SI Chemistry - Full Discipline Demo

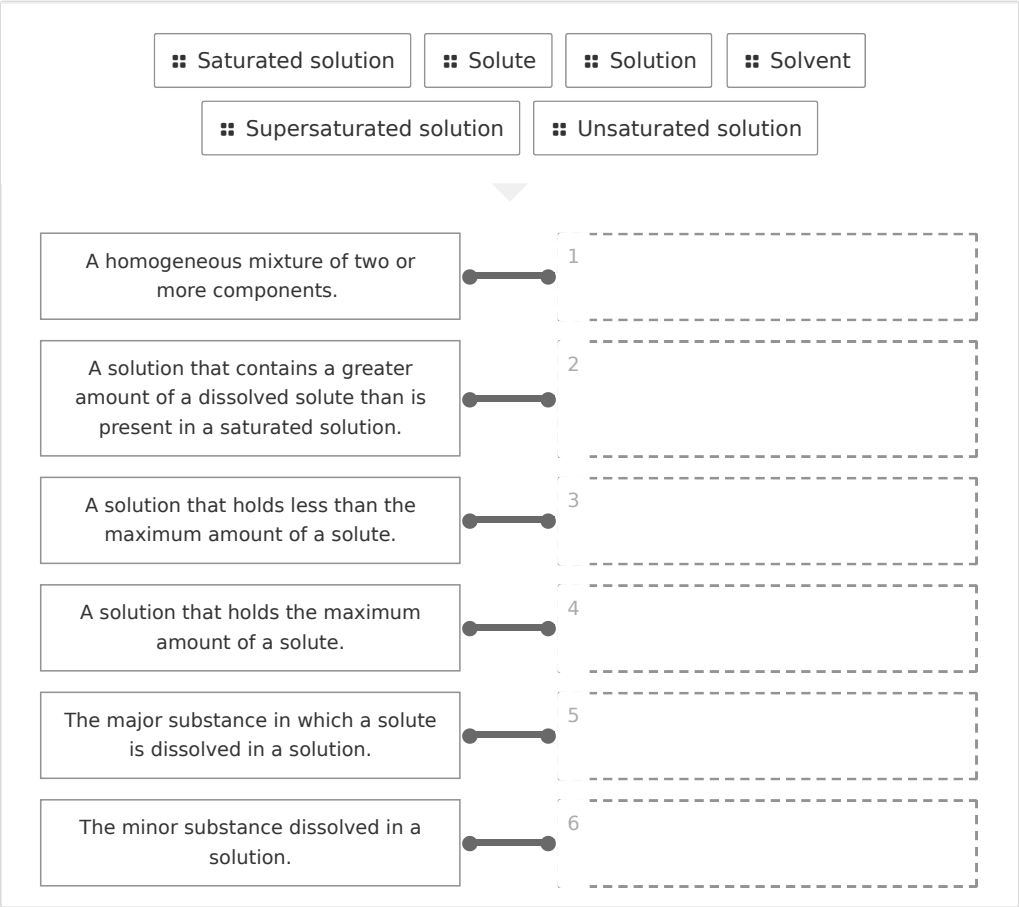
Solutions and Dilutions

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best definition.

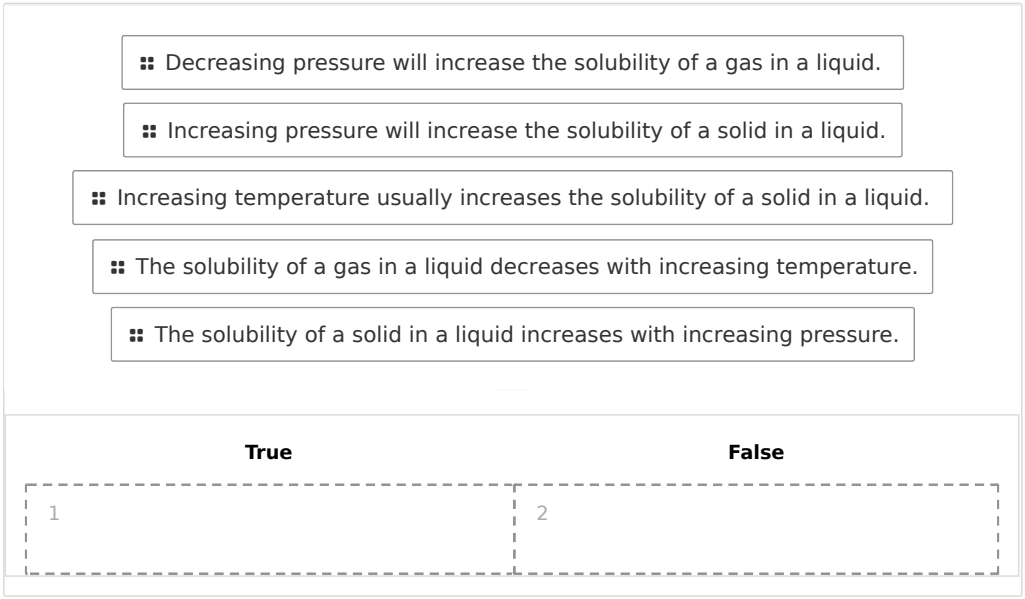


Correct answers:

1 Solution 2 Supersaturated solution 3 Unsaturated solution

4 Saturated solution 5 Solvent 6 Solute

Categorize each statement as true or false.



