SOLUTIONS

Objective: Describing what solutions are, how they form, & how are they're strength is measured.

1. A solution is a _____ _____.

2. The _____ dissolves into the _____.

3. If you put sugar into water, the sugar is the _____ while the water is the _____

4. When a solution holds the maximum amount of stuff it is a _____ solution

5. If there is less than the maximum amount of stuff (_____) the solution is _____

6. Most solutes dissolve better into hot water than cold, the water can "juggle" the particles faster, and hold more solute. If you make a saturated hot solution, then cool it down, the water molecules juggle slower, and DROP solute out of solution as precipitate.

   A few common substances like table sugar and sodium acetate will HOLD onto this excess solute, making the colder solution be weirdly OVER-FULL. These solutions are called

   _____

7. Most solutions you think about will be aqueous (which means dissolved into _____

8. But they can also be gases (ex: _____ is a solution)

   or even solids (ex: all _____are solutions)

When you try to dissolve a solid into a solution, these are the 3 factors that would affect the <u>rate of solvation</u>

9. _____

10. _____

11. _____

<u>How much</u> <u>solute can dissolve into a solvent</u>? *That depends on..*

How much solute can dissolve into a solvent?

12. _____

14. _____

15. _____

16. How does Wegman's get carbon dioxide into water to make seltzer?

CO_2 NON POLAR	H_2O POLAR

17. Concentration or STRENGTH of a solution can be measure by…

18. Molarity is

19. The formula for molarity is written this way: $M =$ _____

20. What is the concentration of a 1650 mL salt water solution containing 125 g NaCl?
You must SUBSTITUTE PROPERLY!!!
Figure out MOLES and LITERS, *then* write molarity formula again.

$$\frac{\qquad\qquad}{\qquad\qquad} \quad M =$$

21. SAY	
21. WRITE	
21. THINK	

22. If you add 43.5 g NaCl to enough water to form a 648 mL solution, what is it's concentration?
Write formula, then substitute.

$$M = \frac{\qquad\qquad}{\qquad\qquad} = \qquad\qquad$$

SAY	
WRITE	
THINK	

23. You put 74.0 g KCl solid into a flask. You fill the flask to 1600. mL, what is the molarity of this solution? Start with the formula, or you know what might happen!

24. Calculate the molarity of a 750 mL $KCl_{(AQ)}$ solution containing 148 grams KCl.

Let's totally change gears now. We have a table called the SOLUBILITY CURVES at STP. Reference Table G

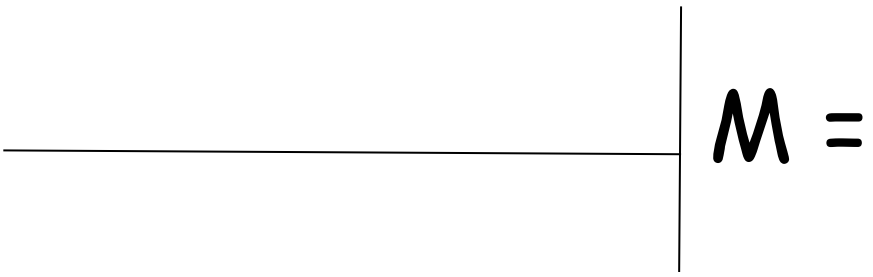
This table shows all at once, 10 different SOLUTES ability to dissolve into 100 mL of water, at ALL temperatures. It's confusing, unless you LOOK AT ONE CURVE AT A TIME. Take it out now. Let's FIX it first.

Change the Y-AXIS to read Solubility (grams of solute in 100 mL water)
(water 1.00 g/mL so 1 gram water = 1 mL)

Think, then do this problem.

25. How many grams of sodium nitrate are in a 325 mL aqueous solution that is saturated at 10°C? Set up the ratio, TEMP, solute/water fraction, graph data, and unknown. Do the math

26. Calculate the MOLARITY of this $NaNO_{3\,(AQ).}$ Get moles and liters, then write the formula.



Solutions Vocabulary to Memorize by Tomorrow (fill in at home from slides)

27. Solute

28. Solvent

29. Saturated

30. Unsaturated

31. Supersaturated

32. Table G

33. Molarity

34. Molarity Formula: $M = \frac{\qquad}{\qquad}$

35. What units go into this formula (only)

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36. Calculate the molarity of a solution containing 259 g KCl in a solution with total volume of 750. mL

37. How many grams of sodium chloride are in an 885 mL aqueous solution that is saturated at 90°C?

38. What is the molarity of this saturated solution of $NaCl_{(AQ)}$? (start with the formula!)

39. THINK: If you had two salty water solutions, say:
One 10 mL saturated $NaCl_{(AQ)}$ and a 500 Liters saturated $NaCl_{(AQ)}$ solution. How would they both taste? How would they both conduct electricity? Would they be "the same"?

