Decision 1: Student Learning Map

Topic: Ch 6 Fundamentals
Days: (25)

Subject(s):
Grade(s): ()

Key Learning(s):

Solubility

Unit Essential Questions(s):

What factors effect the solubility of a material?

Optional Instructional Tools:

Labs 6.1, 6.2, 6.3, 6.4, 6.5, 6.6
WS 6A, 6B, 6C

Concept: Solubility	**Concept:** Energy Transfer	**Concept:** Concentration
Lesson Essential Questions: How do size, mixing, and temperature effect solubility? ()	**Lesson Essential Questions:** How is are energy transferes observed in the dissolving process? ()	**Lesson Essential Questions:** What is the difference between a concentrated and dilute solution? () How is concetration calculated? () How can solublity be predicted graphically? () How are saturated, supersaturated, and unsaturated solutions prepared? ()
Vocabulary: Solute Solvent	**Vocabulary:** endothermic exothermic	**Vocabulary:** solubility curve saturated unsaturated supersaturated concentrated dilute

Attached Document(s):

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab 6.1 - Rate of Dissolving

*Make complete and accurate observations during the lab. Observations include such things as...what is happening; for any chemicals, the color, appearance, phase (solid, liquid, gas), and odor (but **NEVER** taste) ; temperature if requested; etc.*

Procedure	Observations

Part A - Solid vs. Powdered, and, Shaken vs. Not

_____1. Obtain 4 clean, test tubes, which are all the same size.

_____2. Obtain 2 crystals of copper sulfate, $CuSO_4$, from your teacher. Observe:_____

_____

_____3. Place the 2 crystals in 2 test tubes (one crystal in each).

_____4. Place one scoop (the size of the crystals) of powdered copper sulfate, $CuSO_4$, in each of the other test tubes.

_____5. You should now have 2 test tubes with one crystal each, and 2 test tubes with powdered copper sulfate in each.

_____6. Obtain 2 stoppers for 2 of the test tubes.

_____7. As quickly as possible, place 4 cm of water into each test tube (the same amount in each test tube).

_____8. Stopper one crystal test tube and one powder test tube.

_____9. Shake the 2 stoppered test tubes for 1 minute; leave the other test tubes undisturbed.

_____10. Observe while you are shaking to determine which of the 4 test tubes dissolved first, second, third, and fourth (if they do not all dissolve, the color of the solution should give you a clue as to which dissolved more than another) :

Dissolved 1st:_____

Dissolved 2nd:_____

Dissolved 3rd:_____

Dissolved 4th:_____

_____11. Pour the contents of all 4 test tubes into the container specified by your teacher.

Part B - Heated vs. Shaken

_____12. Obtain 2 copper sulfate crystals which are the same size from your teacher.

_____13. Place each in different test tubes.

_____14. Add 4 cm of water to each test tube (the same amount in each).

_____15. Stopper one of the test tubes.

_____16. At the same time, heat the unstoppered test tube gently in a burner flame, while the stoppered test tube is being shaken vigorously.

_____17. Observe which dissolved first.

Dissolved 1st:_____

Dissolved 2nd:_____

_____18. Pour both test tubes in the container specified by your teacher.

_____19. Clean all the glassware; wipe down the counter; wash your hands; drop off your goggles, and have a seat.

Questions

1. What are the 3 factors which influence the dissolving rate of materials ?

a) _____

b) _____

c) _____

2. Explain why each of these factors increases the dissolving rate. Do this by explaining what is happening to the atoms or molecules of copper sulfate and water.

a) _____

_____

b) _____

_____

c) _____

_____

3. Which of these factors increases the dissolving rate the greatest amount ? _____

Name:_____

Exercise : 6-A Solubility Curves

Use the Solubility Curves handout to solve the following problems. be accurate.

1. How many grams of solute are needed to saturate 100 g of water at 80 oC for each of the following solutions ?

a) $K_2Cr_2O_7$ _____ b) $CuSO_4$ _____

c) KNO_3 _____ d) KCl _____

e) NaCl _____

2. The quantity of solute (per 100 g of water) used in making some solutions is listed below. Is each solution saturated, unsaturated, supersaturated ?

a) 20 g $AgNO_3$ at 20 °C _____

b) 103 g $NaNO_3$ at 60 °C _____

c) 103 g KNO_3 at 60 °C _____

d) 40 g KCl at 40 °C _____

e) 25 g $KClO_3$ at 31 °C _____

3. How many additional grams of $NaNO_3$ are needed to keep each of the following $NaNO_3$ solutions saturated during the temperature changes indicated ? Please show your work.

