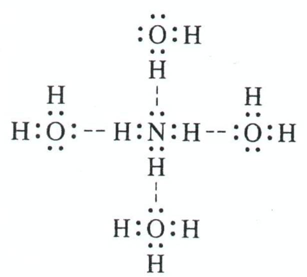
IMF

1\. 1. (a) London forces
(b) hydrogen bonding, dipole–dipole and London forces
(c) dipole–dipole and London forces
(d) hydrogen bonding, dipole–dipole and London forces
(e) dipole–dipole and London forces
(f) hydrogen bonding, dipole–dipole and London forces
(g) hydrogen bonding, dipole–dipole and London forces
(h) dipole–dipole and London forces
(i) dipole–dipole and London forces

2\.



The very high solubility of ammonia in water is due to the high number of hydrogen bonding sites (see diagram). Every ammonia molecule can hydrogen bond at least four times, as can every water molecule in the solution.

3\.
(a) 2-chloropropane should have low or medium solubility, because it is polar and water is also polar.
(b) 1-propanol should have high solubility, because it is not only polar but can hydrogen bond with water molecules.
(c) Propanone should have medium solubility, because it is quite polar, and so is water.
(d) Propane should have low solubility, because it is a nonpolar substance and water is polar.

4\.
(a) Bromine should have stronger intermolecular attractions. Both molecules are nonpolar but bromine has larger molecules with a greater number of electrons, so it should have the stronger London force.
(b) Hydrogen chloride should have stronger intermolecular attractions. Hydrogen chloride and fluorine are isoelectronic which means the London force should be the same. However, HCl has polar molecules so it should have additional dipole–dipole force.
(c) Ammonia should have stronger intermolecular attractions. Ammonia and methane are isoelectronic so the London force should be the same. Unlike methane, ammonia is polar and has hydrogen bonding. Ammonia therefore has additional attractions, dipole–dipole force, and hydrogen bonds.
(d) Water should have stronger intermolecular attractions. Both molecules are polar but hydrogen sulfide is less polar. Although hydrogen sulfide has a greater number of electrons and stronger London forces, water has hydrogen bonding. This is likely much more significant than the difference in London forces.
(e) Silicon tetrahydride should have stronger intermolecular attractions. Both substances are nonpolar and silicon tetrahydride has more electrons per molecule, so it should have more London force.
(f) Ethanol should have stronger intermolecular attractions. The two substances are isoelectronic which means the London force should be the same. Both are polar but ethanol has hydrogen bonding and chloromethane does not.

5\. Ethanol should have the greater surface tension because it has the stronger intermolecular attractions. Propane and ethanol molecules are isoelectronic so the London force is the same for both. There are no other intermolecular attractions between propane molecules because they are nonpolar. However, ethanol has additional dipole–dipole and hydrogen bonds between its molecules.

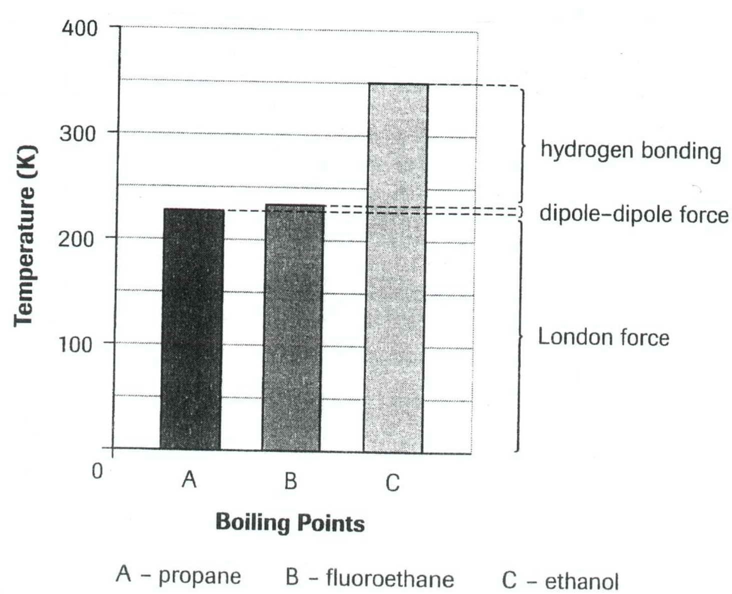
6\. The property that creates a meniscus curve is commonly called "surface tension," (but is more correctly termed "surface energy").This results because the molecules on a surface are attracted both sideways and downward, but not upward, by other molecules. This unbalanced attraction causes the surface to act as though it has a "skin" and can contain slightly more water than the level of the top of the glass.

7. A LeRoy radius for a molecule represents a theoretical boundary first calculated and used by Dr. R. J. LeRoy of Waterloo University. Within this boundary, the energies of molecular changes are primarily quantum mechanical and chemical (involving electron exchange energies) and beyond it, the energies of molecular changes are classic intermolecular (involving van der Waals forces). This theoretical boundary proved so useful to the scientific community that the term "LeRoy Radius" was coined to describe it.

8 Two liquids such as diethyl ether, $CH_3CH_2OCH_2CH_{3(l)}$, and butanol, $CH_3CH_2CH_2CH_2OH_{(l)}$, are placed in a beaker and a thin wire (or pin) is placed horizontally on the surface of each liquid. The independent variable is the substance; the dependent variable is the action of the wire; and controlled variables include the molecular size, polarity, and temperature of the substance, and mass and size of the wire or pin.
(Some variations include: other combinations of liquids with isoelectronic molecules, several different densities of wires of the same length to determine the mass supported by the liquid surface, measure the force required to lift a specific wire or disk from the surface.)

9 This experiment design is judged unacceptable because it does not stipulate or make clear that comparisons must be done for different liquids using the same kind of capillary tubes of equal diameters. As well, the design does not identify the variables for the experiment.

10 (a)



(b) Based on the boiling point graph for these isoelectronic liquids, London force contributes most to intermolecular attraction, hydrogen bonding is usually less significant (about one-half in this example), and dipole–dipole force is almost insignificant.