 \text{ moles of MgO}}{1} \times \frac{40.3 \text{ grams of MgO}}{1 \text{ mole MgO}} = 28.2 \text{ grams of MgO}$
4. Put your answer in significant digits.	4. 40.3 has 3 significant digits and 0.700 has 3 significant digits, so our answer must have 3 significant digits. In this case, no conversion is necessary. Answer: 28.2 grams of MgO

Practice Problems:

1. How many grams are in 0.200 moles of calcium bromide.

2. How many grams are in 0.150 moles of potassium iodide?

Part IV: Grams to Moles

Example: Calculate the number of moles in 25.0 grams of potassium permanganate.

Description of Action	Action
1. Determine what you are given and write it down over 1.	1. $\frac{25.0 \text{ grams of KMnO}_4}{1}$
2. Calculate the gram formula mass of the given.	2. K: $1 \times 39.1 = 39.1$ Mn: $1 \times 54.9 = 54.9$ O: $4 \times 16.0 = 64.0$ $39.1 + 54.9 + 64.0 = 158.0 \text{ g/mol}$
3. According to the chart, when going from grams to moles , we must divide the given by the gram formula mass (in grams).	3. $\frac{25.0 \text{ grams of KMnO}_4}{1} \times \frac{1 \text{ mole of KMnO}_4}{158.0 \text{ grams of KMnO}_4} = 0.1582278 \text{ moles of KMnO}_4$
4. Put your answer in significant figures.	4. 25.0 has 3 significant figures and 158.0 has 4 significant figures so our answer can only have 3 significant figures. Answer: 0.158 moles of KMnO₄

Practice Problems:

1. Calculate the number of moles in 8.76 grams of sodium hydroxide.

2. Convert 100.7 grams of potassium perchlorate to moles.

Part V: Moles to Liters

Example: How many liters is 3.3 moles of hydrogen sulfide?

Description of Action	Action
1. Determine what you are given and write it down over 1.	1. $\frac{3.3 \text{ moles of H}_2\text{S}}{1}$
2. According to our chart, when going from moles to liters , we must multiply the given by 22.4 liters. 1 mole of any gas is equal to 22.4 liters	2. $\frac{3.3 \text{ moles of H}_2\text{S}}{1} \times \frac{22.4 \text{ L H}_2\text{S}}{1 \text{ mole H}_2\text{S}} = 73.92 \text{ L of H}_2\text{S}$
3. Put your answer in significant figures.	3. 3.3 has 2 significant figures and 22.4 has 3 significant figures. Our answer can only have 2 significant figures. Answer: 74 L of H₂S

Practice Problems:

1. How many liters are there in 16.18 moles of ammonium chloride gas?

2. How many liters are there in 2.3 moles of water?

Part VI: Liters to Moles

Example: How many moles are there in 68.0 liters of potassium fluoride gas?

Description of Action	Action
1. Determine what you are given and write it down over 1.	1. $\frac{68.0 \text{ L of KF}}{1}$
2. According to our chart, when going from liters to moles , we must divide the given and 22.4. 1 mole of any gas is equal to 22.4 liters	2. $\frac{68.0 \text{ L of KF}}{1} \times \frac{1 \text{ mole KF}}{22.4 \text{ L KF}} = 3.035714 \text{ moles of KF}$
3. Put your answer in scientific notation.	3. 68.0 and 22.4 both have 3 significant digits so our answer can only have 3 significant digits. Answer: 3.04 moles of KF

Practice Problems:

1. How many moles are there in 32.3 liters of ammonium bromide gas?

2. Convert 18.3 liters of sodium acetate gas to moles.

Homework:

Part I: Convert each of the following from moles to particles.

1. Calculate the number of molecules in 7.43 moles of calcium chloride.
2. Calculate the number of atoms in 0.33 moles of osmium.
3. Calculate the number of **potassium ions** in 6.33 moles of potassium selenide.
4. Calculate the number of molecules in 3.45 moles of beryllium phosphide.

Part II: Convert each of the following from particles to moles.

5. Calculate the number of moles there are in 1.204×10^{24} molecules of strontium chloride.
6. Calculate the number of moles there are in 1.806×10^{27} molecules of ammonium carbide.
7. Calculate the number of moles there are in 2.4×10^{20} atoms of vanadium.
8. Calculate the number of moles there are in 3.02×10^{25} molecules of iron(II) oxide.

Part III: Name each of the following compounds and then convert moles to grams.

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|--------------------------------|---------------------------------------|--------------------------------------|
| 9. 2.5 moles HNO_3 | 10. 42.0 moles AuCl_3 | 11. 2.2 moles SnCl_2 |
| 12. 0.50 moles CaCO_3 | 13. 1.5 moles K_2SO_4 | 14. 6.66 moles Ag_2O |

Part IV: Name each of the following compounds and then convert grams to moles.

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|---------------------------------------|---------------------------------|--|
| 15. 26.4 grams V_2O_5 | 16. 333.80 grams SnF_2 | 17. 922.17 grams Fe_2O_3 |
| 18. 274.65 grams TiO_2 | 19. 116.82 grams HCl | 20. 73.5 grams Al_2O_3 |

Part V: Name each of the following and then convert each from moles to liters.

21. 2.4 moles of AlCl_3

22. 12.7 moles of KClO

23. 0.69 moles of FrF

Part VI: Name each of the following and then convert each from liters to moles.

24. 33.7 liters of SnS

25. 87.2 liters of CdO

26. 53.8 liters of HBr

Part VII: Answer each of the following problems.

27. Calculate the number of hydroxide ions in 23.5 grams of aluminum hydroxide.

28. Calculate the number of molecules of copper(II) chloride there are in 15.75 grams of the substance.

29. How many grams of sodium iodide do you have, if you have 18.06×10^{24} molecules of the substance?

30. Calculate the number of aluminum ions in 37.21 liters of aluminum phosphite gas.

31. How many grams of magnesium bromide would I need to produce 18.0 liters of magnesium bromide gas?

32. What would be the mass of 32.33 liters of sodium sulfite gas?

33. How many hydrogen atoms are in 420.69 grams of ammonium phosphate?