Predicting IFAs

Problems:

For the following, draw the Lewis structure, predict the molecular geometry, indicate partial positive and negative charge build-up (if any), and tell if the molecule is polar or nonpolar. Finally, predict the type of IFAs that would exist in a sample of each pure substance.

1. CF₄

2. F₂

3. CH₃CH₂CH₂CH₂OH

Arrange the three substances from highest to lowest boiling and melting point.
Change of State

[Diagram showing the relationship between temperature and heat added, with labels for solid, liquid, melting point, boiling point, and vapor.]
**Solution:** A homogeneous mixture of two or more substances.

**Solute:** The substance that is dissolved; AKA the substance that is present in the least amount.

**Solvent:** The substance that is dissolving another substance(s); AKA the substance present in the greatest amount.

**Aqueous solution:** When water is the solvent.

Note that the extent to which a solute will dissolve in a solvent is dependent upon the attraction between solute and solvent particles. IFAs are important to determine solubility! In general, like dissolves like.
The Dissolving Process

- Ionic compounds tend to dissolve in water due to ion-dipole interactions. See the solubility chart from chapter 6 for exceptions.

- Polar solutes tend to dissolve in polar solvents.

- Nonpolar solutes tend to dissolve in nonpolar solvents.
Solubility

Solubility refers to the amount of a solute that will dissolve in a given amount of solvent under certain conditions.

1. Temperature: usually as T increases, the solubility will also increase for a solid or liquid. The opposite is true for gases.

2. Pressure: as pressure increases, the solubility of gases increases. There is no affect on solubility of liquids and solids due to pressure.
Concentration

• Molarity: refers to the number of moles of solute per liter of solution.

• w/v %: refers to the number of grams of solute per 100 mL of solution.

• v/v %: refers to the number of milliliters of solute per 100 mL of solution.

• Dilutions: Solutions often come in a concentrated mixture that has to be diluted to the desired concentration. The following equation is used for dilutions: \( C_1V_1 = C_2V_2 \)
Problems From Chapters 8 and 9

1. An alcohol solution is 25% v/v. What does this mean quantitatively?

2. What is the molarity of an aqueous solution prepared by dissolving 23.4 g of sodium sulfate in 1.5 L of total solution?

3. How many sodium ions are found in 1.0 L of the above solution?

4. How much copper (II) sulfate is needed to prepare 250 mL of a 1.2 M solution?

5. How many copper ions are found in 1.0 L of the above solution?

6. Refer back to the change of state diagram for water (page 9 from last note packet). Above what temperature do you expect there to be the fewest IFAs?

7. You wish to make 50.00 mL a 0.400 M solution of sodium chloride from a 2.00 M stock solution. Write out the steps needed to make this solution.

8. Which of the following is capable of hydrogen bonding with water?
   1. Methane (CH₄)
   2. Methanol (CH₃OH)
   3. Carbon tetrachloride
Osmosis and Osmotic Pressure

Osmosis:  The passage of water through a semipermeable membrane from a solution of lower concentration to a solution of higher concentration.

Osmotic Pressure:  The pressure required to halt the passage of solvent molecules across a semipermeable membrane.

Osmolarity (osmol):  The sum of the molarities of all dissolved particles in a solution. The higher the osmolarity, the higher the osmotic pressure will be for that solution.
Osmosis in Living Systems

Isotonic: When two solutions have the same osmolarity and solvent does not exchange from one solution to the other via a semipermeable membrane.

Hypotonic: Having an osmolarity less than the surrounding blood plasma or cells

Hypertonic: Having an osmolarity greater than the surrounding blood plasma or cells.

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Calculate the mass percent of a solution that is prepared by adding 47.5 g of NaOH to 294 g of H₂O.

Calculate the mass/volume percent of a NaCl solution in which 149 g of NaCl is dissolved in enough water to give a total volume of 4.49 L.

Given the formula C₁V₁ = C₂V₂, where C indicates concentration and V indicates volume, which equation represents the correct way to find the concentration of the dilute solution (C₂)?

What is the final volume V₂ in milliliters when 0.591 L of a 39.3 % (m/v) solution is diluted to 24.2 % (m/v)?

A 982 mL NaCl solution is diluted to a volume of 1.11 L and a concentration of 5.00 M. What was the initial concentration C₁?

Consider a 20.0 % (m/v) solution. How can this be written as a conversion factor?

\[
\frac{20.0 \text{ g of solute}}{100 \text{ mL of solution}} \\
\frac{20.0 \text{ g of solute}}{80 \text{ g of solution}} \\
\frac{20.0 \text{ g of solute}}{100 \text{ g of solution}} \\
\frac{20.0 \text{ g of solute}}{80 \text{ mL of solution}}
\]
A semipermeable membrane is placed between the following solutions. Which solution will decrease in volume?

