1. (a) Definitions can be found at the Illustrated Glossary of Organic Chemistry.

Melting is a phase change in which attractive intermolecular forces in the crystal lattice are disrupted and the substance moves to a less ordered liquid phase. In the case of NaCl, the crystal lattice forces that are disrupted are cation-anion attractions (i.e., ionic bonds).

Before melting
Solid phase; crystal lattice. High degree of order.

After melting
Liquid phase; less order.

(b) Evaporation is a phase change in which a liquid moves to the gas phase through disruption of noncovalent intermolecular attractions. Like melting, cation-anion attractions are disrupted when NaCl evaporates. (Because naked ions have strong electrostatic attractions, NaCl probably exists as ion pairs in the gas phase.)

Before evaporation
Liquid phase; close association of all ions.

After evaporation
Less order and less association than in liquid phase (not all ion pairs are shown).

(c) Dissolution is a process in which a solid, liquid or gas becomes homogeneously dispersed in another substance called the solvent. This process requires that the solvent-solute attractive forces overcome the solute-solute attractive forces. The process is diagrammed below.
Before dissolution

Na\(^+\) and Cl\(^-\) ions are strongly associated by cation-anion attractions in crystal lattice.

After dissolution

A shell of dozens of water molecules surrounds each Na\(^+\) and Cl\(^-\).

2. (a) CH\(_3\)F has a polar C–F bond whereas all the bonds in CH\(_4\) are of low polarity. CH\(_3\)F has dipole-dipole and London force intermolecular attractions whereas CH\(_4\) has only London force attractions. Therefore CH\(_4\) has a lower boiling point than CH\(_3\)F.

(b) CH\(_3\)F molecules cannot associate by hydrogen bonding (because they lack a hydrogen bond donor) whereas CH\(_3\)OH molecules can associate this way. Therefore CH\(_3\)F has a lower boiling point than CH\(_3\)OH.

(c) Sulfur is not sufficiently electronegative to give the attached hydrogen atom enough δ\(^+\) charge for hydrogen bonding. CH\(_3\)SH does not associate by hydrogen bonding whereas CH\(_3\)OH does. Therefore CH\(_3\)SH has a lower boiling point than CH\(_3\)OH.

Actual boiling point data: CH\(_4\) - 161° C, CH\(_3\)F - 78° C, CH\(_3\)SH 6° C, CH\(_3\)OH 65° C.

3. Each diol molecule has two OH groups that can donate and accept intermolecular hydrogen bonds. This accounts for the high boiling points of these compounds.

4. (a) Cellulose chains are associated by hydrogen bonding. A very simplistic view of this hydrogen bonding is illustrated below.
(b) A typical hydrogen bond is about 2–5 kcal mol$^{-1}$. A cellulose molecule consists of thousands of glucopyranose units, each with several hydrogen-bonding sites. Thus bonding between two cellulose molecules may be hundreds or even thousands of kcal mol$^{-1}$. 