1	Temperature Change	Grams Solute needed for Saturation at Temps.		Extra Solute Needed
2	10 C to 30 C			
3	40 C to 90 C			
4	20 C to 60 C			
5	50 C to 80 C			
6	70 C to 100 C			

4. How many grams of KNO_3 (per 100 g) of water would be crystallized from a saturated solution as the temperature drops from...

1	Temperature Change	Grams Solute needed for Saturation at Temps.		Solute that Would Crystallize
2	100 C to 70 C			
3	50 C to 40 C			
4	80 C to 0 C			
5	60 C to 30 C			
6	90 C to 10 C			

5. At what temperature, and at what solubility, are the following solutes equally soluble water ?

	Temperature	Solubility
a) $NaNO_3$ and KNO_3	_____	_____
b) KNO_3 and NaCl	_____	_____
c) NaCl and KCl	_____	_____
d) $CuSO_4$ and $KClO_3$	_____	_____
e) $K_2Cr_2O_7$ and NaCl	_____	_____

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab 6.2 - Endothermic and Exothermic Reactions

*Make complete and accurate observations during the lab. Observations include such things as...what is happening; for any chemicals, the color, appearance, phase (solid, liquid, gas), and odor (but **NEVER** taste) ; temperature if requested; etc.*

Procedure	Observations

Part A - Sodium Hydroxide, NaOH

_____1. Obtain one clean, large test tube.

_____2. Place exactly 10.0 mL of water into the test tube.

_____3. Take the temperature of the water in the test tube: _____.

_____4. Carefully place 3 small pellets, or flakes of sodium hydroxide, NaOH, in the test tube. **Sodium hydroxide causes delayed severe chemical burns, please do not touch it with your fingers.**

_____5. Gently stir the sodium hydroxide and water with your thermometer.

_____6. Note the highest (or lowest) temperature reached: _____.

_____7. Feel the test tube:_____

_____8. Pour the test tube's contents down the drain. Rinse the test tube thoroughly.

Part B - Potassium Nitrate, KNO_3

_____1. Obtain one clean, large test tube.

_____2. Place exactly 10.0 mL of water into the test tube.

_____3. Take the temperature of the water in the test tube: _____.

_____4. Add 2 scoops of potassium nitrate, KNO_3, to the water.

_____5. Gently stir the potassium nitrate, KNO_3, and water with your thermometer.

_____6. Note the highest (or lowest) temperature reached: _____.

_____7. Feel the test tube:_____

_____8. Pour the test tube's contents down the drain. Rinse the test tube thoroughly.

Part C - Ammonium Chloride, NH_4Cl

_____1. Obtain one clean, large test tube.

_____2. Place exactly 10.0 mL of water into the test tube.

_____3. Take the temperature of the water in the test tube: _____.

_____4. Add 2 scoops of ammonium chloride, NH_4Cl, to the water.

_____5. Gently stir the ammonium chloride, NH_4Cl, and water with your thermometer.

_____6. Note the highest (or lowest) temperature reached: _____.

_____7. Feel the test tube:_____

_____8. Pour the test tube's contents down the drain. Rinse the test tube thoroughly.

Part D - Sulfuric Acid, H_2SO_4

_____1. Obtain one clean, large test tube.

_____2. Place exactly 10.0 mL of water into the test tube.

_____3. Take the temperature of the water in the test tube: _____.

_____4. Add 2 squirts of sulfuric acid, H_2SO_4, to the water. **Be careful !! This is concentrated and dangerous !!**

_____5. Gently stir the sulfuric acid, H_2SO_4, and water with your thermometer.

_____6. Note the highest (or lowest) temperature reached: _____.

_____7. Feel the test tube:_____

_____8. Pour the test tube's contents down the drain. Rinse the test tube thoroughly.

Data Table

	Chemical in Test Tube	Initial Temp. of Water	Final Temp. of Water	# Degrees Temp. Increased or Decreased	Exothermic or Endothermic
Part A					
Part B					
Part C					
Part D					

