

This is a sample quiz for CH 222 providing examples of solution calculations. Answers are provided on the next pages. *Good luck!*

Problem #1: Fill in the blanks in the table. All solutions are aqueous.

<i>Solute</i>	<i>solution density, g/cm³</i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
NiCl ₂	0.99777			0.00331	
acetone	0.9163				4.00 M
NH ₄ NO ₃	1.112	3.54 m			
HCl	1.47		90.0%		

Problem #2: Fill in the blanks in the table. All solutions are aqueous.

<i>Solute</i>	<i>solution density, g/cm³</i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
KBr	0.9977			0.120	
ethanol	0.9163				0.801 M
MgI ₂	1.112	1.17 m			
H ₂ SO ₄	1.84		95.0%		

Answers appear on the next pages

Problem #1 Answers: (answers in bold)

<i>Solute</i>	<i>solution density, g/cm³</i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
NiCl ₂	0.99777	0.184 m	2.33%	0.00331	0.180 M
acetone	0.9163	5.85 m	25.3%	0.0943	4.00 M
NH ₄ NO ₃	1.112	3.54 m	22.1%	0.0599	3.07 M
HCl	1.47	247 m	90.0%	0.817	36.3 M

For NiCl₂: molar mass = 129.59 g/mol. Assume **1.00000 mol total**

Solute: **0.00331 mol NiCl₂** * 129.59 g/mol = **0.429 g NiCl₂**

Solvent: 1 – 0.00331 = **0.99669 mol H₂O** * 18.016 g/mol = **17.956 g H₂O**

molality = 0.00331 mol NiCl₂ / 0.017956 kg H₂O = **0.184 m**

wt% = (0.429 g NiCl₂) / (0.429 g NiCl₂ + 17.956 g H₂O) * 100% = **2.33%**

mass solution = (0.429 g NiCl₂ + 17.956 g H₂O) = **18.385 g solution**

volume solution = 18.385 g solution * (mL / 0.99777 g) = **18.426 mL solution**

molarity = 0.00331 mol NiCl₂ / 0.018426 L = **0.180 M**

For acetone (CH₃COCH₃): molar mass = 58.078 g/mol. Assume **1.00 L of solution.**

Solute: **4.00 mol acetone** * 58.078 g/mol = **232 g acetone**

mass solution = 1.00 L * (10³ mL/L) * (0.9163 g/mL) = **916 g solution**

mass solvent = 916 g solution – 232 g solute = **684 g solvent (H₂O)**

moles solvent = 684 g H₂O * (mol / 18.016 g) = **38.0 mol H₂O**

molality = 4.00 mol acetone / 0.684 kg H₂O = **5.85 m**

wt% = (232 g acetone) / (232 g acetone + 684 g H₂O) * 100% = **25.3%**

X = (4.00 mol acetone) / (4.00 mol acetone + 38.0 mol H₂O) = **0.0943**

Answers continue on next page

For NH_4NO_3 : molar mass = 80.052 g/mol. Assume **1.000 kg total solvent**

$$\text{Solute: } 3.54 \text{ mol NH}_4\text{NO}_3 * 80.052 \text{ g/mol} = \mathbf{283 \text{ g NH}_4\text{NO}_3}$$

$$\text{Solvent: } 1.000 \text{ kg} * (10^3 \text{ g/kg}) = \mathbf{1000. \text{ g}} * (1 \text{ mol} / 18.016 \text{ g}) = \mathbf{55.51 \text{ mol H}_2\text{O}}$$

$$X = (3.54 \text{ mol NH}_4\text{NO}_3) / (3.54 \text{ mol NH}_4\text{NO}_3 + 55.51 \text{ mol H}_2\text{O}) = \mathbf{0.0599}$$

$$\text{wt}\% = (283 \text{ g NH}_4\text{NO}_3) / (283 \text{ g NH}_4\text{NO}_3 + 1000. \text{ g H}_2\text{O}) * 100\% = \mathbf{22.1\%}$$

$$\text{mass solution} = (283 \text{ g NH}_4\text{NO}_3 + 1000. \text{ g H}_2\text{O}) = \mathbf{1283 \text{ g solution}}$$

$$\text{volume solution} = 1283 \text{ g solution} * (\text{mL} / 1.112 \text{ g}) = \mathbf{1154 \text{ mL solution}}$$

$$\text{molarity} = 3.54 \text{ mol NH}_4\text{NO}_3 / 1.154 \text{ L} = \mathbf{3.07 \text{ M}}$$

For HCl : molar mass = 36.458 g/mol. Assume **100.0 g total solution**

$$\text{Solute: } 90.0 \text{ g HCl} * (\text{mol} / 36.458 \text{ g/mol}) = \mathbf{2.47 \text{ mol HCl}}$$

$$\text{Solvent: } (100.0 - 90.0) = \mathbf{10.0 \text{ g H}_2\text{O}} * (1 \text{ mol} / 18.016 \text{ g}) = \mathbf{.555 \text{ mol H}_2\text{O}}$$

$$X = (2.47 \text{ mol HCl}) / (2.47 \text{ mol HCl} + 0.555 \text{ mol H}_2\text{O}) = \mathbf{0.817}$$

$$\text{molality} = 2.47 \text{ mol HCl} / 0.0100 \text{ kg H}_2\text{O} = \mathbf{247 \text{ m}}$$

$$\text{mass solution} = \mathbf{100.0 \text{ g solution}}$$

$$\text{volume solution} = 100.0 \text{ g solution} * (\text{mL} / 1.47 \text{ g}) = \mathbf{68.0 \text{ mL solution}}$$

$$\text{molarity} = 2.47 \text{ mol HCl} / 0.0680 \text{ L} = \mathbf{36.3 \text{ M}}$$

Problem #2 Answers: (answers in **bold**, try working the problems out on your own!)

<i>Solute</i>	<i>solution density, g/cm³</i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
KBr	0.9977	7.55 m	47.4%	0.120	3.96 M
ethanol	0.9163	0.911 m	4.03%	0.0161	0.801 M
MgI ₂	1.112	1.17 m	24.5%	0.0206	0.982 M
H ₂ SO ₄	1.84	190 m	95.0%	0.777	17.8 M