40. How many grams of NaCl are required to form a 2.50 L of 0.900 M $NaCl_{(AQ)}$?

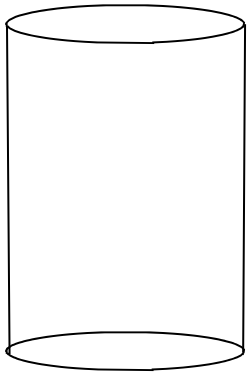
41. Calculate the mass of KOH needed to make a 3.20 Liter solution of $KOH_{(AQ)}$ with a 1.20 M concentration.

42. The WRONG WAY to mix up 1.0 Liters of 1.00 M $NaCl_{(AQ)}$ is to put the _____ into a beaker, and to then add the _____

43. ***The RIGHT WAY to make this solution would be to start with the _____ ,and then add in the _____.***

If we do this WRONG WAY, our solution will have a slightly higher _____. ☹

44. How would you mix up a 2.50 M $KNO_{3(AQ)}$ of 5.65 liters? (the diagram of a beaker might help you)



If you have no solution and you need to make one, use that molarity formula, figure out how many grams of solute you need, and then fill up the beaker with water to the proper total volume.

What if you have some carefully measured solution on the shelf in the lab? You can use that to make another solution, you can DILUTE it. A formula helps you figure out how much "STOCK SOLUTION" you need to use, and then fill with water to dilute to perfect volume.

Stock solution is literally, what you have in the stock room. Stock refers to what you have, not something special. You might have 2.0 M $NaCl_{(AQ)}$ in stock, or not. What ever you do have, that's your stock. OK?

THINK: Using a 2.50M $KNO_{3(AQ)}$ how would you make 1.64 Liters of 1.15 M $KNO_{3(AQ)}$?

45. We need the DILUTION FORMULA written as: _____

46. M_1 means

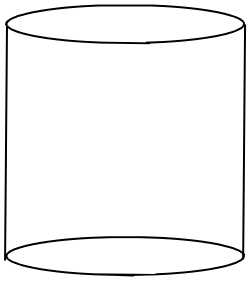
47. V_1 means

48. M_2 means

49. V_2 means

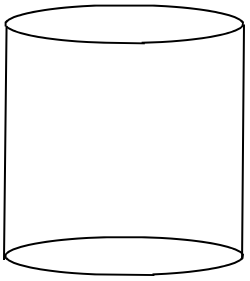
50. Using a 2.50M $KNO_{3(AQ)}$ how would you make 1.64 Liters of 1.15 M $KNO_{3(AQ)}$?

$M_1V_1 = M_2V_2$

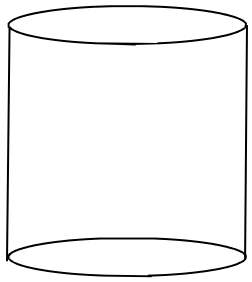


51. How do you prepare a 135 mL $NaCl_{(AQ)}$ solution of 1.00 molarity from a stock solution of 5.50 M?

$M_1V_1 = M_2V_2$



52. Using the stock solution of 12.0 M HCl, how do you make up 2.00 L of 2.25 M HCl solution?



53. Another way to measure concentration of solutions that are VERY WEAK is by using something called…

54. The formula is PPM =

55. You put 1502 grams NaCl into a pool of 312,000 L of water. What's the concentration of this in PPM?

56. PPM is used when molarity is silly small, but you need a measurement that you can easily grasp.

57. Sometimes low concentration environmental _____ are measured this way.
We'll do another problem in PPM later, see if you can remember this formula.

58. There are three properties of water called COLLIGATIVE PROPERTIES.

59. They are

60.

61.

62.