Demonstration

Your teacher will do a demonstration with the concentrated sulfuric acid. Explain what was done, and what happened: _____

_____

_____

Questions

1. **Exothermic reactions are reactions in which heat is given off. The temperature increases during an exothermic reaction.**

   a. Which chemical(s) caused an exothermic reaction when dissolved in water ? _____

   _____

2. **Endothermic reactions are reactions in which heat is taken in. The temperature decreases during an endothermic reaction.**

   a. Which chemical(s) caused an endothermic reaction when dissolved in water ? _____

   _____

3. Using complete sentences (with correct punctuation and spelling), what is one reason sodium hydroxide, NaOH, is used as an ingredient in drain cleaners ? _____

   _____

4. Indicate one example of an exothermic reaction, and one example of an endothermic reaction which you have come across in your life (not the ones you used today in lab):

   Exothermic: _____

   Endothermic: _____

Review Questions

5. What is dissolving ? _____

6. What are the 3 factors which influence the dissolving rate of materials ? a) _____

   b) _____, c) _____

7. Which of these factors is the most effective factor ? _____

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab 6.3 - Benedict's Solution

*Make complete and accurate observations during the lab. Observations include such things as...what is happening; for any chemicals, the color, appearance, phase (solid, liquid, gas), and odor (but **NEVER** taste) ; temperature if requested; etc.*

Procedure	Observations

Day # 1: Solution # 1

_____1. Obtain a 250 mL beaker.

_____2. Wash and dry it thoroughly.

_____3. Mass the beaker:_____.

_____4. Add 17.3 g onto the mass of the beaker: Mass beaker = _____ g
+ 17.3 g
_____
_____ g

_____5. With your beaker on your balance, set the balance to the total mass from Step 4 above.

_____6. Obtain a dish of sodium citrate, from your teacher: _____

_____7. Into your beaker, pour enough sodium citrate until it balances.

_____8. With your beaker and sodium citrate still on the balance, set your balance 10.0 g heavier.

_____9. Obtain a dish of sodium carbonate, Na_2CO_3, from your teacher: _____

_____10. Into your beaker, pour enough sodium carbonate, Na_2CO_3, until it balances.

_____11. Obtain a 100 mL beaker and put about 75 mL of distilled water into the beaker from your teacher.

_____12. Warm and stir the solution **gently** until the chemicals dissolve.

_____13. Let it cool for a few minutes.

_____14. Pour this solution into a 100 mL graduated cylinder.

_____15. Using a wash bottle, add enough distilled water so that it measures 85 mL exactly.

_____16. Pour the solution back into your beaker. This is Solution 1. Set it aside.

_____17. Thoroughly rinse the graduated cylinder, wipe the counter, wash your hands, take off your goggles, and have a seat.

Day # 2: Solution # 2

_____18. Obtain a 50 or 100 mL beaker.

_____19. Clean and dry it thoroughly.

_____20. Mass the beaker:_____.

_____21. Add 1.7 g onto the mass of the beaker: Mass beaker = _____ g
+ 1.7 g
_____
_____ g

_____22. With your beaker on your balance, set the balance to the total mass from Step 21 above.

_____23. Obtain a dish of copper sulfate, $CuSO_4$,, from your teacher: _____

_____24. Into your beaker, pour enough copper sulfate, $CuSO_4$, until it balances.

_____25. Add exactly 10 mL of distilled water to your beaker.

_____26. Stir the solution until all the copper sulfate dissolves. If necessary, warm the solution gently to speed up the dissolving.

