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How to determine which compound has a higher melting point

$\begingroup$ Which of the following compounds has the highest melting point: $\ce{PCl5}$, $\ce{H2O}$, $\ce{NaCl}$, $\ce{SrCl2}$, $\ce{CaF2}$; In general, ion compounds will have higher boiling points than those of bipolar-bipolar interaction compounds. Thus, the compound above that will have the highest melting point will certainly be an ionic compound, either $\ce{NaCl}$, $\ce{CaF2}$ or $\ce{SrCl2}$. I thought I'd have to calculate the molecular weight, but that won't work, because the correct answer is $\ce{CaF2}$, and $\ce{SrCl2}$ has a higher molecular weight. Among ionic compounds, how can this be predicted with the highest boiling point? $\endgroup$ An ionic solid consists of positive ions (cations) and negative ions (anions) held by electrostatic forces in a rigid array or grid. The ion connection refers to the electrostatic pull between cations and anions. The physical properties of ion compounds are: ⚛ High melting points and high boiling points ⚛ ionic solids do not conduct electricity (they are insulators). ⚛ When molten (liquid) ion compounds electricity behavior. ⚛ When dissolved in water to form an aqueous solution ion compounds electricity behavior. ⚛ Hard ⚛ Fragile Please do not block ads on this website. No ads = no money for us = no free stuff for you! Physical properties of ion compounds: High melting point ion compounds have high melting points. The electrostatic pull (ion bond) between cations and anions is strong. It takes a lot of energy to overcome this attraction in order to allow ions to move more freely and form a liquid. The factors that affect the melting point of an ionic compound are: The burden on the ions. Size of ions. (i) Charging on ions Generally, the greater the charge, the greater the electrostatic pull, the stronger the ion bond, the higher the melting point. The table below compares the melting point and ion charges for two ion compounds, sodium chloride (NaCl) and magnesium oxide (MgO). Ionic Composite Melting Point (°C) NaCl Youth Charge Load (Na+Cl-) 801 +1 -1 MgO (Mg2+O2-) 2800 +2 -2 MgO has a higher melting point than NaCl because 2 electrons are transferred from magnesium to oxygen to form MgO while only 1 electron is transferred from sodium to chlorine in NaCl form. (ii) The size of the ions. Smaller ions can pack closer together than larger ions so the electrostatic pull is larger, the ion bond is stronger, the melting point is higher. The melting point of the group 1 metallic fluorides (alkalis) is compared to the radius of the cation in the table below. Ionic composite melting point (°C) Cation radius (pm) NaF 992 higher M.P. 99 smaller radius KF 857 ↑ 136 ☐ RbF 775 ↑ 148 ☐ Csf 683 lower M.P. 169 greater radius As the radius of cations increases under group 1 from Na+ to Cs+, its melting points Reduce. You know that, don't you? Join AUS-e-TUTE! Play the game now! In order for a substance to be able to exert electricity, it must contain movable particles capable of carrying a load. Ionic solid ionic liquid aqueous solution mobility of ions very poor good electrical conductivity very poor good Solid ion compounds do not conduct electricity because ions (charged molecules) are locked in a rigid grid or row. The ions cannot be moved from the grid, so the solid cannot conduct electricity. When heated, the ionic solid melts to form a liquid, or a melted, ionic compound. Ions in the melted, or liquid, ionic compound are free to move out of the mesh structure. When an electrical current passes through a melted ion compound: Cations (positive ions) move towards the descent M+(l) + e-→ M(l) Anion (negative ions) move towards the rise X-(l) → X + e - When an i the onic solid dissolves in water to form an aqueous solution: MX(aq) → M+(aq) + X-(aq) the ions are released from the grid structure and are free to move so the solution conducts the electricity just like the melted (liquid) ionic compound. Do you understand that? Join AUS-e-TUTE! Take the test now! Ionic solids are fragile. When an anxiety is applied to the ionic mesh, the layers shift slightly. The layers are arranged so that each cation is surrounded by anions on the grid. If the layers are shifted then the ions of the same charge will enter by. Ions of the same charge will repel each other, so the mesh structure breaks down into smaller pieces. Can you apply that? Join AUS-e-TUTE! Take the tests now! Switch to content The test ends at the melting point of a compound is the temperature at which the solid phase transitions to the liquid phase at a typical pressure of 1 atmosphere. The melting point of a compound is a natural property, such as solucity, density, color, and electricality that can be used to identify a compound. Determining the exact temperature at which a compound begins to melt is a difficult