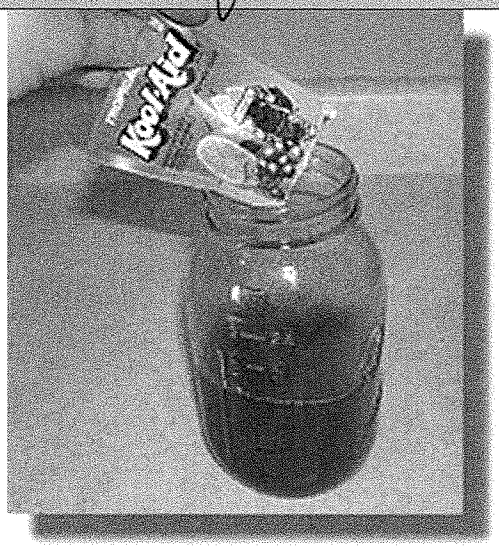
FPS – Solutions Notes and Practice

Name Key Period

Bellwork



1. What do you remember about the difference between homogeneous mixtures and heterogeneous mixtures?

   Homogeneous – same

   Heterogeneous – different

2. Heterogeneous mixtures → not uniform in composition
   a. Suspension → large particles, separate when left unagitated
      Ex: italian dressing
   b. Colloid → pure substance particles in another substance, don't separate
      Ex: Milk (Tyndall effect)
   c. Immiscible → Liquids that don't mix
   d. Examples: oil & water

3. Homogeneous mixtures → uniform composition
   Examples: Kool-Aid

4. Solutions are a group of Molecules that are mixed up in a completely even distribution.

5. There are two parts in a solution.
   a. The Solute is the substance that is dissolved
      Example: salt, sugar, Kool-aid powder

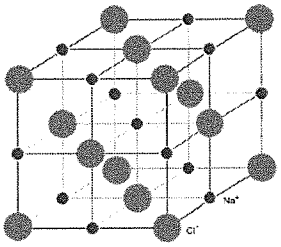
   b. The Solvent is the substance that is DOING the dissolving.
      Example: water – "universal"

6. Solubility is the ability of the solvent to dissolve the solute. If liquids can mix and dissolve in one another, they are called Miscible.

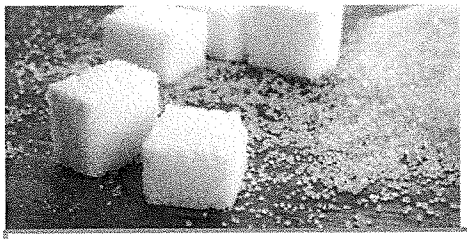
a. What factors affect solubilitv?

temperature

pressure



Structure

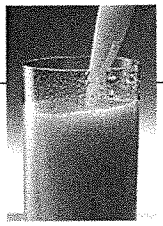


surface area

agitation

7. **"Like dissolves like"**
   a. Polar → polar solvents can only dissolve polar solutes
   b. Nonpolar → nonpolar solvents can only dissolve nonpolar solutes

8. **Concentrations**
   a. Dilute → not much solute per solvent
   b. Concentrated → HIGH amount of solute per solvent



9. We can also classify solutions based on amount of solute.

a. Unsaturated solutions → have less than the maximum amount of solute dissolved in them. (This means more could be added, and the solute would continue to dissolve!)

b. Saturated solutions → have the maximum amount of solute in them. No more can be made to dissolve.

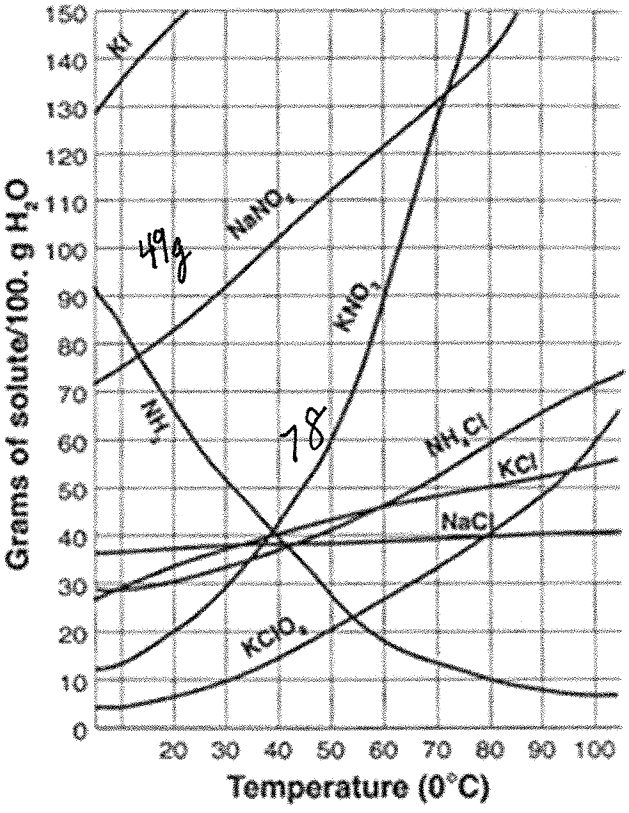
c. Supersaturated solutions → have more than the maximum amount of solute in them. This is not possible for all solutions!