_____27. This is Solution 2.

Combining Solutions 1 and 2

_____28. **SLOWLY**, with **CONSTANT STIRRING**, pour Solution 2 into Solution 1 (observe closely):

_____29. Pour your combined solution into a 100 mL graduated cylinder.

_____30. Add enough distilled water to make 100 mL of solution.

_____31. Pour this solution into a clean 250 mL flask.

_____32. Stopper the flask.

_____33. Thoroughly shake the solution.

_____34. The solution should be deep blue, and perfectly clear: _____

Testing Your Solution

_____35. Place 5 mL of your solution into a clean test tube.

_____36. Gently heat the test tube **just to boiling. DO NOT overheat.**

_____37. Add 5 drops of corn syrup, one drop at a time, to your hot solution: _____

_____

_____38. Let the hot test tube stand for at least one minute. Describe anything which settles to the bottom:

_____

_____39. Give your solution in the flask to your teacher for use later on in the year.

_____40. Clean your glassware, wipe your counter down, wash your hands, take off your goggles, have a seat.

_____

Questions

1. If a brick red solid (precipitate) formed in the last step, you have made Benedict's solution correctly.

   Did you make Benedict's solution correctly ? _____

2. **A brick red precipitate is a positive Benedict's test. It means that there are simple sugars present.** Corn syrup contains the simple sugar dextrose.

   Look up the word dextrose in a dictionary or encyclopedia and write another name for dextrose:

   _____

3. What was the color of Solution 1 ? _____

4. What was the color of Solution 2 ? _____

5. What changes to the color of Solution 2 did you observe as you poured it into Solution 1 ? _____

   _____

6. Why did you heat Solution #1, step 12, and Solution #2, step 26 ? _____

   _____

Review Questions

7. What 3 factors will affect the dissolving rate of materials ? a) _____

   b) _____, c) _____

8. What is an exothermic reaction ? _____

   a. Give an example: _____

9. What is an endothermic reaction ? _____

   a. Give an example: _____

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab 6.4 - Concentrated vs. Dilute Solutions

*Make complete and accurate observations during the lab. Observations include such things as...what is happening; for any chemicals, the color, appearance, phase (solid, liquid, gas), and odor (but **NEVER** taste) ; temperature if requested; etc.*

Procedure	Observations

Part A - Making the Standard Solution

_____1. In a small beaker (50 or 100 mL), obtain 40 mL of colored solution from your teacher. You will use this solution in Parts A, B, and C. What color is the solution ? _____

_____2. Using a 10 mL graduated cylinder, pour 10 mL of this colored solution into a clean test tube.

_____3. Set this test tube aside. This test tube will be the **standard solution A** for comparison.

Questions - Part A

A1. What is a solute ? _____

A2. What is a solvent ? _____

Part B - Adding Water to the Standard Solution

_____4. Using a 10 mL graduated cylinder, pour 5 mL of colored solution into another test tube.

_____5. Add 5 mL of water to this test tube.

_____6. Pluck the test tube.

_____7. Compare the color of this test tube (**water solution B**) to the **standard solution A** from Part A.

Questions - Part B

B1. Which is more **concentrated** (darker in color) ? _____

B2. Which is more **dilute** (lighter in color) ? _____

B3. Which has more solute in it ? _____

B4. How did you determine the answer to B3 ? _____

_____

B5. From what you just learned in this Part B, how can you make a solution more dilute ? _____

_____

Part C - Boiling the Standard Solution

_____8. Pour 10 mL of the colored solution from the beaker into an evaporating dish.

_____9. Make mental note how much this is in the dish.

_____10. Pour 10 more mL of colored solution from the beaker into the same evaporating dish.

_____11. On a wire gauze with a center, slowly heat the dish until about 10 mL are left (the same level you are remembering from Step 9).

_____12. Set the dish on the counter to cool.

_____13. If any solid is on the edges of the dish, swirl the dish to dissolve the solid.

_____14. When you can pick up the dish with your bare hands, pour the remaining solution in a test tube.

_____15. Compare the color of this test tube (**boiled solution C**), to the **standard solution A** from Part A.

Questions Part C

C1. Which is more **concentrated** (darker in color) ? _____

C2. Which is more **dilute** (lighter in color) ? _____

C3. Which has more solute in it ? _____

C4. What material boiled away during Part C ? _____

C4. From what you just learned in Part C, how can you make a solution more concentrated ? _____

_____

Summary Questions

1. Name one way to make a solution more dilute: _____

2. Name 2 ways to make a solution more concentrated (one was done in lab, the other was not):

   a) _____, b) _____

3. In terms of concentrated and dilute, what is frozen orange juice ? _____

   a. How much water is in frozen orange juice ? _____

4. What type of solution would have a greater density, a concentrated or dilute solution ? _____

   a. Explain why: _____