Name:_____ **Date:**_____

Moles and Matter – What do you know?...

Solve the following moles problems and take care to have the math show how you got your answer.

Give the masses of the following compounds:

1) K_2CrO_4

$2 \times 39.1 + 52 + 64 = 194_g$ ✓2

2) CO_2

$1L \times 32 = 44_g$

3) $Na_3Fe(CN)_6$

$3 \times 23 + 55.8 + (6 \times (12 + 14)) = 280.8_g$

Solve the following quantity problems.

4) Determine the number of particles in the following:

a. Three and half moles of Munchkins (that's a lot of Munchkins)

$3.5 \text{ mol} \times 6.02 \times 10^{23} \text{ parts/mol} = 21.07 \times 10^{23} \text{ parts} = 2.11 \times 10^{24} \text{ parts}$

b. 14.5 moles of $CaCO_3$

$14.5 \text{ mol} \times 6.02 \times 10^{23} \text{ parts/mol} = 87.3 \times 10^{23} \text{ parts} = 8.73 \times 10^{24} \text{ parts}$

c. 1.23×10^{-3} moles of NaCl

$1.23 \times 10^{-3} \text{ mol} \times 6.02 \times 10^{23} \text{ parts/mol} = 7.40 \times 10^{20} \text{ parts}$

Solve the following mass problems:

5) Determine the mass in grams of the following:

a. Half a mole of $K_2Cr_2O_7$

$0.5 \times 2 \times 39.1 + 2 \times 52.0 + 7 \times 16.0$

$0.5 \times 78.2 + 104 + 112$

$0.5 \text{ mol} \times 294.2 \text{ g/mol} = 147.1 \text{ g}$

b. 58 mg of Caffeine

$58 \times 10^{-3} = 5.8 \times 10^{-2}\ g$ or $0.058\ g$

c. 2.045 moles of HCl (Cl= chlorine not carbon and iodine)

$1\ g/mol + 35.5\ g/mol = 36.5\ g/mol \times 2.045\ mol = 74.64\ g$

Use the following quantities to determine the amount of moles requested in each problem.

6) How many moles are in the following:

a. 71.4g of Barium (lower left of the periodic table)

$71.4\ g / 137.3\ g/mol = 0.52\ mol$

b. 3.31 kg of water

$3.31\ kg = 3310\ g / 18\ g/mol = 183.9\ mol$

c. 2.23×10^{23} particles of CO_2

$\frac{2.23 \times 10^{23}\ particles}{6.02 \times 10^{23}\ particles/mol} = 0.37 \times 10^{0} = 0.37 = 3.7 \times 10^{-1}\ mol$

d. 9.43×10^{22} particles of sugar

$\frac{9.43 \times 10^{22}\ particles}{6.02 \times 10^{23}\ particles/mol} = 1.57 \times 10^{-1}\ mol$

Percent composition asks you to determine the mass of each type of element in a compound expressed as a percentage of the compound. Be careful of the small numbers!!

7) Determine percent by mass of each element in $Na_3Co(NO_2)_6$

a. Na

17% $68.7 / 403.6 = 0.17$ 17% $3 \times 22.9 + 58.9 + 6(14 + 32)$

$68.7 + 58.9 + 6 \times 46$

b. Co

14.6% $58.9 / 403.6 = 0.146$ 14.6% 403.6

c. N

20.8% $6 \times 14 = 84 / 403.6 = 0.208 = 20.8\%$

d. O

$6 \times 16_g = 192_g / 403.6 = 0.476 = 47.6\%$

e. Based on the percentages of the previous compound, how much nitrogen would you get if you were able to break down 825.5 grams of the compound?

$N = 20.8\%$ $\quad 825.5_g \times 0.208 = 171.7_g$ of N

f. Again, from the previous compound, what total mass of cobalt would you need to make 5 kilograms of the chemical?

$5\,kg = 5{,}000_g \times \%\,Co$

$5{,}000_g \times 0.146 = 730_g$

Use the following mass information to determine the empirical and molecular formulas for the following chemicals.

8) If 225 grams of a compound breaks up into 77.2 grams of sodium, 40.3 grams of carbon, and 107.5 grams of oxygen, what is its empirical formula?

$Na = 77.2/225 = 0.343$ $\quad 34.3/23.9 = 1.5 = 1$ $\quad \frac{77.2_g}{22.9\,g/mol} = 3.37\,mol = 1\,Na$

$C = 40.3/225 = 0.179$ $\quad 17.9/12 = 1.5 = 1$ $\quad \frac{40.3_g}{12\,g/mol} = 3.35\,mol = 1\,C$

$O = 107.5/225 = 0.478$ $\quad 47.8/16 = 3 = 2$ $\quad \frac{107.5_g}{16\,g/mol} = 6.72 = 2\,O$

$NaCO_2$ $\qquad$ $NaCO_2$

9) If this compound has a molar mass of 134.0g, what is its molecular formula?

$NaCO_2 = 23 + 12 + 32 = 67\,g$ $\quad \frac{134}{67} = 2$

$2 \times NaCO_2 = Na_2C_2O_4$

Calculate the formulae from the mass data for each of the following hydrated compounds.

10) If 25.0 grams of $NiCl_2 \cdot ?H_2O$ are heated and 11.37 grams of water are driven off, what is the formula for the hydrate?

$11.37\,g\ H_2O \,/\, 18\,g/mol = 0.632\ mol \,/\, 0.105 = 6$

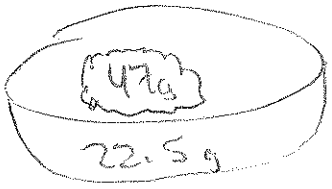
$25\,g - 11.37\,g\ NiCl_2 = 13.63\,g \,/\, 129.7\,g/mol = 0.105\ mol \,/\, 0.105 = 1$

$58.7\,g + 71\,g$

$129.7\,g$

$NiCl_2 \cdot 6H_2O$

11) If a crucible has a mass of 22.5 grams and full of Na_2CrO_4 hydrate weighs 69.5 grams before it gets heated, calculate the formula for the hydrate if the crucible plus the anhydrous compound weigh 55.0 grams after heating.



$69.5\,g - 55\,g = 14.5\,g\ H_2O \,/\, 18\,g/mol = 0.806\ mol \,/\, 0.251 = 4$

69.5 g

55 g

$14.5\,g\ H_2O$

$2(23) + 52 + 64 = 162$

$55\,g - 22.5\,g = 32.5\,g\ Na_2CrO_4 \,/\, 162\,g/mol = 0.201\ mol \,/\, 0.251 = 1$

$Na_2CrO_4 \cdot 4H_2O$