d. How do you think we could create a supersaturated solution?

HEAT IT UP !!!!

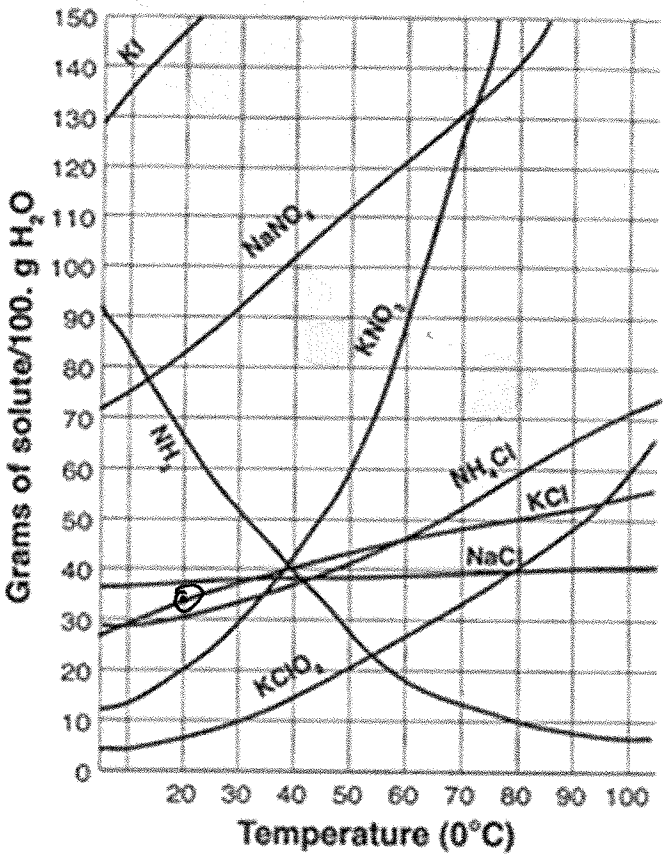
Solubility curves

Solubility Curve



- Which salt is least soluble in water at 60°C? NH_3
- Which salt shows the greatest increase in solubility from 0-60°C? KNO_3
- At 50°C, 70 g of KNO_3 is dissolved in 100 g of water. Is the solution saturated, unsaturated or supersaturated? Super-higher than its solubility
- Which is the most soluble salt at 20°C? KI
- What is the solubility of KCl at 80°C? 50g per 100g
- What it the temperature at which KNO3 has a solubility of 90g/100g of water? 60°C

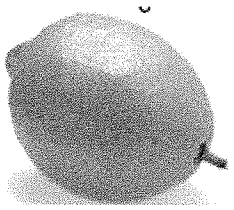
Solubility Curve



- Which salt is most soluble in water at 60°C? $NaNO_3$
- Which salt shows the least increase in solubility from 0-60°C? NaCl (NH_3 decreases)
- At 50°C, 40 g of KCl is dissolved in 100 g of water. Is the solution saturated, unsaturated or supersaturated? unsaturated - just below!
- Which is the least soluble salt at 20°C? $KClO_4$
- What is the solubility of KCl at 20°C? ~35 g / 100g
- What it the temperature at which KNO3 has a solubility of 20g/100g of water? 20°C

Acids and Bases

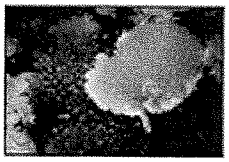
The Chemistry of Acids and Bases – Label the following an "acid" or a "base"



acid

acid

base



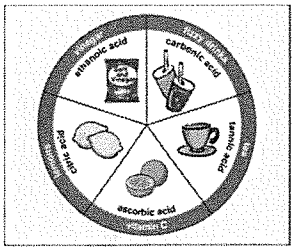
acid

1. What is an acid?

a. An acid is a solution that has an excess of H^+ ions. It comes from the Latin word *acidus* that means "sharp" or "sour".

b. The more H^+ ions, the more acidic the solution.