63. The reason for all of these colligative properties is: _____

64. Water has a normal boiling point of _____K. 65. Water has a normal freezing point of _____K.

66. Water has vapor pressure AT 20ºC of ABOUT _____ (how did you know this?)

67. Water boils when it all has enough energy to break up all of the _____ _____ that hold it together as a liquid.

68. If we add NaCl, this salt will _____ or it will _____ in the water.

69. That looks like this: _____ → _____ + _____

70. In solution, the H_2O molecules are _____ to each other, by _____ , and they are attracted to the ions as well, also by hydrogen bonding.

71. This will create more _____ which will INCREASE the boiling point.

Mathematically, the <u>BOILING POINT ELEVATION</u> for water is:

_____

Fill in this chart…

	Formula	Kinds of particles*	Total moles of particles
ex	1.0 M $NaCl_{(AQ)}$	1 mole Na^{+1} and 1 mole Cl^{-1}	2
73	2.0 M $NaCl_{(AQ)}$	____ moles Na^{+1} and ____ moles Cl^{-1}	
74	3.0 M $NaCl_{(AQ)}$	____ moles Na^{+1} and ____ moles Cl^{-1}	
75	2.0 M $CaCl_{2(AQ)}$	____ moles Ca^{+2} and ____ moles Cl^{-1}	
76	3.0 M $CaCl_{2(AQ)}$	____ moles Ca^{+2} and ____ moles Cl^{-1}	
77	2.50 M $NaCl_{(AQ)}$	____ moles Ca^{+2} and ____ moles Cl^{-1}	
78	1.25 M $NaCl_{(AQ)}$	____ moles Na^{+1} and ____ moles Cl^{-1}	

	Formula	Kinds of particles*	Total moles of particles
79	1.75 M $NaCl_{(AQ)}$	_____ moles Na^{+1} & _____ moles Cl^{-1}	
80	2.25 M $CaCl_{2(AQ)}$	_____ moles Ca^{+2} & _____ moles Cl^{-1}	
81	3.0 M $Al(OH)_{3(AQ)}$	_____ moles Al^{+3} & ____ moles OH^{-1}	
82	1.0 M $NH_{3(AQ)}$		
83	2.50 M $C_{12}H_{22}O_{11(AQ)}$		
84	1.0 M AgCl		

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85. Calculate the temperature that a 1.00 liter, 2.00 M $NaCl_{(AQ)}$ solution will boil in Kelvin temperature. Remember, each mole of particles will elevate the BP by 0.50 K/mole of particles per liter.

86. Calculate the Kelvin BP of a 1.00 Liter, 3.00 M $CaCl_{2(AQ)}$.

87. The freezing point is _____ when you put particles into solution. That's because the particles "get in the way" of the water molecules forming into their neat hexagons. It takes a lower temperature to lock the water molecules into place with those ions in the way.

88. The FREEZING POINT DEPRESSION for water is:

89. For every mole of particles in a liter of solution, the freezing point will drop or decrease by…_____K

90. Calculate the temperature that a 1.00 liter, 2.00 M $NaCl_{(AQ)}$ solution will freeze in Kelvin.

91. Calculate the FP in Kelvin of a 1.00 Liter, 3.00 M $CaCl_{2(AQ)}$.

92. Express the concentration of the following solution in parts per million: 98.0 g of lithium chromate (Li_2CrO_4) is dissolved into an aqueous solution with total volume of 57,800 liters.

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93. Vapor Pressure is

94. And vapor pressure has units of _____ and you can find it on TABLE H

95. When solutions have lots of ions in solution, the Vapor pressure will be LOWER because...

We can rank the vapor pressure of these solutions from lowest to highest by comparing the number of moles of particles per liter in each.
Rank these 1.0 liter aqueous solutions by vapor pressure.

	Aqueous solution	Number of moles of particles per liter	Vapor Pressure Rank
96	1.00 M NaCl		
97	1.00 M $CaCl_2$		
98	1.00 M NBr_3		
99	1.00 M $Al(OH)_3$		

Next we will examine the dissociation of ionic compounds into water. We'll count ions!

