EXPRESSING SOLUTION CONCENTRATION
(Molarity, Mole Fraction, Parts per million, Parts per billion)

Name KEY
Period _____

1. What is the molarity of a solution that has 150 grams of $MgSO_4$ dissolved in 250 mL of solution?

150 g $MgSO_4$ → 1.25 mol
250 mL → .25 L
M = 5.0 M $MgSO_4$

2. What amount of $AgNO_3$ in grams is needed to make a 5.5 *M* solution in 430 mL of solution?

$\frac{5.5\ mol}{L} = \frac{x}{.43L}$ x = 2.365 mol $AgNO_3$ → 401.8 g
= 4.0×10^2 g $AgNO_3$

3. A gas mixture contains 45.6 grams of carbon monoxide and 899 grams of carbon dioxide. What is the mole fraction of carbon monoxide?

45.6 g CO → 1.63 mol CO
899 g CO_2 → 20.4 mol CO_2
$X_{CO} = \frac{1.63}{1.63+20.4} = 0.0740$

4. What is the mole fraction of xenon in a mixture that contains 0.584 grams of xenon, 86.40 grams of argon, and 3.62 grams of neon?

0.584 g Xe → .00445 mol Xe
86.40 g Ar → 2.165 mol Ar
3.62 g Ne → .179 mol Ne
2.348 total
$X_{Xe} = \frac{.00445}{2.348} = 0.0019$

5. A gas mixture contains the following gases with the mole fractions indicated: NH_3 (0.214), Cl_2 (0.452), NH_2Cl (0.118), and N_2 (0.175). The mixture also contains HCl gas. What is the mole fraction of HCl gas?

0.214 + 0.452 + 0.118 + 0.175 + X = 1.0
0.959 + x = 1.0
X_{HCl} = 0.041

6. A gas mixture contains 70.25 grams of steam (H_2O), 1.470 grams of hydrogen, and 6.58 grams of nitrogen. What is the mole fraction of steam?

H_2O: 3.90 mol
H_2: 0.7292 mol
N_2: 0.235 mol
$X_{H_2O} = \frac{3.90}{4.8642} = .802$

7. If a 100.0 mL sample of air contains 3.3×10^{-5} mL N_2O, what is the concentration of N_2O in parts per billion (ppb)?

$\frac{3.3 \times 10^{-5}\ mL\ N_2O}{100.0\ mL\ air} \times 10^9 = 330$ ppb

8. The surface concentration of fluorine in seawater is 1.3 mg/kg. Express this amount in parts per million (ppm).

$\frac{1.3\ mg\ F_2}{1\ kg\ seawater} \rightarrow \frac{1.3\ mg}{10^6\ mg} \times 10^6 = 1.3$ ppm

9. Iridium is used in the manufacture of transistors. The purest grade is 99.99999% iridium. Express the amount of impurities in ppb.

Assume 100 g:
100 g
− 99.99999 g pure
0.00001 g impure

$\frac{0.00001\ g}{100\ g} \times 10^9 = 100$ ppb

10. The concentration of trimethyl lead in French wines was 460 picograms/gram in 1879. It is now only 40 pg/g as a result of the reduction of the levels of lead additives in gasoline. Express these concentrations in parts per billion.

$\frac{460\ pg}{1\ g} \Rightarrow \frac{460\ pg}{10^{12}\ pg} \times 10^9 = 0.46$ ppb

$\frac{40\ pg}{1\ g} \rightarrow \frac{40\ pg}{10^{12}\ pg} \times 10^9 = 0.04$ ppb

1. What is the percent by mass of NaOCl in a bleach solution containing 54.3 grams NaOCl dissolved in 1500 grams of solution?

$\frac{54.3\text{ g}}{1500\text{ g}} \times 100\% = 3.62\%$

2. A 100.5 ml intravenous (IV) solution contains 5.10g of glucose ($C_6H_{12}O_6$). What is the molarity of this solution?

$5.10\text{ g} \times \frac{1\text{ mol}}{180\text{ g}} = 0.0283\text{ mol} \div .1005\text{ L} = .282\text{ M}$

3. What is the molality of a solution made by dissolving 8.11g of potassium sulfide (K_2S) in 47.6 grams of ethanol (C_2H_5OH)?

$8.11\text{g } K_2S \times \frac{1\text{ mol}}{110.3\text{ g}} = .0735\text{ mol} \div .0476\text{ kg} = 1.54\text{ m}$

4. What is the mole fraction of oxygen in a mixture that contains 66.8g oxygen, 44.1g nitrogen, and 21.5g hydrogen?

O_2, N_2, H_2 $\quad \frac{2.088}{14.413} =$ 0.1448

2.088 mol O_2 + 1.575 mol N_2 + 10.75 mol H_2 = 14.413 mol

5. The maximum allowable concentration of chromium in drinking water is 4.2 mg in 42 kg of water. What is this concentration in parts per million??

$1\text{ kg} = 10^6\text{ mg}$

$\frac{4.2\text{ mg}}{42 \times 10^6\text{ mg}} \times 10^6 = \frac{4.2}{42} = .1$ 0.1 ppm

6. The maximum allowable concentration of cadmium in drinking water is 1 mg in 200 kg of water. What is this concentration in parts per billion?

$1\text{ mg} \times \frac{1\text{ g}}{1000\text{ mg}} \times \frac{1\text{ kg}}{1000\text{ g}} = \frac{1}{10^6} = 10^{-6}\text{ kg}$ $\quad \frac{10^{-6}\text{ kg}}{200\text{ kg}} \times 10^9$ 5ppb

7. A mixture of gases contains gases in the following mole fractions: CH_4 (0.510), C_2H_6 (0.431), C_3H_8 (0.011), C_4H_{10} (0.013). The mixture also contains C_2H_2. What is the mole fraction of C_2H_2?

$CH_4 + C_2H_6 + C_3H_8 + C_4H_{10} + (X) = 1.0$

0.035

$1.0 = .510 + .431 + .011 + .013 + X$

$1.0 = .965 + X$

$0.09\text{ g mol } NH_4Cl \times \frac{53.5\text{ g}}{1\text{ mol}} = 4.8\text{g}$

8. How many moles of NH_4Cl are contained in 600ml of a 0.15M solution? How many grams?

4.8 g NH_4Cl $\quad 0.15\frac{\text{mol}}{\text{L}} \times .6\text{ L} = 0.09\text{ mol } NH_4Cl$

9. A saturated solution of KCl was made with 300 g of H_2O at 80°C. How much KCl could be recovered by evaporating the solution to dryness?

$\frac{50\text{g KCl}}{100\text{ g } H_2O}$ @ 80°C $\left\{ \frac{50}{100} = \frac{150}{300} \right.$ = 150 g KCl

10. A saturated solution of $KClO_3$ in 200 g of water at 80°C is cooled to 30°C. How much $KClO_3$ will precipitate out of solution?

84g − 22g = 62g

@80°C $\frac{42\text{g}}{100\text{g } H_2O} \times 200 = 84\text{g}$