2. **Properties of an Acid**



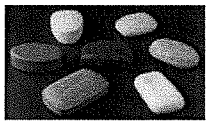
a. Tastes sour
b. Conduct electricity
c. Corrosive
d. Some acids react strongly with Metals to produce H_2 (hydrogen gas)
e. Turns blue litmus paper red
f. Neutralize with a base if same concentration
g. Strong acids fully ionize in water. Weak acids have fewer hydrogen ions in solution.

3. **Uses of acids**


Acids

a. Acetic acid = vinegar
b. Citric acid (lemons, limes, oranges)
c. Ascorbic Acid = Vitamin A which your body needs.
d. Sulfuric acid is used in production of fertilizer, steel, paint, and plastics.

4. *What is a base?*
a. A base is a solution that has excess OH^- ions
b. Another word for base is alkali.



5. *Properties of a base*


Bases

a. Feel slippery
b. Taste bitter
c. Corrosive
d. Can conduct electricity
e. Do not react with metals.
f. Turn red litmus paper blue.

6. *Uses of bases*
a. Bases give soap, ammonia, and many other cleaning products some of their useful properties.
b. The OH^- ions interact strongly with certain substances such as dirt and grease.
c. Chalk and oven cleaner are examples of bases.
d. Your blood can be slightly basic solution.

Baking soda

7. *pH Scale*

a. pH means "potential Hydrogen" – measure H^+

b. pH is a measure of how acidic or basic a solution is.

c. The pH scale ranges from 0 - 14.

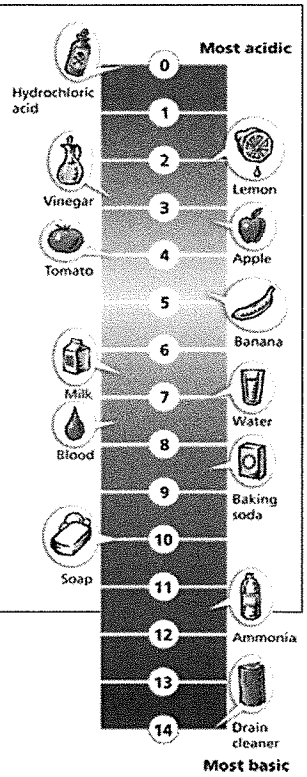
d. Acidic solutions have pH values less than 7.

e. A solution with a pH of 0 is very acidic.

f. A solution with a pH of 7 is neutral.

g. Pure water has a pH of 7.

h. Basic solutions have pH values of more than 7.



Solubility Curve Worksheet

1) Define solubility.

2) Look at the graph below. In general, how does temperature affect solubility?
↑ temperature, ↑ solubility

3) Which compound is LEAST soluble at 10 °C? $KClO_3$

4) How many grams of KCl can be dissolved in 100g of water at 80°C? 50g

5) How many grams of NaCl can be dissolved in 100g of water at 90°C? 40g

6) At 40°C, how much KNO_3 can be dissolved in 100g of water? ~62g

7) Which compound shows the least amount of change in solubility from 0°C-100°C?
NaCl

8) At 30°C, 90g of $NaNO_3$ is dissolved in 100g of water. Is this solution saturated or unsaturated?
unsaturated

9) At 60°C, 72g of NH_4Cl is dissolved in 100g of water. Is this solution saturated or unsaturated?
supersaturated! (or saturated is fine too)

10) A saturated solution of $KClO_3$ is formed from one hundred grams of water. If the saturated solution is cooled from 90°C to 50°C, how many grams of precipitate are formed? 29 g (so how much does it change)
(49g - 20g = 29g)

