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Summer Edition

Chemistry

Activity 1

knoxschools.org/kcsathome

Introduction to Moles

Follow Along Notes & Embedded Practice

CHEM1.PS1.3:
"Perform stoichiometric calculations involving the following relationships: mole-mole; mass-mass; mole-mass; mole-particle; and mass-particle…"

Table of Contents:

To be successful in this topic you need to understand:

- ❑ Why we use moles to measure
- ❑ How it is related to a balanced equation
- ❑ How to predict the number of moles of a substance with a balanced equation
- ❑ Conversion units for moles
- ❑ How to set up a mole conversion problem correctly
- ❑ How to convert between moles, mass, and particles using the conversion units so that units cross out correctly

Topics to refresh on before we start:

- **Scientific Notation Video:** https://youtu.be/Dme-G4rc6NI
- **Calculator Use Video:** https://youtu.be/FIDAJwvxX5Q
- **Molar Mass Video:** https://youtu.be/Qflq48Foh2w

Periodic Table of the Elements

1 IA 11A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.88	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.933	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.732	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.922	34 **Se** Selenium 78.09	35 **Br** Bromine 79.904	36 **Kr** Krypton 84.80
37 **Rb** Rubidium 84.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.71	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.327	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.85	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.967	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [268]	110 **Ds** Darmstadtium [269]	111 **Rg** Roentgenium [272]	112 **Cn** Copernicium [277]	113 **Uut** Ununtrium unknown	114 **Fl** Flerovium [289]	115 **Uup** Ununpentium unknown	116 **Lv** Livermorium [298]	117 **Uus** Ununseptium unknown	118 **Uuo** Ununoctium unknown

Lanthanide Series	57 **La** Lanthanum 138.906	58 **Ce** Cerium 140.115	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.24	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.966	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
Actinide Series	89 **Ac** Actinium 227.028	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]

Part 1: *What is a mole?*

1. ***Create***
    a. Create your own grouping for the number of seeds you would like to count and name it.

    _____

    b. Write how many seeds are equal to that quantity.

    _____

    c. Hypothesize at least one reason scientists might want to group things when quantifying them.

    _____

2. ***Design & Predict***

    Let's use a made up quantifier of seeds. **1 Fox of seeds = 25 seeds**.

    a. If one Fox of seeds measures 50g on a scale, how many grains of rice would you have in 3 Foxes of seeds?

    _____

    b. If you have 1.25 Foxes of seeds, how much should it measure on the scale in grams? Remember that **1 Fox = 25 seeds = 50g**

    _____

3. ***Check Your Understanding***

    If 12 eggs =1 dozen, how many **dozens** would you have if you had 291 eggs? _____

Part 2: *Conversion Units*

Conversion Units of H_2O

A. 1 mole H_2O = _____ g H_2O

B. 1 mole H_2O = _____ L H_2O

C. 1 mole H_2O = _____ particles H_2O

Put moles as a <u>denominator</u> for each conversion factor above:

A._____ B._____ C._____

Put moles as a <u>numerator</u> for each conversion factor above:

A._____ B._____ C._____

Conversion Units of CO_2

A. 1 mole H_2O = _____ g H_2O

B. 1 mole H_2O = _____ L H_2O

C. 1 mole H_2O = _____ particles H_2O

Put moles as a <u>denominator</u> for each conversion factor above:

A._____ B._____ C._____

Put moles as a <u>numerator</u> for each conversion factor above:

A._____ B._____ C._____

Extra Practice Resources:

Quizlet
Online flashcards
https://bit.ly/QuizletMolePractice

Pearson
virtual lab simulation
https://bit.ly/pearsonvirtualsimulation

Part 3: *Setting up a mole conversion problem g← →mole*

1. **How many total grams of carbon would you have in 2.50 moles of carbon?**
   - *Get carbon's mass from the periodic table*
   - *Carbon's molar mass is **12.01g per one mole***

   2.50 **moles C** x $\frac{12.01\ \textbf{g C}}{1\ \textbf{mole C}}$ = **grams of carbon**