task; because of this, the melting point of the compounds is referred to as a range. The lower limit of the melting point range is the temperature at which the first drops of liquid are observed. The upper limit of the range is the temperature at which the entire solid phase has switched to the liquid phase. In the literature there are reference guides with acceptable values, which are used to identify compounds. The effect of cross-border forces on melting points An important factor affecting the melting point of the compound is the type of cross-border forces present within the union. The cross-border forces are attractive or repulsive between the molecules of a compound. In the solid phase, the molecules of a compound will form an organized grid structure as the molecules are packed close together. There are three main types of formulas forces: Hydrogen welding - Hydrogen welding is a type of intermolec molecular force that occurs due to the traction forces between an electroarnaric oxygen and a hydrogen atom. Therefore, for this type of cross-border force to exist, the compound must contain oxygen and hydrogen. Therefore, compounds containing hydroxyl groups, such as alcohols, easily form hydrogen bonds. Within the hydroxyl group, a dipole is formed as the most electronetic oxygen pulls the density of the electrons towards it, making the oxygen have a partial negative charge. This also leaves hydrogen with a partial positive load. Nearby electron oxygens are attracted by the partial positive charge, forming a hydrogen bond. Of the three types of cross-border forces, hydrogen welding is the strongest. Bipolar-Dipole Interactions – The second strongest type of intermolec molecular force, bipolar-bipolar interactions forms in molecules containing electron atoms such as oxygen, nitrogen, and any of the alhalides such as chlorine and fluoride. For example, a hydrocarbon molecule containing fluoride will form bipolar interactions. How? The electron atom fluoride will pull the electron density towards it, making it have a partial negative load. The connective atom, carbon, loses some of this electron density and thus gains a partial negative load. This is a temporary dipole in the fluoride-carbon bond. As contrasting charges attract, partially negative fluoride is attracted by the partially positive carbon of another neighboring molecule, forming a bipolar-bipolar interaction. London diaspora forces – This type of interaction is a form of van der Waals forces and is present in all associations. London's dispersal forces are the weakest type of cross-border forces. Like bipolar-bipolar interactions, there is a redistribution of electron density around the molecule, causing the formation of temporary loads. Unlike bipolar-bipolar interactions, the dipoles formed in London's dispersal forces are very weak and minimal. For example, non-polar compounds such as methane, ethane, pentane and octane interact through London's dispersal forces. The surface and length of the molecule determines the strength of attractive forces, so that compounds with more surface have greater London dispersion forces than smaller compounds. As a result, octane will have stronger London dispersal forces than methane. Each type of cross-border force has a different pull force. Therefore, compounds containing hydrogen bonds require more energy to break down attraction between molecules from a non-polar compound that has only London's dispersion forces. Thus, the presence of hydrogen bonds increases the melting point of a compound. The effect of impurities on melting points Reported bibliography values of melting points assumes that you have a clean sample of the in question. Often in the laboratory or in unknown samples, the samples tested are not pure compounds. Impurities cause the observed melting point of a mixture to be lower than the actual melting temperature of the pure compound. The observable range is greater than that of the pure substance. In a pure compound, the solid consists of a uniform and ordered structure and requires a certain amount of temperature to break the structure apart for the compound to transition to the liquid phase. In a mixture containing impurities, the solid phase consists of an disorganized structure. This requires much less energy to transition to the liquid phase, thus reducing the melting point. This phenomenon is known as melting point depression. The more impurities in the sample, the greater the range of the melting point and the lower the melting temperature. ✖ We use/store this information to ensure that you have proper access and that your account is secure. We may use this information to send you notifications about your account, institutional access, and/or other related products. To learn more about our GDPR policies click here. If you want more information about storing data, contact gdpr@jove.com. gdpr@jove.com.