Questions

Topic:	Water Chemistry	Bonding and Solubility

1. Draw the valence structures of four water molecules as they might appear in their liquid form. Please include non-bonding electron pairs.

2. a. What type of bonding holds the oxygen and hydrogen atoms together?

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b. Water is labeled as a polar molecule. Why?

_____

_____

c. Hydrogen bondings occur between water molecules. Label a hydrogen bond on your diagram above.

d. Describe in words, specifically the parts of the molecules between which hydrogen bonding occurs.

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_____

e. list three other substances that have hydrogen bonds between molecules.

_____

f. why is hydrogen bonds so strong relative to other types of dipole-dipole bonding?

_____

_____

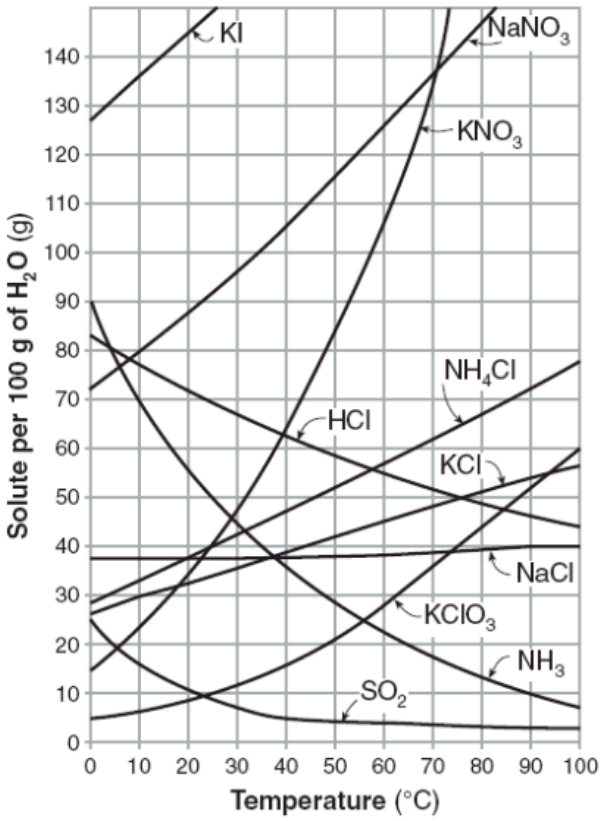
3. Each of the following picture demonstrates a property of water. Identify the property and explain in terms of hydrogen bonding present between the water molecules.

Cooling down a sweaty basketball player	Properties
	

Ice block	Properties
	

Smog	Properties
	

4.



substance	Solubility at 100g H_2O
KNO_3 at 70°C	140g
NH_4Cl at 90°C	72g
NaCl at 100°C	
KI at 20°C	
$NaNO_3$ at 35°C	
SO_2 at 50°C	
NH_3 at 20°C	
$KClO_3$ at 65°C	
KCl at 75°C	
NH_4Cl at 65°C	
HCl at 10°C	
$NaNO_3$ at 70°C	
KNO_3 at 10°C	

Sometimes they ask about 50g (half of what is on the table) or 200g (double the amount on the table).

5. According to the solubility table above, which solution is saturated at 30°C?

(1) 12 grams of $KClO_3$ in 100 grams of water
(2) 12 grams of $KClO_3$ in 200 grams of water
(3) 30 grams of NaCl in 100 grams of water
(4) 30 grams of NaCl in 200 grams of water

6. One hundred grams of water is saturated with NH_4Cl at 50°C. According to the solubility table, if the temperature is lowered to 10°C, what is the total amount of NH_4Cl that will precipitate?

(1) 5.0 g (2) 17 g (3) 30 g (4) 50g

7. Base your answers on the information below.
When cola, a type softdrink, is manufactured, $CO_2(g)$ is dissolved in it.
A) A capped bottle of cola contains $CO_2(g)$ under high pressure. When the cap is removed, how does pressure affect the solubility of the dissolved $CO_2(g)$?

_____

_____

B) A glass of cold cola is left to stand 5 minutes at room temperature. How does temperature affect the solubility of the $CO_2(g)$?

_____

_____

C) Draw a set of axes and label one of them "Solubility'' and the other "Temperature."
D) Draw a line to indicate the solubility of $CO_2(g)$ versus temperature on the axes drawn in part A.

8. A student uses 200 grams of water at a temperature of 60°C to prepare a saturated solution of potassium chloride, KCl.

a) Identify the solute in this solution.

b) How many grams of KCl must be used to create this saturated solution?

_____

c) This solution is cooled to 10°C and the excess KCl precipitates (settles out). The resulting solution is saturated at 10°C. How many grams of KCl precipitated out of the original solution?

9.

The Solubility of the Solute at Various Temperatures

Temperature (°C)	Solute per 100 g of H_2O(g)
0	18
20	20
40	24
60	29
80	36
100	49

a) Graph the data from the data table. Circle and connect the points

b) Based on the data table, if 15 grams of solute is dissolved in 100 grams of water at 40°C, how many more grams of solute can be dissolved in this solution to make it saturated at 40°C?

c) According to the solubility table, how many grams of $KClO_3$ must be dissolved in 100 grams of H_2O at 10°C to produce a saturated solution?

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10. Two alcohols that are used in our everyday lives are rubbing alcohol and ethylene glycol. Rubbing alcohol is used as an antiseptic. Ethylene glycol is the main ingredient in antifreeze, which is used in automobile cooling systems.

Explain, in terms of molecular polarity, why rubbing alcohol, 2-propanol, is soluble in water.

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11. The solubility of $KClO_3(s)$ in water increases as the

(1) temperature of the solution increases	(3) pressure on the solution increases
(2) temperature of the solution decreases	(4) pressure on the solution decreases

12. According to the solubility table, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of H_2O at 10°C?

(1) KI (2) KNO_3 (3) $NaNO_3$ (4) NaCl

13. A student adds solid KCl to water in a flask. The flask is sealed with a stopper and thoroughly shaken until no more solid KCl dissolves. Some solid KCl is still visible in the flask. The solution in the flask is

(1) saturated and is at equilibrium with the solid KCl

(2) saturated and is not at equilibrium with the solid KCl

(3) unsaturated and is at equilibrium with the solid KCl

(4) unsaturated and is not at equilibrium with the solid KCl

14. A student conducts an experiment to determine how the temperature of water affects the rate at which an antacid tablet dissolves in the water. The student has three antacid tablets of the same size and composition. The student drops one tablet into each of three beakers containing 200ml of water at different temperatures and measures the time it takes for each tablet to completely dissolve. The results are shown in the table below.

Beaker	Original water temperature (°C)	Time for tablet to dissolve (s)
1	20	40
2	30	25
3	40	10

a) Describe the effect of water temperature on the rate of dissolving.

_____

b) What change, other than temperature, would affect the rate of dissolving?

_____

Working space: