

Worksheet 4.1: Solutions

Water's solvent properties

No.	Answer
1	a Ion–dipole bond b Hydrogen bond c Covalent bond
2	Glucose contains many more hydroxy groups that can hydrogen bond to water and thus increase solubility. Hexanol is largely non-polar.
3	Various answers possible. Examples include salt, sugars and amino acids.
4	Since ammonia has three polar hydrogens and only one lone pair, it can form an average of two hydrogen bonds with other ammonia molecules. Water has two polar hydrogens and two lone pairs, so it can form four hydrogen bonds with other water molecules.
5	Various answers possible. Examples include sodium, chloride, calcium, carbonate and sulfate.
6	$1.00 \text{ g mL}^{-1} = 1.00 \text{ kg L}^{-1}$ volume of seawater = $1.35 \times 10^9 \text{ km}^3 = 1.35 \times 10^{21} \text{ L}$ $m(\text{H}_2\text{O}) = \text{density} \times \text{volume} = 1.00 \times 1.35 \times 10^{21} = 1.35 \times 10^{21} \text{ kg}$ $m(\text{Br}^-) \text{ in mg} = \text{concentration (ppm)} \times \text{mass of 'solution' in kg}$ $= 67 \times 1.35 \times 10^{21} = 9.0 \times 10^{22} \text{ mg}$
7	The solubility of gases decreases as temperature increases.
8	The gases are mostly only weakly bonded to water, so the increased kinetic energy, of the warmer water molecules, easily breaks these bonds, allowing the gases to escape into the air.
9	Polar: NH_3 and HCl ; non-polar: O_2 and N_2 .
10	Increased polarity means increased solubility.
11	All can form dispersion forces with water. For O_2 and N_2 , these are the only intermolecular bonds present. NH_3 can hydrogen bond to water. HCl can form dipole–dipole bonds with water. (In fact, both NH_3 and HCl ionise in water—because they act as a base and an acid respectively.)
12	With water, NH_3 can form hydrogen bonds, but HCl only forms the weaker dipole-dipole bonds and in turn O_2 only forms dispersion forces.
13	N_2
14	The boiled water will contain little, if any, dissolved gas.
15	a $m(\text{CO}) = \frac{75}{100} \times 1.5 \times 0.002 = 0.00225 \text{ g}$ b CO is polar, while N_2 is not.
16	The hot water would not contain enough dissolved oxygen to support life.

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