

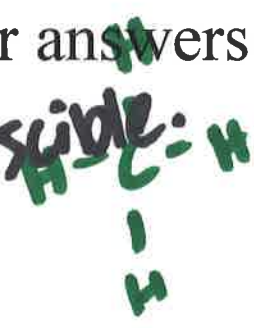
Water and Aqueous Solutions Exam Review

1. Label each substance as ionic or molecular and then as miscible or immiscible in water. Explain your answers in terms of polarity.



molec., NP, immiscible

covalent



-mixable

b.



ionic, miscible

c.



immiscible

d.



ionic, miscible

e.



sugar, molecular, miscible

f.



ionic, miscible

"like dissolves like"

water is polar:

polar & ionic
dissolve

nonpolar dissolves

nonpolar

will it dissolve in water?

yes
ionic: M & NM

molec: all NM

yes
NP
(draw pic!)

2. Circle the substances in question #1 that would be electrolytes.

- electrolytes conduct an electric current
- ions must be present
- ionic compounds dissolved in water or melted and acids!

↑ starts w/ H

b, d, f

3. Identify the solvent and solute in vinegar, a dilute aqueous solution of acetic acid.

aqueous soln: mixture w/ water as the solvent!

solvent: water
solute: acetic acid

4. Identify the following as:

interm. in size
(A) colloids

settles upon standing
(B) Suspensions

(C) Emulsion

liquid in liquid colloid

a. A Jello

b. A Paint

c. B Muddy water

d. A Glue

e. A Milk

f. C Soap

used in

emulsifying agent

Solution < Colloid < Suspension

5. Answer the following about hydrates.

a. A crystal that loses water vapor to the air is called

efflorescent

(crystal that contains water of hydration)

b. A crystal that absorbs water vapor from the air is called

deliquescent

hygroscopic (water absorbing)

c. What is a desiccant? (include an example)

water absorbing substance used as drying agent
Silica gel pack

agent

6. Answer the following questions.

a. How many oxygen atoms are in 2 formula units of $\text{Na}_3\text{PO}_4 \cdot 7\text{H}_2\text{O}$? 22 oxygen atoms

$4 + 7 = 11$ in
 \downarrow 1 fu
 $2 \times 11 = 22$

b. What happens when the hydrate is heated? (write eqn) it becomes anhydrous



\uparrow
water is in the crystal

c. What is the name of the above hydrate?

Sodium phosphate heptahydrate

\uparrow
no water

d. What is the percent of water in the above hydrate?

Na $3 \times 23.0g = 69.0g$
P $1 \times 31.0g = 31.0g$
O $4 \times 16.0g = 64.0g$
H₂O $7 \times 18.0g = 126.0g$

mass of water

$\frac{126.0g}{290.0g}$

$\times 100 =$

43.45% H₂O

mass hydrate

$\frac{\text{mass H}_2\text{O}}{\text{mass hydrate}} \times 100$

8. List and define the major factors that affect the rate of solution. \ how fast it dissolves

a. agitation --- brings solvent in contact w/ fresh solute

b. temperature --- increases the motion of the particles

c. particle size --- smaller particles have a greater surface area to come in contact w/ water

to dissolve
solute
the fastest

∴ stir it, crush it, heat it

Saturated

9. $\text{Sr}(\text{OH})_2$ has a solubility of 11.3 g/ 100 g H_2O at 20.0 °C.

a. How much would be needed to make a saturated solution with 500.0 g H_2O ? ^{full}

$$\frac{11.3 \text{ g Sr(OH)}_2}{100 \text{ g H}_2\text{O}} = \frac{x \text{ g Sr(OH)}_2}{500 \text{ g H}_2\text{O}} \text{ sat.}$$

\downarrow
56.5 g Sr(OH)₂

b. How much would be needed to make an unsaturated solution with 500.0 g H_2O ?
 IS NOT FULL

any number less than 56.5g

c. How much would be needed to make a supersaturated solution with 500.0 g H_2O ?
 overfull

any number greater than 56.5g

10. Label the picture shown. (unsaturated, saturated, supersaturated)

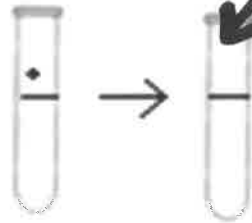


at 25 C

Saturated



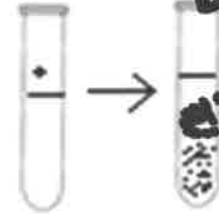
b/c
Solid is
present at
bottom of
test tube



at 90 C

unsat.

the crystal
of solute
dissolves



at 20C

super sat.

the crystal
of solute
causes
crystallization

* 1 mol = g * 1000 mL = 1 L *

11. Convert the values in the table on the right.

$M = \frac{\text{mol solute}}{\text{L solution}}$

	Amount of solute	Volume of solution	Molarity
A	4.55 mol	238 mL	19.1 M
B	2.44 g NaCl	0.0036 L	12 M NaCl
C	2.0 mol	3331 mL	0.60 M

