Molarity Practice Worksheet

Find the molarity of the following solutions:

1) 0.5 moles of sodium chloride is dissolved to make 0.05 liters of solution.

2) 0.5 grams of sodium chloride is dissolved to make 0.05 liters of solution.

3) 0.5 grams of sodium chloride is dissolved to make 0.05 mL of solution.

4) 734 grams of lithium sulfate are dissolved to make 2500 mL of solution.

5) 6.7×10^{-2} grams of $Pb(C_2H_3O_2)_4$ are dissolved to make 3.5 mL of solution.

6) I have two solutions. In the first solution, 1.0 moles of sodium chloride is dissolved to make 1.0 liters of solution. In the second one, 1.0 moles of sodium chloride is added to 1.0 liters of water. Is the molarity of each solution the same? Explain your answer.

Solutions to the Molarity Practice Worksheet

For the first five problems, you need to use the equation that says that the molarity of a solution is equal to the number of moles of solute divided by the number of liters of solution.

1) In this problem, simply solve using the molarity equation to find that the concentration of the solution is 10 M.

2) To use the molarity equation, you need to convert grams of sodium chloride to moles of sodium chloride before you can use the molarity equation. Because you have 0.0085 moles of NaCl in this solution, the total concentration is 0.17 M.

3) To use the molarity equation, you need to convert grams of NaCl to moles and mL of solution to liters. When you do this, the total concentration of the solution is 170.9 M. As it turns out, this isn't a realistic value for molarity, so you'd never see a solution with this concentration out in the real world. Why did I give it to you then? I did it because I wanted you to see that just by changing a few units, you can get very different final answers.

4) This is done in the same method that you'd solve #3. Because you have 6.68 moles of Li_2SO_4 and 2.500 liters of water, the overall molarity of your solution is 2.67 M.

5) This problem is also solved in the same way as #3 and #4. Because you have 1.51×10^{-4} moles of $Pb(C_2H_3O_2)_4$, and 0.0035 L of water, the total concentration is 4.32×10^{-2} M, or 0.0432 M.

6) The equation for molarity states that the molarity of a solution is equal to the number of moles of solute divided by the number of liters of solution. In the first equation, the molarity will clearly be equal to 1.0 M, because there are 1.0 moles of NaCl and a solution volume of 1.0 L. In the second solution, the molarity will be different, because the solution volume will be greater than 1.0 liters. Why? If you already have 1.0 L of water and add 1.0 moles of salt to it, it will overflow, right? This is because the volume will be (roughly) equal to the volume of the water plus the volume of the salt, which will be greater than 1.0 L. It is for this reason that when you make a solution, you always dissolve the solute in only a little bit of water and then add water to make your final volume.

Molarity Calculations

Calculate the molarities of the following solutions:

1) 2.3 moles of sodium chloride in 0.45 liters of solution.

2) 1.2 moles of calcium carbonate in 1.22 liters of solution.

3) 0.09 moles of sodium sulfate in 12 mL of solution.

4) 0.75 moles of lithium fluoride in 65 mL of solution.

5) 0.8 moles of magnesium acetate in 5 liters of solution.

6) 120 grams of calcium nitrite in 240 mL of solution.

7) 98 grams of sodium hydroxide in 2.2 liters of solution.

8) 1.2 grams of hydrochloric acid in 25 mL of solution.

9) 45 grams of ammonia in 0.75 L of solution.

Explain how you would make the following solutions. You should tell how many grams of the substance you need to make the solution, not how many moles.

