

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

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

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

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

<i>Solute</i>	<i>solution density, g/cm<sup>3</sup></i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
KBr	0.9977			<b>0.120</b>	
ethanol	0.9163				<b>0.801 M</b>
MgI <sub>2</sub>	1.112	<b>1.17 m</b>			
H <sub>2</sub> SO <sub>4</sub>	1.84		<b>95.0%</b>		

*Answers appear on the next pages*

Problem #1 Answers: (answers in bold)

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

For NiCl<sub>2</sub>: molar mass = 129.59 g/mol. Assume **1.00000 mol total**

*Solute:* **0.00331 mol NiCl<sub>2</sub>** \* 129.59 g/mol = **0.429 g NiCl<sub>2</sub>**

*Solvent:* 1 – 0.00331 = **0.99669 mol H<sub>2</sub>O** \* 18.016 g/mol = **17.956 g H<sub>2</sub>O**

*molality* = 0.00331 mol NiCl<sub>2</sub> / 0.017956 kg H<sub>2</sub>O = **0.184 m**

*wt%* = (0.429 g NiCl<sub>2</sub>) / (0.429 g NiCl<sub>2</sub> + 17.956 g H<sub>2</sub>O) \* 100% = **2.33%**

*mass solution* = (0.429 g NiCl<sub>2</sub> + 17.956 g H<sub>2</sub>O) = **18.385 g solution**

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

*molarity* = 0.00331 mol NiCl<sub>2</sub> / 0.018426 L = **0.180 M**

For acetone (CH<sub>3</sub>COCH<sub>3</sub>): 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 \* (10<sup>3</sup> mL/L) \* (0.9163 g/mL) = **916 g solution**

*mass solvent* = 916 g solution – 232 g solute = **684 g solvent (H<sub>2</sub>O)**

*moles solvent* = 684 g H<sub>2</sub>O \* (mol / 18.016 g) = **38.0 mol H<sub>2</sub>O**

*molality* = 4.00 mol acetone / 0.684 kg H<sub>2</sub>O = **5.85 m**

*wt%* = (232 g acetone) / (232 g acetone + 684 g H<sub>2</sub>O) \* 100% = **25.3%**

*X* = (4.00 mol acetone) / (4.00 mol acetone + 38.0 mol H<sub>2</sub>O) = **0.0943**

*Answers continue on next page*

For  $\text{NH}_4\text{NO}_3$ : 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  $\text{HCl}$ : 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/cm<sup>3</sup></i>	<i>molality (m)</i>	<i>weight percent solute</i>	<i>mole fraction solute (X)</i>	<i>Molarity (M)</i>
KBr	0.9977	<b>7.55 m</b>	<b>47.4%</b>	0.120	<b>3.96 M</b>
ethanol	0.9163	<b>0.911 m</b>	<b>4.03%</b>	<b>0.0161</b>	0.801 M
MgI <sub>2</sub>	1.112	1.17 m	<b>24.5%</b>	<b>0.0206</b>	<b>0.982 M</b>
H <sub>2</sub> SO <sub>4</sub>	1.84	<b>190 m</b>	95.0%	<b>0.777</b>	<b>17.8 M</b>