A: $M = x$

mol = 4.55 mol

$L = \frac{238 \text{ mL}}{1000 \text{ mL}} = 0.238 \text{ L}$

$M = \frac{4.55 \text{ mol}}{0.238 \text{ L}} = 19.1 \text{ M}$

B. $M = x$

mol = $\frac{2.44 \text{ g NaCl}}{58.5 \text{ g NaCl}} \times 1 \text{ mol} = 0.041709 \dots$

$L = 0.0036 \text{ L}$

$M = \frac{0.041709 \dots \text{ mol}}{0.0036 \text{ L}} = 12 \text{ M NaCl}$

C. mol = 2.0 mol

$L = \frac{3331 \text{ mL}}{1000 \text{ mL}} = 3.331 \text{ L}$

$\frac{2.0}{3.331} = 0.60 \text{ M}$

12. A student in the lab has 1.25L of a 5.00M solution of KCl.

39.1
35.5

$$M = \frac{\text{mol}}{\text{L}}$$

a. How many moles and grams of KCl are present in the solution?

$$M = 5.00 \text{ M}$$
$$\text{mol} = x$$
$$L = 1.25 \text{ L}$$

$$5.00 = \frac{x}{1.25}$$

$$x = 6.25 \text{ mol KCl}$$

$$\frac{6.25 \text{ mol KCl} \times 74.6 \text{ g KCl}}{1 \text{ mol KCl}} = 466 \text{ g KCl}$$

b. If the student adds 1.4 L of H₂O what is the new molarity?

c. How many grams of KCl are in the solution from part b?

$$M = x$$
$$\text{mol} = 6.25 \text{ mol KCl}$$
$$L = 1.4 \text{ L} + 1.25 \text{ L} = 2.7 \text{ L}$$

$$M = \frac{6.25 \text{ mol}}{2.7 \text{ L}} = 2.3 \text{ M}$$

466 g KCl
b/c they
only added
water - not
additional
solute!

Solution stoichiometry

13. In the reaction to make silver nitrate (AgNO_3) how many liters of 1.3 M silver (Ag) are needed to react with 5.00 L of a 12.0 M nitric acid (HNO_3) solution?

$$X \text{ M} \Rightarrow X \text{ mol} = 1 \text{ L}$$



$$\begin{array}{l} ? \text{ L} \\ 1.3 \text{ mol} = 1 \text{ L} \end{array} \quad \begin{array}{l} 5.00 \text{ L} \\ 12.0 \text{ mol} = 1 \text{ L} \end{array}$$

g: 5.00 L HNO_3
w: ? L Ag
 $3 \text{ mol Ag} = 4 \text{ mol HNO}_3$

5.00 L HNO_3 soln.	12.0 mol HNO_3	3 mol Ag	1 L Ag soln.
		4 mol HNO_3	1.3 mol Ag
		= $\frac{180}{5.2} = \boxed{34.6 \text{ L Ag soln}}$	

