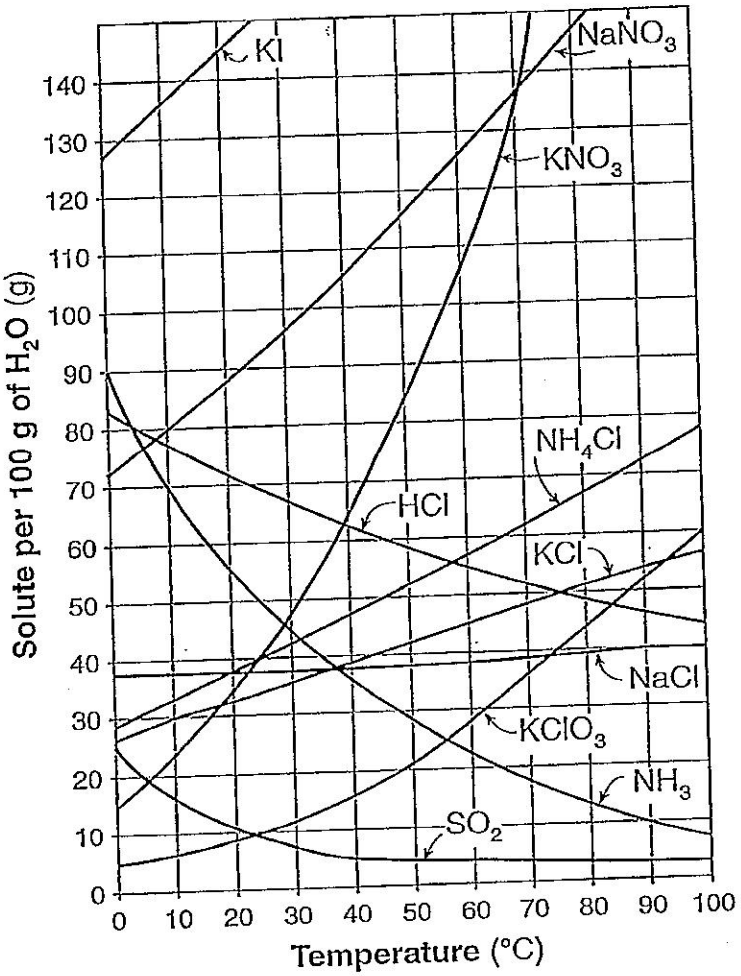
Table G

Solubility Curves



Overview:

A solution is a homogeneous mixture of two or more substances. A solution has two components, the dissolved substance, called the solute, and the dissolving substance, called the solvent. In most solutions, the solvent is water and these are called aqueous solutions (aq). Temperature is one factor that determines the solubility of a solute in water. If the solute is a gas, pressure, as well as temperature, determines the solubility of that solute. The solubility of a solute as a function of temperature gives rise to a solubility curve.

The Table:

This table shows the mass of solute (dissolved substance), in grams (g), that can be dissolved in 100 g of H_2O as a function of temperature. From the intersection point of a solubility curve and a given temperature line, reading directly to the left gives the amount of that solute, in g, needed to saturate 100 g of H_2O at that temperature. A saturated solution contains the maximum amount of that solute that can be dissolved in 100 g of H_2O at that temperature. An equilibrium exists between dissolved solute and excess undissolved solute in a saturated solution.

Since the solubility of a solid solute increases with temperature, if the solution is cooled sufficiently, solute may start to drop out or precipitate out of solution. The resulting solution is then a saturated solution.

If the amount of solute dissolved in 100 g of H_2O is below the amount read from the solubility curve at that temperature, the solution is unsaturated.

If the amount of solute dissolved in 100 g of H_2O is greater than that amount read from the solubility curve at that temperature, the solution is supersaturated.

The graph shows that the solubility of solid solutes in H_2O generally increases as the temperature increases, while the solubility of gases (HCl, NH_3 and SO_2) decreases as the temperature increases.

If the amount of H_2O is different from 100 g, the amount of solute needed to saturate that amount of H_2O will change accordingly. For example, if 50 g of H_2O is used, take half the amount of solute as read from the table. If 200 g of H_2O is used, take twice the amount of solute as read from the table.

Additional information:

- A solution is homogeneous since the solute is distributed uniformly throughout.
- The dissolved solute in a solution cannot be separated from the solvent by filtration.
- A supersaturated solution is very unstable. Any disturbance, such as stirring or adding a crystal of the solute, will cause the excess solute to crystallize or drop out of solution, forming a saturated solution.
- The presence of solute raises the boiling point of the solvent and lowers the freezing point of the solvent.
- In using this table, be sure to use the correct solubility curve and the correct temperature line.
- Pressure has a negligible effect on the solubility of a solid in water. However, an increase in pressure increases the solubility of a gas in water and a decrease in pressure decreases the solubility of a gas in water.

Set 1 — Solubility Curves

1. A dilute, aqueous potassium nitrate solution is best classified as a

(1) homogeneous compound
(2) homogeneous mixture
(3) heterogeneous compound
(4) heterogeneous mixture

1 _____

2. According to Reference Table G, which substance forms an unsaturated solution when 80 grams of the substance is added in 100 grams of H_2O at 10°C?