Solution A: 2.18 % (m/v) starch

Solution B: 7.13 % (m/v) starch

A semipermeable membrane is placed between the following solutions. Which solution will increase in volume?

Solution C: 5.17 % NaCl

Solution D: 11.7 % NaCl

The number of components in a solution is ________.

at least 2
3
4
5
6

In a mixture of 5 mL water, 10 mL alcohol, and 50 mL acetone the solvent(s) is(are) ________.
Which statement best explains the meaning of the phrase "like dissolves like"?

A solvent will easily dissolve a solute of similar mass.
The only true solutions are formed when water dissolves a non-polar solute.
A solvent and solute with similar intermolecular forces will readily form a solution.
The only true solutions are formed when water dissolves a polar solute.
None of these statements is correct.

When a solid dissolves, each molecule is removed from the crystal by interaction with the solvent. This process of surrounding each ion with solvent molecules is called

hemolysis.
solvation.
creation.
dilution.
electrolysis.

Consider the following four liquids:
1. water: highly polar; H-bonding
2. hexanol: slightly polar; some H-bonding
3. chloroform: slightly polar; no H-bonding
4. octane: non-polar; no H-bonding
Which pair of liquids is immiscible?

water and octane
hexanol and chloroform
water and hexanol
chloroform and octane
none of the above

Which of the following should be immiscible with carbon tetrachloride, CCl₄?

Br₂
C₄H₁₀
C₆H₁₂
C₃H₈
CH₃CH₂OH

The solubility of gases in liquids
decreases as temperature increases and increases as pressure increases.
decreases as temperature increases and decreases as pressure increases.
increases as temperature increases and decreases as pressure increases.
is independent of temperature and increases as pressure increases.
increases as temperature increases and increases as pressure increases.

All of the statements about molarity are correct except

the abbreviation is M.
the interpretation of the symbol is "moles of solute per mole of solvent."
moles = molarity × volume.
volume = moles/molarity.
the molarity of a diluted solution is less than the molarity of the original solution.

How many grams of NaOH are needed to make 750 mL of a 2.5% (w/v) solution?

3.9 g
7.5 g
19 g
50 g
20 g

What is the % (w/v) concentration of a solution containing 12 grams of solute in 400 mL of solution?

1.2%
12%
6.0%
4.0%
3.0%

Which solution is the most concentrated? Each choice refers to the same solute and solvent.

50 g solute in 175 mL solution
20 g solute in 50 mL solution
30 g solute in 150 mL solution
2.4 g solute in 5 mL solution
2.4 g solute in 2 mL solution

What is the molarity of a solution prepared by dissolving 3.50 mol NaCl in enough water to make 1.50 L of solution?

5.25 M
2.33 M
0.429 M
87.8 M
137 M
What is the molarity of a solution prepared by dissolving 1.25 mol of AgNO₃ in enough water to make 625 mL of solution?

0.00200 M
2.00 M
0.340 M
0.0118 M
0.500 M

Normal saline is 0.920% (w/v) NaCl in water. How many grams of NaCl are needed to prepare 15.0 L of normal saline?

1.38 g
138 g
807 g
53.8 g
16.3 g

How many mL of 0.105 M AgNO₃ are needed for an experiment that requires 0.00510 mol of AgNO₃?

0.536 mL
20.6 mL
17.8 mL
48.6 mL
18.70 mL

Which substance is not an electrolyte?

HCl
CH₄
NH₄NO₃
KOH
NaCl

Considering 1.0 M solutions of each substance, which contains the largest concentration of ions?

NH₃
K₂SO₄
FeCl₃
KCl
NaOH

Considering 0.10 M solutions of each substance, which contains the smallest concentration of ions?

K₂CO₃
Ca(NO₃)₂
FeSO₄
Na₂SO₄
(NH₄)₃PO₄
The passage of a solvent across a semipermeable membrane because of concentration differences is called

dialysis.
hydration.
solvation.
osmosis.
hemolysis.

What is the osmolarity of a 0.20 M solution of KCl?

0.20 Osmol
0.10 Osmol
0.30 Osmol
0.40 Osmol
0.80 Osmol

Which solution has the greatest osmolarity?

0.6 M NaCl
0.10 M KNO₃
0.2 M CaBr₂
0.14 M KF
0.35 M AlCl₃

After swimming in the ocean for several hours, the swimmers noticed that their fingers appeared to be very wrinkled or shriveled up. This is an indication that seawater is ________ relative to the fluid in cells.

hypotonic
hypertonic
isotonic
none of these