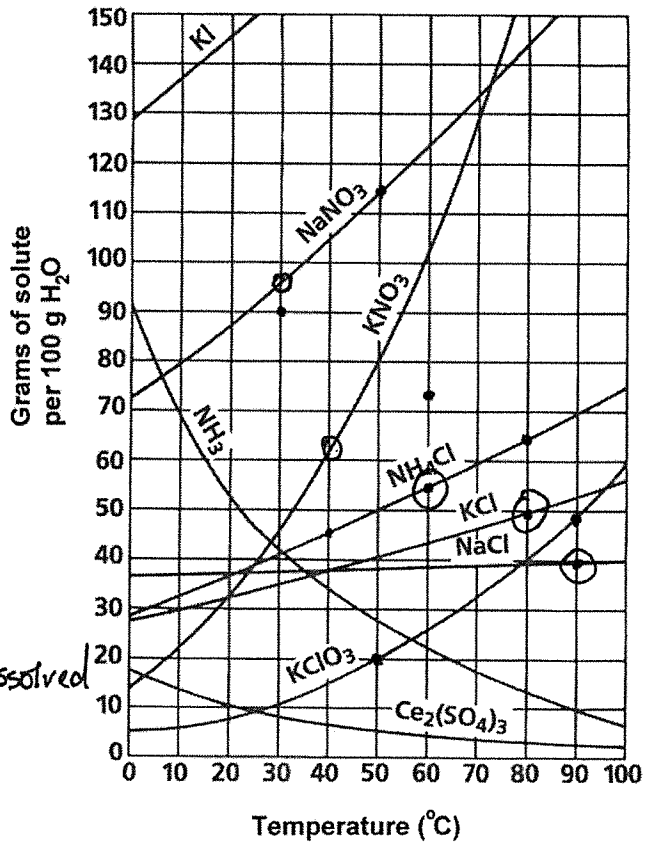
11) A saturated solution of NH_4Cl is formed from one hundred grams of water. If the saturated solution is cooled from 80°C to 40°C, how many grams of precipitate are formed? 20g
(65g - 45g = 20g)

12) Which compounds show a *decrease* in solubility from 0°C-100°C?
NH_3, $Ce_2(SO_4)_3$

13) Which compound is the most soluble at 10°C?
KI

14) Which compound (besides $Ce_2(SO_4)_3$) is the least soluble at 50°C? $KClO_3$

15) For each of the following solutions, explain how much of the solute will dissolve and how much will remain undissolved at the bottom of the test tube?
   a) 120 g of KCl in 100 g of water at 80°C
   50g dissolved, 70g undissolved
   b) 130 g of $NaNO_3$ in 100 g of water at 50°C
   115g dissolved
   15g undissolved



Solutions Review Worksheet

16) What are the 3 different types of mixtures?

colloid, suspension, solution

17) What is a solution?

homogeneous mixture

18) Classify each of the following as a heterogeneous mixture or a homogeneous mixture.

a) salad He

b) tap water Ho

c) muddy water He

19) What is the difference between a solute and solvent?

solute: substance being dissolved

solvent: substance doing the dissolving

20) What is considered to be the "universal" solvent? water

21) ~~Describe (in detail) the 3 steps in solution formation.~~

22) ~~What is the difference between dissociation and solvation?~~

23) Not all solutions are solids dissolved in liquids. Provide 2 examples of other types of solutions.

alloys (solid + solid) soda pop (gas in liquid)

24) EXPLAIN the 3 factors that affect the rate of dissolving?

temperature

surface area

structure + agitation

+ structure

25) Define solubility

ability of solute to dissolve in solvent at given temp.

26) What are 3 factors that affect solubility?

a) Surface area
b) temperature
c) pressure

27) Explain the rule, "Like Dissolves Like".

polar solvents dissolve polar solutes

6) State whether each of the following will conduct an electric current. Also, explain why each does or does not conduct an electric current.

a) salt (NaCl) water

Yes – freely moving ions

b) sugar water

No – no ions

c) solid NaCl

No – ions can't move freely

~~28) When does solution equilibrium occur?~~

29) What are the differences between a saturated solution, unsaturated solution and a supersaturated solution?

saturated: max solute @ specific temperature

unsaturated: more solute can dissolve @ specific temperature

supersaturated: More solute dissolved than maximum!

30) How could you tell by looking at a solution that it was saturated? Give an example.

if more is added will not dissolve — precipitate out

ex: Kool-Aid – add more powder & it settles at bottom

31) What is the Tyndall Effect? Cite a common example of this effect.

32) In what type of mixture is it easiest to separate the component substance? WHY?

33) Given an unknown mixture consisting of two substances, explain how a scientist could use lab techniques to determine whether the mixture is a true solution, a colloid, or a suspension.