10) 2 L of 6 M HCl

11) 1.5 L of 2 M NaOH

12) 0.75 L of 0.25 M Na_2SO_4

13) 45 mL of 0.12 M sodium carbonate

14) 250 mL of 0.75 M lithium nitrite

15) 56 mL of 1.1 M iron (II) phosphate

16) 6.7 L of 4.5 M ammonium nitrate

17) 4.5 mL of 0.05 M magnesium sulfate

18) 90 mL of 1.2 M BF_3

Molarity Calculations – Answer Key

Calculate the molarities of the following solutions:

1) 2.3 moles of sodium chloride in 0.45 liters of solution. **5.11 M**

2) 1.2 moles of calcium carbonate in 1.22 liters of solution. **0.98 M**

3) 0.09 moles of sodium sulfate in 12 mL of solution. **7.5 M**

4) 0.75 moles of lithium fluoride in 65 mL of solution. **11.5 M**

5) 0.8 moles of magnesium acetate in 5 liters of solution. **0.16 M**

6) 120 grams of calcium nitrite in 240 mL of solution. **3.79 M**

7) 98 grams of sodium hydroxide in 2.2 liters of solution. **1.11 M**

8) 1.2 grams of hydrochloric acid in 25 mL of solution. **1.35 M**

9) 45 grams of ammonia in 0.75 L of solution. **3.53 M**

Explain how you would make the following solutions.

10) 2 L of 6 M HCl **Dissolve 426 g HCl, dilute to 2 L**

11) 1.5 L of 2 M NaOH **Dissolve 120 g NaOH, dilute to 1.5 L**

12) 0.75 L of 0.25 M Na_2SO_4 **Dissolve 26.64 g Na_2SO_4, dilute to 0.75 L**

13) 45 mL of 0.12 M sodium carbonate **Dissolve 0.57 g Na_2CO_3, dilute to 45 mL**

14) 250 mL of 0.75 M lithium nitrite **Dissolve 9.92 g $LiNO_2$, dilute to 250 mL**

15) 56 mL of 1.1 M iron (II) phosphate **Dissolve 22.02 g $Fe_3(PO_4)_2$, dilute to 56 mL**

16) 6.7 L of 4.5 M ammonium nitrate **Dissolve 2412 g NH_4NO_3, dilute to 6.7 L**

17) 4.5 mL of 0.05 M magnesium sulfate **Dissolve 0.02709 g $MgSO_4$, dilute to 4.5 mL**

18) 90 mL of 1.2 M BF_3 **Dissolve 7.32 g BF_3, dilute to 90 mL**

Making Solutions Practice Worksheet

1) Explain how you would make 450 mL of a 0.250 M NaOH solution.

2) To what volume will you have to dilute 30.0 mL of a 12 M HCl solution to make a 0.35 M HCl solution?

3) How many grams of calcium chloride will be needed to make 750 mL of a 0.100 M $CaCl_2$ solution?

4) Explain why this experimental procedure is incorrect: To make 1.00 L of a 1.00 M NaCl solution, I will dissolve 58.5 grams of sodium chloride in 1.00 L of water.

Making Solutions Practice Worksheet

1) Explain how you would make 450 mL of a 0.250 M NaOH solution.

   Add water to 4.52 grams of sodium hydroxide until the final volume of the solution is 450 mL.

2) To what volume will you have to dilute 30.0 mL of a 12 M HCl solution to make a 0.35 M HCl solution?

   1030 mL

3) How many grams of calcium chloride will be needed to make 750 mL of a 0.100 M $CaCl_2$ solution?

   8.33 grams

4) Explain why this experimental procedure is incorrect: To make 1.00 L of a 1.00 M NaCl solution, I will dissolve 58.5 grams of sodium chloride in 1.00 L of water.

   If you were to do this, the solution would have a final volume greater than 1.00 L, because sodium chloride itself takes up space. The correct way to do this would be to add water to 58.5 grams of sodium chloride until the final volume of the solution is 1.00 L.

Dilutions Worksheet

1) If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?

2) If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?

3) How much 0.05 M HCl solution can be made by diluting 250 mL of 10 M HCl?

4) I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?

5) How much water would I need to add to 500 mL of a 2.4 M KCl solution to make a 1.0 M solution?