Correct answers:

1

Increasing temperature usually increases the solubility of a solid in a liquid.

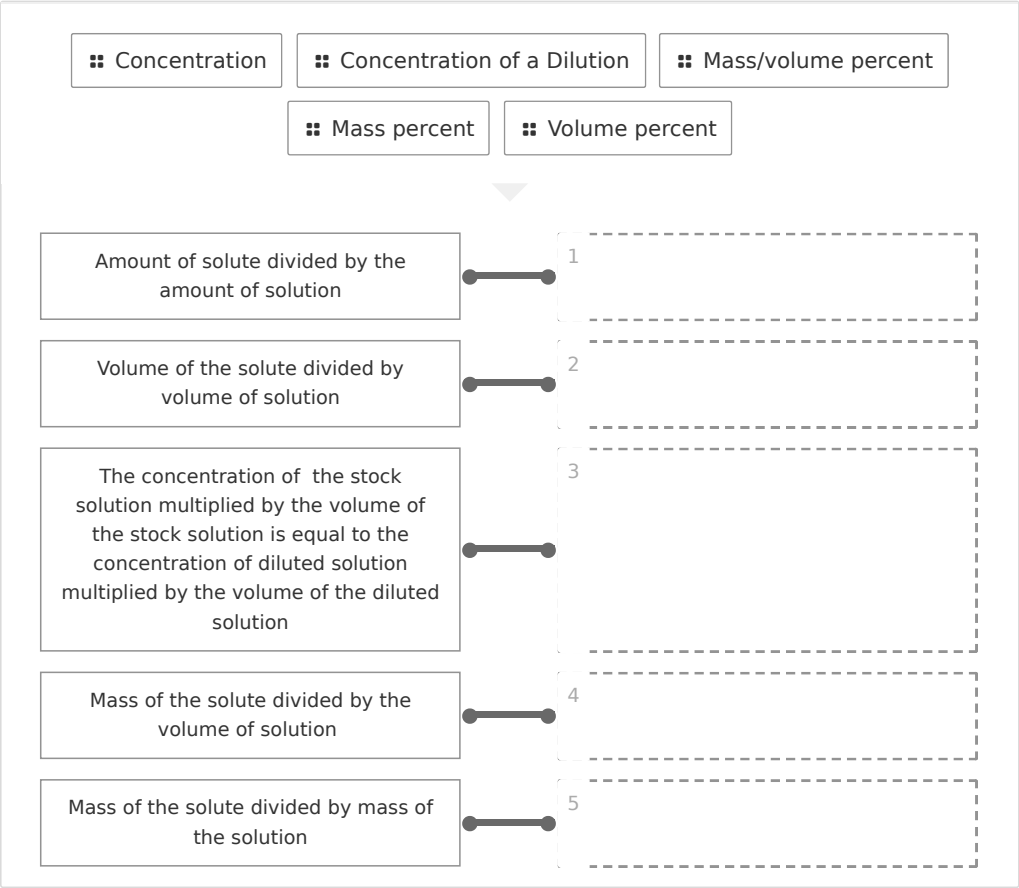
The solubility of a gas in a liquid decreases with increasing temperature.

2 Decreasing pressure will increase the solubility of a gas in a liquid.

The solubility of a solid in a liquid increases with increasing pressure.

Increasing pressure will increase the solubility of a solid in a liquid.

Match each concentration with the correct expression.



Correct answers:

1 Concentration 2 Volume percent 3 Concentration of a Dilution

4 Mass/volume percent 5 Mass percent

Exploration

When sugar and water are mixed, a clear liquid results. In this scenario, the sugar is considered a _____.

- solute ✔
- solution
- solvent
- All of the above

The solubility of a gaseous solute in water is _____ by an increase in pressure.

- [x] increased ✔
- [ ] decreased
- [ ] not affected

When a solution contains less than the maximum amount of dissolvable solute, the solution is said to be unsaturated.

- [x] True ✔
- [ ] False

The _____of a solution is the mass of the solute divided by the volume of the solution.

- [ ] volume percent
- [ ] mass percent
- [ ] volume/mass percent
- [x] mass/volume percent ✔

A dilution is a solution made by adding a solvent to a supersaturated solution.

- [ ] True
- [x] False ✔

Exercise 1

The normal recipe for preparing Kool-Aid® calls for adding the entire package and 1 cup of sugar to 2 quarts of water. Calculate the volume percent of this solution and determine which of your samples is the closest to the concentration of the recommended preparation. Again, assume that the weight of the drink mix is 0.0 g. The total volume of the solution is 8 and 2/3 cups.