Tyndall effect, filtration

❖ *Use the solubility cure below to answer the following questions:*

34) Which salt is LEAST soluble at 20 °C? KNO_3

35) How many grams of KBr can be dissolved in 100g of water at 60°C? ~89g

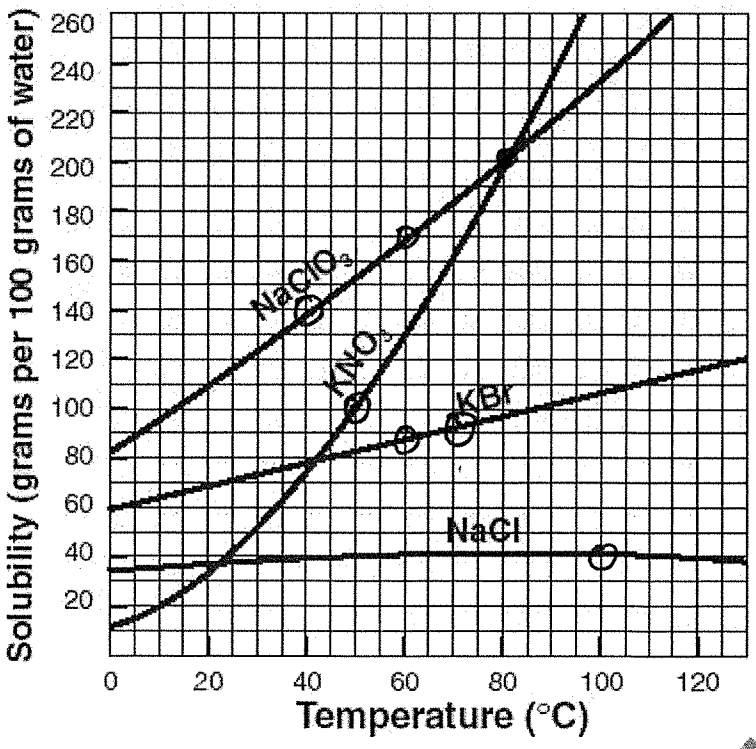
36) How many grams of NaCl can be dissolved in 100g of water at 100°C? 40g

37) At 40°C, 180g of $NaClO_3$ is dissolved in 100g of water. Is this solution saturated or unsaturated?
saturated

38) At 70°C, 70g of KBr is dissolved in 100g of water. Is this solution saturated or unsaturated?
unsaturated

39) A saturated solution of $NaClO_3$ is formed from one hundred grams of water. If the saturated solution is cooled from 80°C to 60°C, how many grams of precipitate are formed? 30g (200 - 170)

40) How much of the solute will dissolve and how much will remain undissolved at the bottom of the test tube?
   a) 160 g of KNO_3 in 100 g of water at 50°C
   100g dissolved
   60g undiss



Getting to Know the pH Scale

Name _____
Date _____
Period _____

Classifying Acids and Bases

The pH of a solution is a number which tells how acidic or basic a solution is. pH values can range from 0-14. Determine whether the brief statements below describe an acid, a base, or a neutral solution. On the blank in front of the statement, write acid, base, or neutral. You may need to review your notes.

acid 1. Blue litmus paper turns red.

acid/neutral 2. Red litmus paper doesn't change color.

acid 3. Contains more H^+ ions than water.

acid 4. pH of 4.

neutral 5. pH of 7.

acid 6. Vinegar.