2. **How many moles of NaCl would you have in 4.67 grams of NaCl?**
   - *Remember that the molar mass of NaCl is 58.44g per one mole*
   - *(Na 22.99g + Cl 35.45g = **NaCl 58.44g**)*

   4.67 grams NaCl x _____ =

3. **How many grams of $Al_2(CO_3)_3$ are there in 1.23 moles of $Al_2(CO_3)_3$?**
   - *Molar mass of **$Al_2(CO_3)_3$ is 233.99 g** per one mole*
   - *2 aluminum (2 x 26.98g) + 3 carbon (3 x 12.01g) + 9 oxygen (9 x 16.00g) = 233.99g $Al_2(CO_3)_3$*

4. **How many moles of $Al_2(CO_3)_3$ are there in 7.22 grams of $Al_2(CO_3)_3$?**
   - *Molar mass of **$Al_2(CO_3)_3$ is 233.99 g** per one mole*
   - *2 aluminum (2 x 26.98g) + 3 carbon (3 x 12.01g) + 9 oxygen (9 x 16.00g) = 233.99g $Al_2(CO_3)_3$*

Part 4: *Setting up a mole conversion problem L→ mole*

*(Remember that **1 mole** = **22.4L** at STP)*

5. **How many total moles of carbon would you have in 2.5L of carbon?**

$$2.5\text{L C} \times \frac{1\ \text{moles C}}{22.4\text{L C}} = 0.11\ \text{moles of carbon}$$

6. **What volume of oxygen gas would you have in 2.5 moles of oxygen gas?**

$$2.5\ \text{moles } O_2 \times \frac{22.4\ \text{L } O_2}{1\ \text{mole } O_2} = 56\ \text{L of } O_2$$

7. **What volume of NaCl would you have in 3.25 moles of NaCl?**

3.25 **moles NaCl** x _____ =

8. **How many moles of $Al_2(CO_3)_3$ are there in 0.87L of $Al_2(CO_3)_3$?**

9. **What volume of $Al_2(CO_3)_3$ are there in 1.3 moles of $Al_2(CO_3)_3$?**

Part 5: *Setting up a mole conversion problem mole← → particles*

*(Remember that **1 mole** = **6.02 x 10^{23} particles**)*

10. **How many total moles of carbon would you have in 2.3x10^{12} particles of carbon?**

$2.3\text{x}10^{12}$ **particles C** x $\frac{1 \text{ mole C}}{6.02\text{x } 10^{23} \text{ particles C}}$ = **4.44 x 10^{24} moles of carbon**

11. **How many particles of NaCl would you have in 12.7 moles of NaCl?**

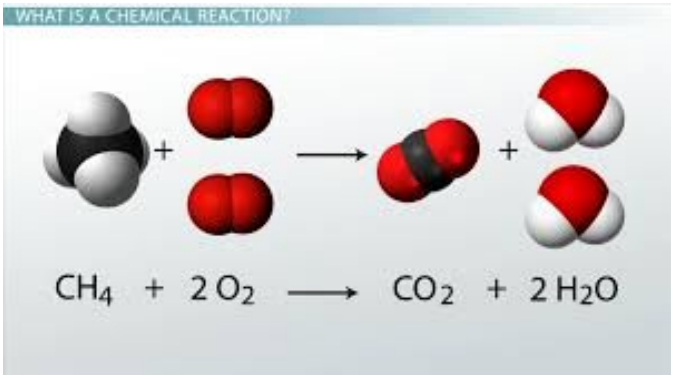
12.7 moles of NaCl x _____ =

12. **How many moles of $Al_2(CO_3)_3$ are there in 3.72 x 10^{22} particles of $Al_2(CO_3)_3$?**

13. **How many particles of $Al_2(CO_3)_3$ are there in 0.724 moles of $Al_2(CO_3)_3$?**

Part 6: *Mole to mole conversion with a balanced equation*

To refresh on balancing equations, use the PHET simulation:
https://bit.ly/PHETbalalncingEq