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

2 _____

3. A saturated solution of $NaNO_3$ is prepared at 60°C using 100. grams of water. As this solution is cooled to 10°C, $NaNO_3$ precipitates (settles) out of the solution. The resulting solution is saturated. Approximately how many grams of $NaNO_3$ settled out of the original solution?

(1) 46 g (3) 85 g
(2) 61 g (4) 126 g

3 _____

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

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

4 _____

5. Based on Reference Table G, what is the maximum number of grams of KCl(s) that will dissolve in 200 grams of water at 50°C to produce a saturated solution?

(1) 38g (3) 58 g
(2) 42 g (4) 84 g

5 _____

6. According to Reference Table G, 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 _____

7. A mixture of crystals of salt and sugar is added to water and stirred until all solids have dissolved. Which statement best describes the resulting mixture?

(1) The mixture is homogeneous and can be separated by filtration.
(2) The mixture is homogeneous and cannot be separated by filtration.
(3) The mixture is heterogeneous and can be separated by filtration.
(4) The mixture is heterogeneous and cannot be separated by filtration.

7 _____

8. A solution that is at equilibrium must be

(1) concentrated (3) saturated
(2) dilute (4) unsaturated

8 _____

9. What occurs when NaCl(s) is added to water?

(1) The boiling point of the solution increases, and the freezing point of the solution decreases.
(2) The boiling point of the solution increases, and the freezing point of the solution increases.
(3) The boiling point of the solution decreases, and the freezing point of the solution decreases.
(4) The boiling point of the solution decreases, and the freezing point of the solution increases.

9 ____

10. According to Reference Table G, how many grams of $KClO_3$ must be dissolved in 100 grams of H_2O at 10°C to produce a saturated solution?

_____

Base your answers to question 11 on the information below and on your knowledge of chemistry.

When cola, a type of soda pop, is manufactured, $CO_2(g)$ is dissolved in it.

11. *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) In the accompanying space, draw a set of axes and label one of them "Solubility" and the other "Temperature."

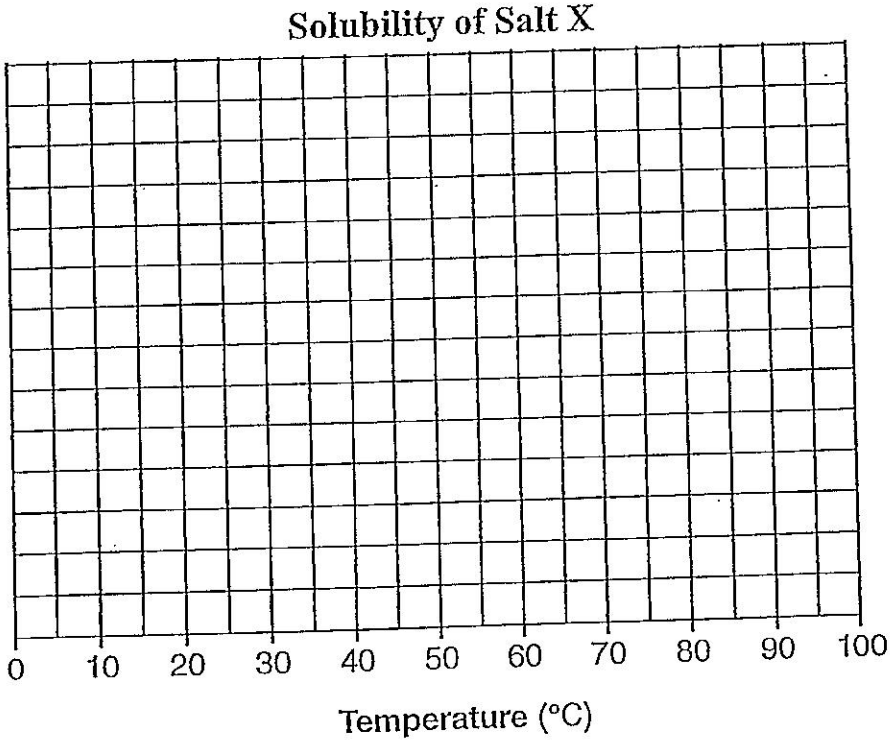
d) Draw a line to indicate the solubility of $CO_2(g)$ versus temperature on the axes drawn in part *c*.

12. Given the data table below showing the solubility of salt X:

Temperature (C°)	Mass of Solute per 100 g of H_2O
10	22
25	40
30	48
60	107
70	135

a) Which salt on Table G is most likely to be salt X? _____

b) On the graph below, scale and label the *y*-axis including appropriate units.



c) Plot the data from the data table. Surround each point with a small circle and draw a best-fit curve for the solubility of salt X.

d) Using your graph, predict the solubility of salt X at 50°C. _____

e) If the pressure on the salt solution was increased, what affect would this pressure change have on the solubility of the salt?

_____

_____