Dilutions Worksheet

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Dilutions Worksheet - Solutions

1) If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?

$$M_1V_1 = M_2V_2$$
$$(0.15\ M)(125\ mL) = x\ (150\ mL)$$
$$x = 0.125\ M$$

2) If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?

$$M_1V_1 = M_2V_2$$
$$(0.15\ M)(100\ mL) = x\ (150\ mL)$$
$$x = 0.100\ M$$

3) How much 0.05 M HCl solution can be made by diluting 250 mL of 10 M HCl?

$$M_1V_1 = M_2V_2$$
$$(10\ M)(250\ mL) = (0.05\ M)\ x$$
$$x = 50{,}000\ mL$$

4) I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?

$$M_1V_1 = M_2V_2$$
$$(1.5\ M)(345\ mL) = x\ (250\ mL)$$
$$x = 2.07\ M$$

5) How much water would I need to add to 500 mL of a 2.4 M KCl solution to make a 1.0 M solution?

$$M_1V_1 = M_2V_2$$
$$(2.4\ M)(500\ mL) = (1.0\ M)\ x$$
$$x = 1200\ mL$$

1200 mL will be the final volume of the solution. However, since there's already 500 mL of solution present, you only need to add 700 mL of water to get 1200 mL as your final volume. The answer: 700 mL.

Dilutions Worksheet - Solutions

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$$M_1V_1 = M_2V_2$$
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$$M_1V_1 = M_2V_2$$
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3) How much 0.05 M HCl solution can be made by diluting 250 mL of 10 M HCl?

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$$M_1V_1 = M_2V_2$$
$$(1.5\ M)(345\ mL) = x\ (250\ mL)$$
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1200 mL will be the final volume of the solution. However, since there's already 500 mL of solution present, you only need to add 700 mL of water to get 1200 mL as your final volume. The answer: 700 mL.

USING SOLUBILITY CURVES

Practice using the solubility curve reference sheet by answering the following questions.

1. If 50 grams of water saturated with ammonium chloride at 40° C is slowly evaporated to dryness, how many grams of the dry salt will be recovered?

2. What is the smallest mass of water required to completely dissolve 23 grams of ammonium chloride at 40°C?

3. A saturated solution of $NaNO_3$ in 100 grams of water at 40° C is heated to 50°C. What is the rate of increase in solubility in grams per degree?

4. Which salt has solubility values that are least affected by temperature?

5. If 30 grams of KCl is dissolved in 100 grams of water at 45° C, how many additional grams of KCl would be needed to make the solution saturated at 80°C ?

6. At what temperature do potassium bromide and potassium nitrate have the same solubility in water?

7. At 25° C, 100 grams of water is saturated with $NaClO_3$. How many grams of $NaClO_3$ will fall out of solution when it cools to 0°C ?

8. At 50°C, 100 grams of water is saturated with NaCl. How many grams of NaCl will precipitate when the solution is cooled to 40°C ?