14. **For every <u>1 mole of CH_4</u> in this equation you would have:**

    a. _____ moles of O_2

    b. _____ moles of CO_2

    c. _____ moles of H_2O

15. **For every <u>2 moles of CH_4</u> in this equation you would have:**

    a. _____ moles of O_2

    b. _____ moles of CO_2

    c. _____ moles of H_2O

16. **How many moles of O_2 would you need to make:**

    a. 0.73 moles of CO_2

    b. 12.3 moles of H_2O

    c. 4.2 moles of CH_4

Part 7: *Extra Practice*

Grams ← → Moles Conversions

28. 1 mole Li_2O = _____ g Li_2O	33. 1 g Li_2O = _____ mole(s) Li_2O
29. 2 moles Li_2O = _____ g Li_2O	34. 2 g Li_2O = _____ mole(s) Li_2O
30. 1 mole O_2 = _____g O_2	35. 1 g O_2 = _____mole(s) O_2
31. 1 mole $C_6H_{12}O_6$ = _____g $C_6H_{12}O_6$	36. 1 g $C_6H_{12}O_6$ = _____mole(s) $C_6H_{12}O_6$
32. 0.89 moles $Cu(NO_3)_2$ = _____g $Cu(NO_3)_2$	37. 1 g $Cu(NO_3)_2$ = _____mole(s) $Cu(NO_3)_2$

Show your work here:

Liters (at STP) ← → Mole Conversions

38. 1 mole Li_2O = _____ L Li_2O	43. 22.4 L Li_2O = _____ mole(s) Li_2O
39. 2 moles Li_2O = _____ L Li_2O	44. 2 L Li_2O = _____ mole(s) Li_2O
40. 1 mole O_2 = _____L O_2	45. 1 L O_2 = _____mole(s) O_2
41. 1 mole $C_6H_{12}O_6$ = _____L $C_6H_{12}O_6$	46. 44.8. L $C_6H_{12}O_6$ = _____mole(s) $C_6H_{12}O_6$
42. 1 mole $Cu(NO_3)_2$ = _____L $Cu(NO_3)_2$	47. 1 L $Cu(NO_3)_2$ = _____mole(s) $Cu(NO_3)_2$

Show your work here:

Particles ← → Mole Conversions

48. 1 mole Li_2O = _____ particles Li_2O	53. Particles Li_2O = _____ mole(s) Li_2O
49. 2 moles Li_2O = _____ particles Li_2O	54. Particles Li_2O = _____ mole(s) Li_2O
50. 1 mole O_2 = _____particles O_2	55. particles O_2 = _____mole(s) O_2
51. 1 mole $C_6H_{12}O_6$ = _____particles $C_6H_{12}O_6$	56. particles $C_6H_{12}O_6$ = _____mole(s) $C_6H_{12}O_6$
52. 1 mole $Cu(NO_3)_2$ = _____particles $Cu(NO_3)_2$	57. particles $Cu(NO_3)_2$ = _____mole(s) $Cu(NO_3)_2$

Show your work here:

Mole ← → Mole Conversions using balanced equations

_2_Li + _1_O_2 → _1_Li_2O

58. 1 mole Li_2O = _____ mole(s) O_2	60. 0.78 mole O_2 = _____ mole(s) Li_2O
59. 2 mole Li_2O = _____ mole(s) O_2	61. 6.23 mole Li_2O = _____ mole(s) Li_2O

Show your work here:

_2_N_2 + _3_H_2 → _2_NH_3

62. 1 mole N_2 = _____ mole(s) H_2	64. 3 mole O_2 = _____ mole(s) NH_3
63. 2.3 moles NH_3 = _____ mole(s) H_2	65. 44.8 mole N_2 = _____ mole(s) H_2

Show your work here:

Extra Practice with your Pearson Online Textbook:

- **Online Practice Problems:** https://bit.ly/PearsonPracticeProblemsMole
- **Extra Practice Tutorial:** https://bit.ly/PearsonMoleTutorial