14. A gas has a solubility of 12.4 g/L at 3.5 atm of pressure. What is its solubility at 1.7 atm of pressure?

Henry's Law

$$\frac{S_1}{P_1} = \frac{S_2}{P_2}$$

$$S_1 = 12.4 \text{ g/L}$$
$$P_1 = 3.5 \text{ atm}$$

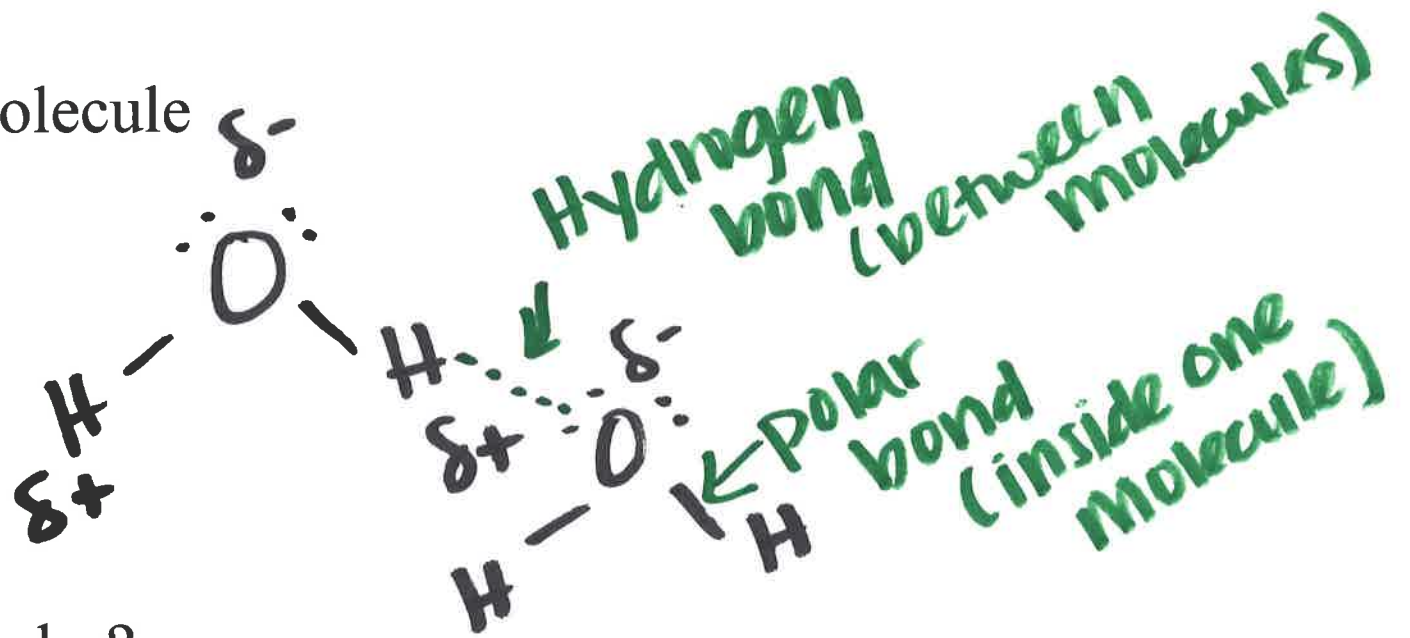
$$S_2 = x$$
$$P_2 = 1.7 \text{ atm}$$

$$\frac{12.4}{3.5} = \frac{x}{1.7}$$

$$21.08 = 3.5x$$

$$S_2 = 6.0 \text{ g/L}$$

15. Draw a water molecule



Is it polar or nonpolar?

Polar b/c of lone pairs on central atom

What is its shape?

bent

oxygen most electronegative!

16. Define and give an example of the following:

Suspension- heterogeneous aqueous mixture that settles out upon standing

Colloid- intermediate sized particles- don't settle out
example: liquid children's medicine, muddy water

Both of these exhibit the Tyndall effect. (scattering of light)

Brownian motion- constant, chaotic movement of particles in a colloid

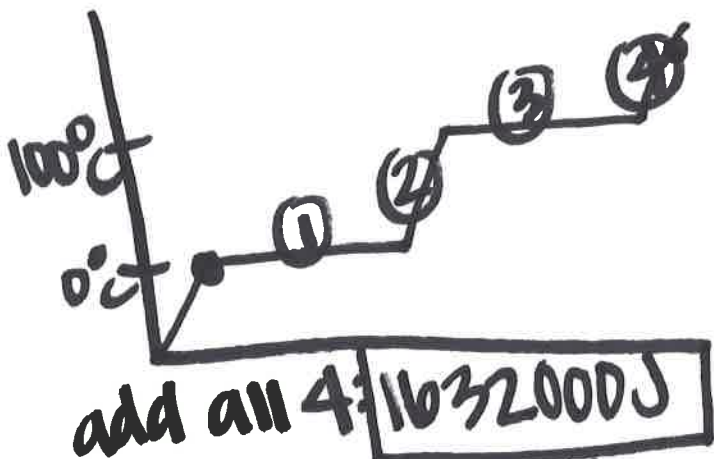
17. Emulsifying agents have one polar and one nonpolar end of the molecule.

Emulsions are a colloidal dispersion of liquids in liquids.

Examples: Emulsion: mayonnaise
Emulsifying agent: egg yolk
SOAP

$$m = 540 \text{ g}$$

18. How many joules are required to heat 12 ice cubes from 0°C to steam at 120°C if each cube has a mass of 45g ? Draw and label the heat curve. (FYI: You will need 4 steps to complete this problem 😊)



$$\textcircled{1} q = m H_f$$

$$m = 540 \text{ g}$$

$$H_f = 334 \text{ J/g}$$

$$q = (540)(334)$$

$$q_1 = 180000 \text{ J}$$

$$\Delta H_v: 2260 \text{ J/g}$$

$$\Delta H_f: 334 \text{ J/g}$$

$$C_{\text{water}}: 4.184 \text{ J/g}^\circ\text{C}$$

$$C_{\text{ice}}: 2.11 \text{ J/g}^\circ\text{C}$$

$$C_{\text{steam}}: 2.08 \text{ J/g}^\circ\text{C}$$

$$\textcircled{2} q = m c \Delta T$$

$$m = 540 \text{ g}$$

$$c = 4.184 \text{ J/g}^\circ\text{C}$$

$$T_i = 0^\circ\text{C}$$

$$T_f = 100^\circ\text{C}$$

$$\Delta T = 100^\circ\text{C}$$

$$q = (540)(4.184)(100) = 230000 \text{ J}$$

↑
final
ans.

$$\textcircled{3} q = m H_v$$

$$m = 540 \text{ g}$$

$$H_v = 2260 \text{ J/g}$$

$$q = (540)(2260)$$

$$q = 1200000 \text{ J}$$

$$\text{total: } 1632000 \text{ J}$$

$$\textcircled{4} q = m c \Delta T$$

$$m = 540 \text{ g}$$

$$c = 2.08 \text{ J/g}^\circ\text{C}$$

$$T_i = 100^\circ\text{C}$$

$$T_f = 120^\circ\text{C}$$

$$\Delta T = 20^\circ\text{C}$$

$$q = (540)(2.08)(20)$$

$$q = 22000 \text{ J}$$