9. How many grams of sodium chloride are required to saturate 500 grams of water at 100°C?

10. Which compound is least soluble in water at 12°C ?

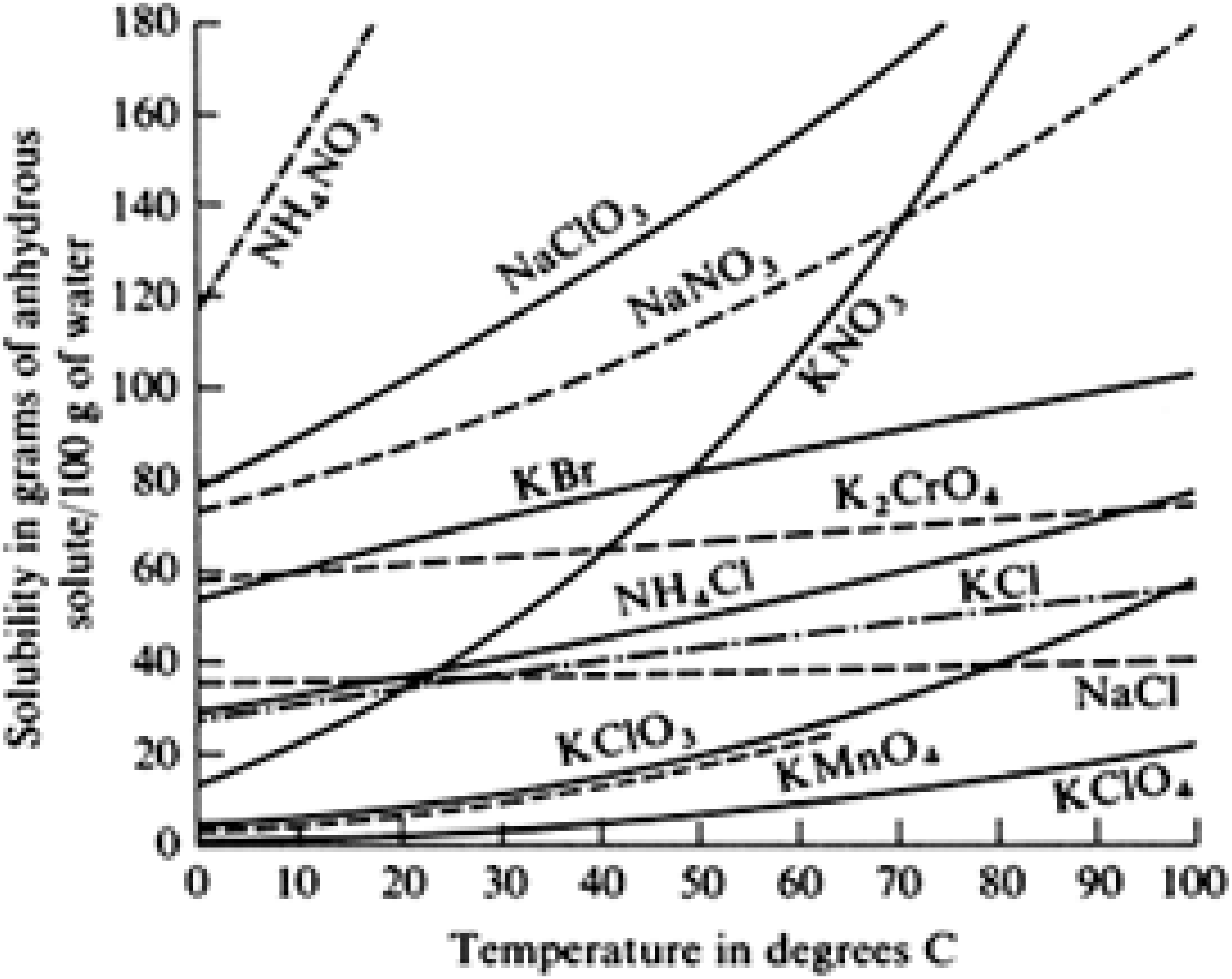
11. Which compound is most soluble in water at 50°C?

12. At 80°C, 100 grams of water is saturated with KCl. How many grams of KCL will precipitate when the solution is cooled to 45° C?

13. A saturated solution of which compound contains 132 grams of solute per 100 grams solute per 100 grams of water at 70°C.

14. How many grams of sodium nitrate, are required to saturate 200 grams of water at 10°C ?

15. Which saturated solution of a chloride has the greatest percentage by mass of solute at 60° C ?


Solubility in grams of anhydrous solute/100 g of water
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100
Temperature in degrees C
NH_4NO_3
$NaClO_3$
$NaNO_3$
KNO_3
KBr
K_2CrO_4
NH_4Cl
KCl
NaCl
$KClO_3$
$KMnO_4$
$KClO_4$

Concentration Practice Problems

1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?
2. What is the molarity of 245.0 g of H_2SO_4 dissolved in 1.00 L of solution?
3. What is the molarity of 5.30 g of Na_2CO_3 dissolved in 400.0 mL solution?
4. What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?
5. How many moles of Na_2CO_3 are there in 10.0 L of 2.0 M solution?
6. How many moles of Na_2CO_3 are in 10.0 mL of a 2.0 M solution?
7. How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?
8. What weight (in grams) of NaCl would be contained in problem 7?
9. What weight (in grams) of H_2SO_4 would be needed to make 750.0 mL of 2.00 M solution?
10. What volume (in mL) of 18.0 M H_2SO_4 is needed to contain 2.45 g H_2SO_4?
11. What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?
12. How many grams of $Ca(OH)_2$ are needed to make 100.0 mL of 0.250 M solution?
13. What is the molarity of a solution made by dissolving 20.0 g of H_3PO_4 in 50.0 mL of solution?
14. What weight (in grams) of KCl is there in 2.50 liters of 0.50 M KCl solution?
15. What is the molarity of a solution containing 12.0 g of NaOH in 250.0 mL of solution?
16. Determine the molarity of these solutions:

