2/4/2019

Q: Which has the highest mp ?

CH_3OH	mol	x
CaS	ionic	Ca^{2+} S^{2-}
NaCl	ionic	Na^+ Cl^-
CsI	ionic	Cs^+ I^-
H_2O	mol	x

Soln's

ex

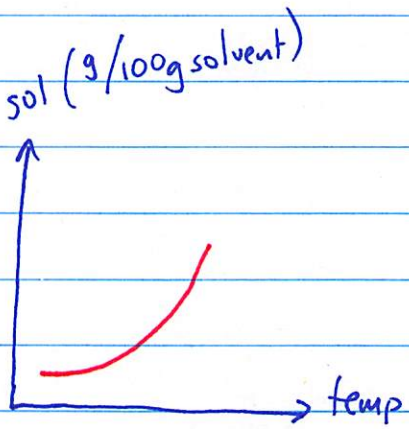
- Unsaturated (more solute can be dissolved) — $1 g\ NaCl / 100 g\ H_2O$
- Saturated (max " dissolved) — $36 g\ NaCl / 100 g\ H_2O$
- Supersaturated (> max solute, 'unstable')

Temp dependence of solubility (s) in (l)

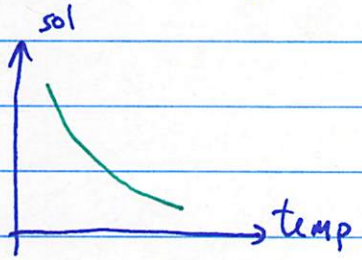
more/less

most solids are more soluble in liquids @ higher temp

wash hands in HOT water



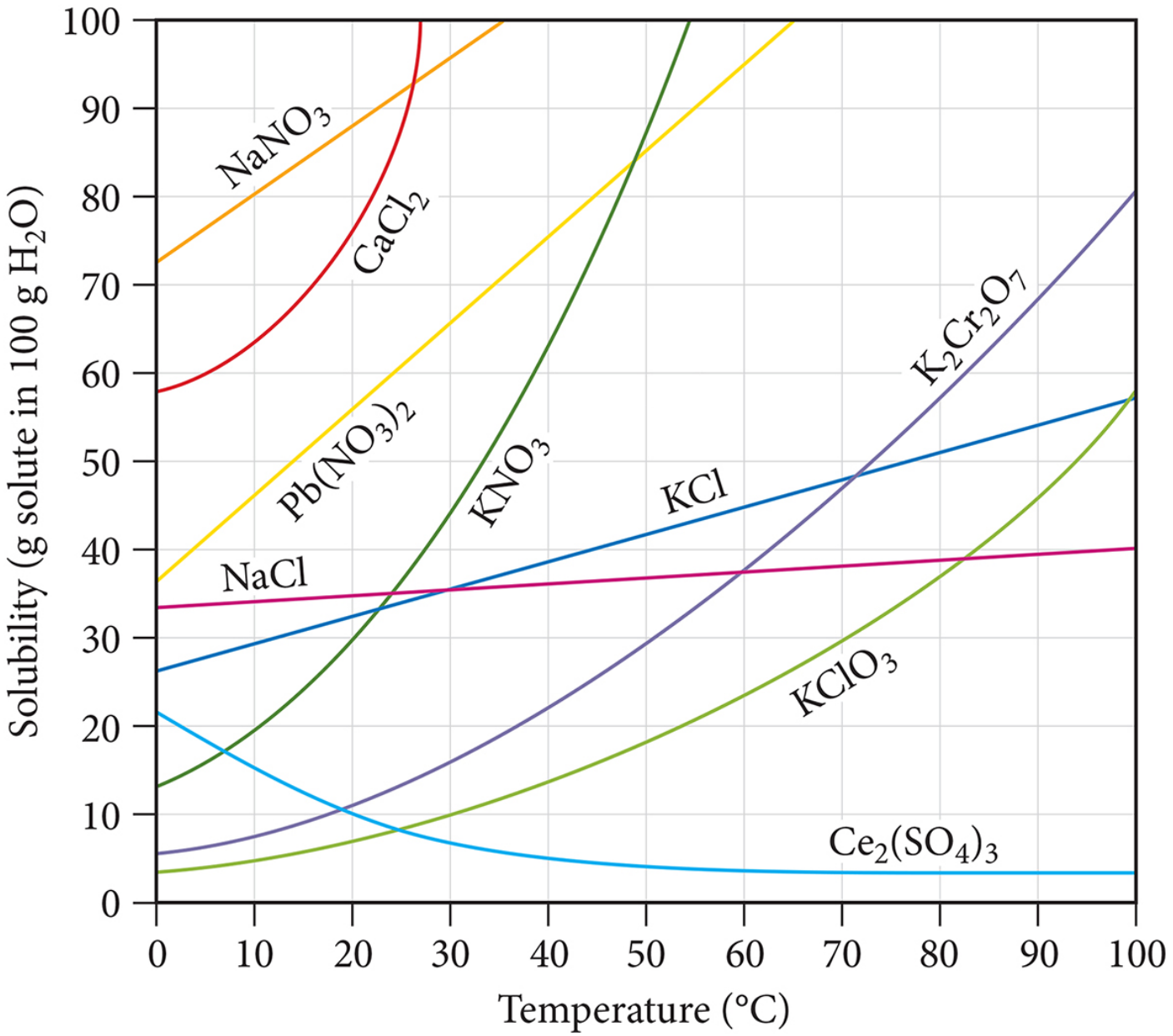
However, w/ gases ... most gases are less soluble in solvents (liq) as $T \uparrow$