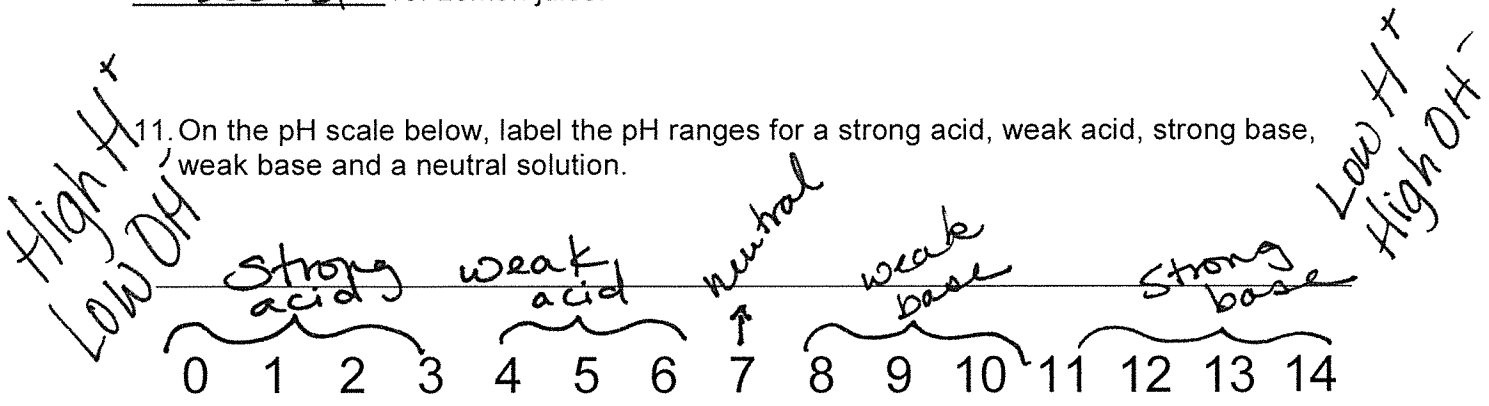
base 7. Contains less H^+ ions than water.

base 8. Drain cleaner.

base 9. Household ammonia.

acid 10. Lemon juice.

11. On the pH scale below, label the pH ranges for a strong acid, weak acid, strong base, weak base and a neutral solution.



Measuring the pH of a Solution

12. Each pH increment on the pH scale represents a ten-fold change in H^+ ion concentration. For example, a solution that has a pH of 6 is 100 times more acidic than a solution that has a pH of 8.

    a. How much more acidic is a solution that has a pH of 3 than a solution that has a pH of 4?

    10 x

    b. A solution with a pH of 8 has how much more H+ ions than a solution with a pH of 12?

    10,000 x

    c. A solution with a pH of 12 is how much more basic than a solution with a pH of 7?

    100,000 x

13. Litmus paper can be used to determine if a solution is an acid or a base. There are two types of litmus paper. Red litmus paper will turn *blue* in the presence of a base. Blue litmus paper will turn *red* in the presence of an acid. Read the descriptions of the following solutions and **predict** what the litmus paper results should be. Then **conclude** as to whether it is an acid, base or neutral solution. Write your answers below in the table.

Table 1. Predicted Results of Litmus paper tests on Different Solutions.

Solution	Red litmus Result	Blue litmus Result	Acid, Base, or Neutral
a) Solution with a pH of 4	red	red	acid
b) Solution has equal amounts of H^+ ions and OH^- ions	red	blue	neutral
c) Seawater, pH 8.5	blue	blue	base
d) Distilled water (pure water)	red	blue	neutral
e) Coffee, pH 5.2	red	red	acid
f) Solution with a pH of 7.0	red	blue	neutral
g) Solution with a high concentration of H^+ ions	red	red	acid
h) Solution with a pH of 11	blue	blue	base
i) Lime juice, pH 3.3	red	red	acid
j) Solution with less H^+ ions than OH^- ions	blue	blue	base

Interpreting the Data

14. Table 2 has a list of results that a student recorded from her investigation of pH. She used both red and blue litmus paper and pH paper to test a number of different solutions. She neglected to follow directions and did not test each solution with all three pH indicators so some data is missing. Use the results she did collect to determine if each solution is an acid, base, or a neutral solution. Write your conclusion provided in table 2.

Table 2. Results of Different pH Indicator Tests on Different Solutions.

Solution	Red litmus Result	Blue litmus Result	pH paper	Acid, Base, or Neutral
A	Red	Blue	7	neutral
B	Red	Red	less than 7	acid
C	Blue	Blue	11	base
D	Blue	Blue	8	base
E	Red	Red	4	acid
F	Blue	Blue	12	base
G	Red	Blue	7	neutral

Use table 3 to answer the following questions.

Table 3. pH Values of Some Common Substances

Substance	pH
Hydrochloric acid (HCl)	1.0
Sulfuric acid (H_2SO_4)	1.2
Tomatoes	4.2
Rainwater	6.2
Pure Water	7.0
Sea water	8.5
Ammonium chloride	11.1
Sodium hydroxide (NaOH)	13.0

15. What is the strongest acid listed in Table 3? HCl

16. What is the pH of the weakest acid listed in Table 3? Rainwater

17. What is the strongest base listed in Table 3? NaOH

18. According to the pH values of Table 3, does a solution with a hydrogen ion concentration less than that of pure water have a pH greater or less than 7? greater (basic)