    a) 4.67 moles of Li_2SO_3 dissolved to make 2.04 liters of solution.

    b) 0.629 moles of Al_2O_3 to make 1.500 liters of solution.

    c) 4.783 grams of Na_2CO_3 to make 10.00 liters of solution.

    d) 0.897 grams of $(NH_4)_2CO_3$ to make 250 mL of solution.

    e) 0.0348 grams of $PbCl_2$ to form 45.0 mL of solution.

17. Determine the number of moles of solute to prepare these solutions:

    a) 2.35 liters of a 2.00 M $Cu(NO_3)_2$ solution.

    b) 16.00 mL of a 0.415-molar $Pb(NO_3)_2$ solution.

    c) 3.00 L of a 0.500 M $MgCO_3$ solution.

    d) 6.20 L of a 3.76-molar Na_2O solution.

18. Determine the grams of solute to prepare these solutions:

    a) 0.289 liters of a 0.00300 M $Cu(NO_3)_2$ solution.

    b) 16.00 milliliters of a 5.90-molar $Pb(NO_3)_2$ solution.

    c) 508 mL of a 2.75-molar NaF solution.

    d) 6.20 L of a 3.76-molar Na_2O solution.

    e) 0.500 L of a 1.00 M KCl solution.

    f) 4.35 L of a 3.50 M $CaCl_2$ solution.

19. Determine the final volume of these solutions:

a) 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution.

b) 4.907 moles of Al_2O_3 to make a 0.500 M solution.

c) 0.783 grams of Na_2CO_3 to make a 0.348 M solution.

d) 8.97 grams of $(NH_4)_2CO_3$ to make a 0.250-molar solution.

e) 48.00 grams of $PbCl_2$ to form a 5.0-molar solution.

Molality: Remember molality is defined as the # moles of solute ÷ # of Kg of <u>solvent.</u>

$$m = \frac{mol}{kg}$$

a. How many grams of KCl must be dissolved in 255 g of water to prepare a 0.445 m solution?

b. What is the molality of a solution prepared by dissolving 35.2 g of KCl in 300 ml of water? (Assume the density of water is 1.00 g/ml)

c. How many grams of KCl are contained in a 5.15 m solution if 825 grams of water are used to prepare the solution?

d. How many moles of KCl are contained in a 5.15 m solution if 825 grams of water are used to prepare the solution?

Per Cent by mass . % = g of solute ÷ total grams of solution.

$$\%m = \frac{mass.solute}{total.mass} \times 100$$

a. What is the percent by mass of a solution prepared by dissolving 4.50 g of KCl in 25.0 g of water?

b. A solution contains 1.00 mole of KCl and 2.00 mole of water. What is the percent by mass of KCl in the solution?

c. What is the percent by mass of water in the solution in part 2b above?

d. How many grams of KCl are contained in 1000 g of a solution if the solution is 4.52% KCl by mass?

Molarity. M = the number of moles of solute ÷ volume of solution (L)

$$M = \frac{mol}{L}$$

a. What is the molarity of a solution prepared by dissolving 2.50 g of KCl in 100. ml of solution?

b. How many moles of solute are contained in 200. ml of a 0.125 M solution of KCl?

c. 8.97 grams of $(NH_4)_2CO_3$ are used to make a 0.250-molar solution. What is the final volume of this solution?

d. How many grams of $KMnO_4$ are required to prepare 750.0 mL of a 0.125 M solution?

e. How many grams of glucose are contained in 500.0 mL of 0.30 M glucose, $C_6H_{12}O_6$, used in intravenous injection?