Volume % = (1 cup/ 8 $^{2}/_{3}$ cups) x 100% = 11.55%. rounded to 12%. The stock solution, at 15%, is closest to the concentration of the recommended recipe.

A solute often takes on properties of the solvent. How was this exhibited in Part 1?

Solid sugar dissolved into a liquid solution because the solvent was a liquid.

List and describe the methods discussed to express the concentration of a solution.

Mass or weight percent ($m_{solute}/m_{solution}$ %) is the mass of a solute divided by the mass of the solution multiplied by 100. Volume percent ($V_{solute}/V_{solvent}$ %) is a measure of the concentration of a substance in a solution. Volume percent is often used when preparing solutions consisting of multiple liquids. Mass/volume percent (m/V %) is used when a solid solute is added to a liquid solvent and the volume of the solvent is adjusted to produce the desired final volume of solution.

Describe the effects of temperature and pressure on solubility. If you had used boiling water instead of lukewarm water, would your results have changed? If so, how?

Usually, the solubility of a solid solute increases as the temperature of a liquid solution increases. The solubility of a gaseous solute in a liquid solvent decreases as the temperature of the solution

increases. Gases under higher pressures are more soluble than gases under lower pressures. Pressure has a negligible effect on the solubility of liquids and solids.

Rubbing alcohol is a commonly used disinfectant and has a cooling effect when applied to the skin. The active ingredient in rubbing alcohol is isopropanol. In drugstores, the most common concentration of rubbing alcohol sold contains 70% (vol/vol) isopropanol in water. Assuming the rubbing alcohol manufacturer uses a 100% isopropanol solution, what volume of pure isopropanol is required to produce a 200-mL bottle of rubbing alcohol? Show all calculations in your answer.

Calculate the volume of the 100% isopropanol needed to make 200 mL of the 70% solution by using the equation $C_1V_1 = C_2V_2$. $(100\%)V_1 = (70\%)(200mL)$; $V_1 = 140$ mL

Data Table 1: Concentration and Physical Properties of Drink Mix Solutions
(SAMPLE ANSWER BELOW)

Solution	Concentration (%)	Color Intensity	Taste
Stock Solution (S)	15.0%	Darkest red	A little too sweet, but tastes about right
Dilution 1	2.48%	Lighter red	Not very sweet
Dilution 2	5.63%	Dark red	A little watered down
Dilution 3	1.88%	Lightest red	Watered down, not much flavor
Dilution 4	3.75%	Red	Watered down

Photo 1: Drink Mix Color Comparison
(SAMPLE ANSWER BELOW)

Competency Review

The solvent in a solution is the component that _____.

- gets dissolved
- dissolves the solute ✔
- changes phases
- forms a precipitate

Bronze is a solid solution consisting of 90% copper and 10% tin. Tin is considered the solute of this solution.

- True ✔
- False

The solubility of salt is 35.7 g per 100 g of water at 25.0°C. To find the percentage of salt in a saturated solution, which concentration calculation should be used?

- volume mass percent
- mass percent ✔
- volume percent
- mass volume percent

An increase in temperature _____ the solubility of a solid solute dissolving in a liquid solvent.

- increases ✔
- decreases
- does not influence

A homogeneous mixture of two or more substances is called a(n) _____.

- colloid
- compound
- aggregation
- solution ✔

A _____ solution contains the maximum amount of dissolved solute under stable conditions.

- concentrated
- supersaturated
- unsaturated
- saturated ✔

An increase in _____ will increase the solubility of a gas in water.

- temperature
- pressure ✔
- water volume
- gas volume

A 60% alcohol solution is composed of _____ mL of alcohol and _____ mL of water.

- 60; 100
- 60; 40 ✔
- 40; 100
- 40; 60

To dilute a stock solution, the solution and additional solvent are combined.

- True ✔
- False

_____ solutions contain more solute than could be dissolved under normal conditions.

- Saturated
- Unsaturated
- Aqueous
- Supersaturated ✔

Extension Questions

In Denver, Colorado the elevation is about 5,280 feet above sea level. Explain what potential effects this may have on the solubility of a gaseous solute in a liquid solution. (SAMPLE ANSWER BELOW)

Air pressure decreases with increasing elevation. In Denver, air pressure is significantly lower than at sea level. Solutions under higher pressure have increased solubility. If pressure is increased, gas

molecules are forced into solution increasing the number of gas molecules in the solution. The lower pressure in Denver will decrease the solubility of a gaseous solute in a liquid.

At the top of Mt. Everest, the elevation is about 29,000 feet above sea level. Explain what potential effects this may have on the solubility of a gaseous solute, like oxygen gas, in a liquid solution (i.e. water). Would it increase or decrease? Why?

You must explain why to receive credit. (Try to summarize your reason in one simple sentence).

(SAMPLE ANSWER BELOW)

No sample answer provided