Hot water: less $O_2(g)$ can dissolve

Cold water: more $O_2(g)$ can dissolve.

Most solids have an increased solubility
in liquids with increasing temperature,
but there are a *few* exceptions!

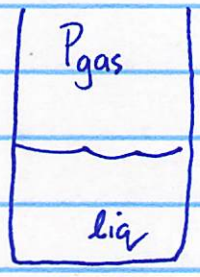


Cold soda pop

Warm soda pop

Unlike solids, gases have a *lower* solubility in liquids with increasing temperature! Warm “pop” tastes disgusting in part due to the lower solubility of the carbon dioxide gas (the “fizz”).

Effect of gas pressure above liquid + sol.



as $P_{gas}\uparrow$, $S_{gas}\uparrow$ ← solubility

Henry's Law: $S_{gas} = K_H \times P_{gas}$

K_H: Henry's law constant
- depends upon: gas
  temp
  solvent

O_2: $K_H = 1.3 \times 10^{-3}$ M/atm (H_2O, 25°C)

Q: what's sol. of O_2 in H_2O @ 25°C if P_{O_2} is 25atm.

A: $S_{gas} = K_H \times P_{gas}$, $S_{O_2} = 1.3 \times 10^{-3} \frac{M}{atm} \times 25 atm$

$= 0.033$ M (2s.f.)

$= 0.0325$ M

Breath — ethanol(g)

Blood — [ethanol]

$S_{ethanol} = K_H \times P_{ethanol}$

if we know K_H (ethanol in blood @ 37°C)
then we can solve for $S_{ethanol}$
if we measure $P_{ethanol}$ (Breathalyzer)

- legal limit, OH: 0.017 M
  (0.08%)

Ammonia gas (NH_3) has an incredibly large solubility in water, reflected by its large Henry's law constant. This is partially due to the fact that it hydrogen-bonds to water and so the solute-solvent IMFs are so strong (like-dissolves-like).

There's also a second reason for its incredibly large value… but we will have to wait to discuss it when we look at chemical equilibria. If you're curious, drop me an email and I will explain. :)

TABLE 13.4 Henry's Law Constants for Several Gases in Water at 25 °C

Gas	k_H (M/atm)
O_2	1.3×10^{-3}
N_2	6.1×10^{-4}
CO_2	3.4×10^{-2}
NH_3	5.8×10^{1}
He	3.7×10^{-4}

Expressing soln conc:

- Qualitative measures of conc.
(no #)

DILUTE - low amt solute

CONCENTRATED - high " "