Dilution. Molarity of initial x vol. of initial = Molarity of final x vol. of final

$$M_1V_1 = M_2V_2$$

a. What volume (mL) of concentrated H_3PO_4 (14.7 M) should be used to prepare 125 mL of a 3.00 M H_3PO_4 solution?

b. What volume (mL) of 0.872 M K_2CrO_4 should be used to prepare 100.0 mL of a 0.125 M solution?
If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?

c. If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?

d. How much 0.05 M HCl solution can be made by diluting 250 mL of 10 M HCl?

e. I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?

f. How much water would I need to add to 500 mL of a 2.4 M KCl solution to make a 1.0 M solution?

Molarity Practice Answers

1. 0.479 M
2. 2.50 M
3. 0.125 M
4. 0.167 M
5. 20. mol
6. 0.020 mol
7. 0.020 mol
8. 1.16 g
9. 147 g
10. 1.39 mL
11. 250. mL
12. 1.85 g
13. 4.08 M
14. 92.5 g
15. 1.20 M
16. a. 2.29 M
    b. 0.419 M
    c. 4.51×10^{-3} M
    d. 0.037 M
    e. 0.00278 M
17. a. 4.70 mol
    b. 6.64×10^{-3} mol
    c. 1.50 mol
    d. 23.3 mol
18. a. 0.163 g
    b. 31.24 g
    c. 58.8 g
    d. 1.40×10^{3} g
    e. 37.3 g
    f. 1690 g
19. a. 1.20 L
    b. 9.81 L
    c. 21.2 mL
    d. 373 mL
    e. 34.3 mL

<u>Colligative Properties Worksheet</u>

1) If I add 45 grams of sodium chloride to 500 grams of water, what will the melting and boiling points be of the resulting solution?

2) Which solution will have a higher boiling point: A solution containing 105 grams of sucrose ($C_{12}H_{22}O_{11}$) in 500 grams of water or a solution containing 35 grams of sodium chloride in 500 grams of water?

3) 5 grams of salt (NaCl) is added to 170 mL of water. What are the new freezing and boiling points?

4) What is the change in freezing point of a solution containing 132 g $C_{12}H_{22}O_{11}$ and 250 g of H_2O?

5) What is the boiling point of a solution containing 52 g $MgSO_4$ and 334 g H_2O?

Colligative Properties Worksheet

FYI: K_f of water is 1.86^0 C/m; K_b of water is 0.52^0 C/m

1) Explain why the addition of a solute decreases the melting point of a liquid.

2) What is the melting point of a solution in which 3.5 grams of sodium chloride is added to 230 mL of water?

3) What is the boiling point of a solution in which 22.5 grams of sucrose ($C_{12}H_{22}O_{11}$) is dissolved in 550 mL of water?

4) Rank the following solutions from lowest to highest boiling point, a 2.5 m solution of sodium chloride, a 3.5 m solution of magnesium chloride, or a 4.5 m solution of sulfur dioxide?

5) If an aqueous solution has a boiling point of 102.5^0, what's the effective molality of the solute?

Colligative Properties Worksheet Answers

FYI: K_f of water is 1.86^0 C/m; K_b of water is 0.52^0 C/m

1) Explain why the addition of a solute decreases the melting point of a liquid.

2) What is the melting point of a solution in which 3.5 grams of sodium chloride is added to 230 mL of water? **-0.967^0**

3) What is the boiling point of a solution in which 22.5 grams of sucrose ($C_{12}H_{22}O_{11}$) is dissolved in 550 mL of water? **100.06^0**

4) Rank the following solutions from lowest to highest boiling point, a 2.5 m solution of sodium chloride, a 3.5 m solution of magnesium chloride, or a 4.5 m solution of sulfur dioxide?

4.5 m SO_2 < 2.5 m NaCl < 3.5 m $MgCl_2$

5) If an aqueous solution has a boiling point of 102.5^0, what's the effective molality of the solute? **4.81 m**