	Compound	Write the Formula	What ions are formed when this is put into water
100	Sodium carbonate		
101	Ammonium sulfide		
102	Aluminum nitrate		
103	Lead (IV) acetate		
104	Silver chloride		

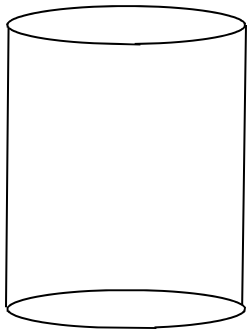
105. What is the freezing point of a 1.00 liter solution of 1.00 M Tin (IV) nitrate?
Round to NEAREST WHOLE KELVIN

106. In a solution labeled 2.46 M $KCl_{(AQ)}$ that is 2.00 Liters in volume,
how many grams of KCl are in this solution?

107. According to an article in the *New England Journal of Medicine,* mercury toxicity begins at 0.100 PPM. If a crazy person dropped 125 grams of mercury into the school pool, that is 102,900 liters, would you be able to safely swim in there? (1 pound = 454 grams)

108. What is the molarity of a solution where 148 g KCl is dissolved into a solution of 5000. mL?

109. How do you prepare a 25.5 mL 0.850 Molar $NaOH_{(AQ)}$, if you start with a stock solution of 6.40 M?



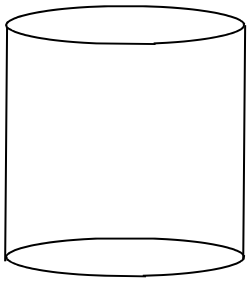
110. You dissolve 2.25 moles of KBr into water forming a 1.00 liter solution. What is this solution's boiling point, and freezing point, IN KELVIN? (don't worry about the SF in this problem, please)

111. You have two 1.0 liter glasses of solution of equal volume in the same room (same temp and pressure). One solution is a 3.50 M $NaCl_{(AQ)}$, the other is a 3.00 M $Ca(NO_3)_{2(AQ)}$.
Which one would evaporate dry first, and why?

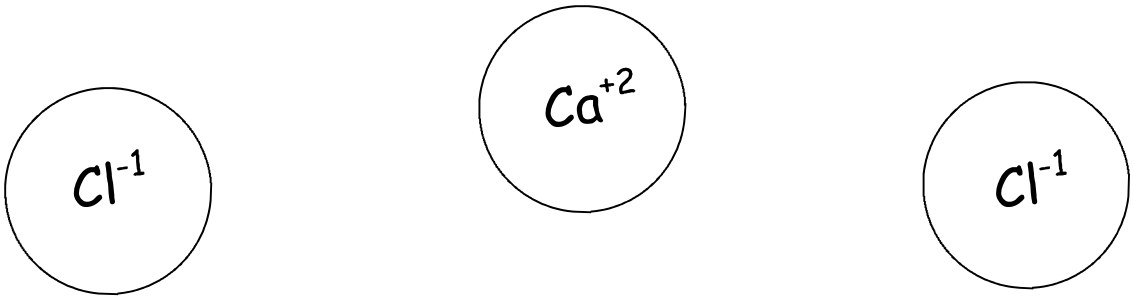
1.0 Liter
3.50 M $NaCl_{(AQ)}$

1.0 Liter
3.00 M $Ca(NO_3)_{2(AQ)}$

112. If you have a 2.40 M $HCl_{AQ)}$ stock solution, how do you make a 50.0 mL of 3.00 M $HCl_{(AQ)}$ solution from it?



112. These ions of $CaCl_{2(AQ)}$ are surrounded by water molecules. Properly orient the water around the ions.



113. You prepare a 235 mL saturated solution of ammonium chloride at 20.°C. You go to lunch and come back in an hour. The room temperature has warmed up this solution by 5.0°C . How would you best describe this solution at 25.0 centigrade?

A. Saturated at 25.°C
B. Supersaturated at 25.°C
C. Unsaturated at 25.°C
D. Still saturated at 20.°C

114. If you have lots of sulfur solid floating on your pond (or lots of water strider bugs), and you wanted to clear the surface, you could add some soap. Explain this.

115. Oil floats on water. Explain these things: why oil floats on water, and why it does not sink. Then explain why it does not just mix up in the water.

116. Using a 1.00 M stock of sugar water, tell how to make up a 26.0 mL solution of 0.350 M sugar water?

Read the BASICS again.
Hand in all Solutions HW assignments.
Hand in the CO_2 in Soda Lab.
Hand in the Solutions Lab.
Get ready to crush the Solutions Celebration of Knowledge.