

## Chapter 1 : Melting-point depression - Wikipedia

*For liquids it is known as the freezing point and for solids it is called the melting point. The melting point of a solid and the freezing point of the liquid are normally the same. Table of Boiling and Melting/Freezing Points at Sea Level (Standard Atmospheric Pressure).*

Our objective is to determine the melting point of an organic compound. The Theory What is the importance of knowing the melting point of organic compounds? The melting point is an important physical property of a compound. The melting point can be used to identify a substance and as an indication of its purity. The melting point of solid is defined as the temperature at which the solid exists in equilibrium with its liquid under an external pressure of one atmosphere. A pure crystalline compound usually possesses a sharp melting point and it melts completely over a narrow range of temperature of not more than 0. The presence of even small amount of impurities usually produces a depression in the freezing points and shows a marked increase in the width of the melting point range. What are the factors that affect the melting point? Size of the molecule Melting point is also used for the identification and characterisation of a compound. If the melting point of two pure samples shows a clear difference in melting points, it indicates that the two compounds must have different structural arrangements. If two materials have the same melting point, then they may not necessarily have the same structure. Consider the isomers n-butanol and t-butanol. Both have the same molecular formula  $C_4H_{10}O$ , but differ in their structure. Force of attraction between the molecules The force of attraction between the molecules affects the melting point of a compound. Stronger intermolecular interactions result in higher melting points. Ionic compounds usually have high melting points because the electrostatic forces holding the ions ion-ion interaction are much stronger. In organic compounds the presence of polarity, or especially hydrogen bonding, generally leads to higher melting point. Consider the following examples. The only force of attraction between butane molecules is weak Van der Waals force of attraction, so it has very low melting point. But in the case of methyl propionate, because of the presence of polar  $C=O$  group, the molecules are held together by dipole-dipole interaction. Therefore, its melting point is greater than that of butane. The melting point of sodium butanoate is higher than that of butyric acid because the attractive force in sodium butanoate is strong ionic interaction. Melting point of some common organic compounds Compound.

## Chapter 2 : h2g2 - Melting Points of Some Common Substances

*Iron - Melting Points of Binary Eutectic Alloys - Fe - Iron - binary eutectic alloys and melting points Latent Heat of Melting for some common Materials - Latent heat of fusion when changing between solid or liquid state for common materials like aluminum, ammonia, glycerin, water and more.*

Application September 20, , Serial No. It is, in a sense, a fractional solidification and separation by the aid of an emulsion whereby separation is facilitated. It is a continuation-in-part of my copending application, S. I I have discovered that I can obtain a highly effective separation of mixtures of materials having different melting points by forming an emulsion of said mixture with a non-solvent material and thereafter cooling said emulsion to such. In this casethe non-solvent surrounds the crystals or solid particles and the liquid particles and produces a free settling, free draining and freefiltering system, I then separate the liquids from the solids and thereafter separate out the non solvent material. I believe that myinvention is of rather gen. My present inventionrelates more particularly to the separation of mixtures of aromatic compounds such as a mixture of naphthalene and anthracene as well as mixtures of other similar products obtained in the distillation of coal tars. The invention-may also be carried out in the separation of mixtures of isomers such as a mixture of alpha and beta naphthols or their derivatives with water asthe non-solvent. In accordance with a preferred form of embodiment of my invention, as shown on the attached drawing, which represents a general or typical flow sheet, it will be noted that I conveniently provide a plurality of tanks I0 and II, in one of which I provide a suitable source of nonsolvent liquid which in many cases can be water, and in the other tank I provide the mixture of materials having different melting points. These tanks may be steam-jacketed if high. Predetermined quantities of the non-solvent and multiple melting point mixture are then intimately mixed as by proportioning pump I5, the streams being consolidated in the manifold I6 and introduced into mixer II. This mixer is of any suitable type of emulsifier or homogenizer, but I find that in many cases a rotary pump is adequate if provided with a by-pass I8 and a relief valve I9. It will be appreciated that by adjusting the capacity of the mixer II it will be possible to recycle the material through the mixer as many times as may be desirable so that the resulting material discharged through line 20 is suitably emulsified. I may find it desirable to add a gas through line 2 to the mixture ,in manifold I6 to aerate or otherwise expand the emulsion, and in some cases, I can use the gas to the exclusion of a liquid non-solvent material. I prefer to directly cool the emulsion as by the direct introduction of a coolant at 22 into the by-passline I8, where this is possible, otherwise indirect cooling may be applied satisfactorily. Both direct and indirect cooling may be used, if desired. I Having established a suitable emulsion with a large interfacial area between the crystallized material and the non-solvent, I am able to obtain a very high rate of separation in the liquidsolid separator Although this is indicated as of the centrifugal type, it may be either a dentrifugal filter, having a foraminous filter basket, or it may be of a clarifier type, having a solid bowl. It is, of course, in the contemplation of my invention, that the separator, the primary function of which is to separate liquids from solids, may be of any desired type, including pressure or vacuum filters of the continuous or other type, and having filter discs or a ,drum as may be desired. In some cases gravity settling may be practicable. In the preferred form of embodiment of my invention, and for some types of mixtures to be separated, I find a centrifugal basket filter, having a perforated, rotating basket lined on the interior with a foraminous filter medium, to be most effective. The cake formed is normally a fine-grained, free-filtering, porous type, and as the filtering force is gravitational by nature, the entire cake is submitted to the filtering force without an external crushing action. It is, of course, possible and usually desirable to wash such cake with a wash liquid from line 26, and such wash liquid will readily permeate the cake, and uniform drying and washing of the cake are thus possible. The wash liquid may be either a diluent for the liquid material of the emulsion, or a liquid which is inert and non-reactive therewith. In the method of dewaxing an oil asdisclosed in my patent, No. However, it may be preferable to use an inert and nonsolvent wash liquid as set forth in my patent, No. With the proper temperature control, the liquid that is removed from the filter cake is withdrawn through the line 25 either into the wash tank 21 or into the filtrate tank 28, each of which is suitably heated to assure continuity of flow. The

tanks 21 and 28 have discharge lines 30 and 3 and a steam condensate drain at The filter cake, which is the high melting point material; may be removed from the separator and placed in the tank 34 and heated so that the higher melting material may be withdrawn as a liquid at My process is applicable to the separation of mixtures of aromatic organic compounds whether such mixtures are customarily separated by distillation, crystallization, or other fractionation procedure or are ordinarily difficultly separable. Such a mixture may be composed of homologous or isomeric aromatic compounds, or the components of the mixture may be structurally unrelated aromatic compounds which have relatively close melting points or boiling points, for example. As an example of the application of my invention to the separation of a mixture of aromatic compounds of different melting points, I have separated a mixture of alpha naphthol and beta naphthol into fractions each respectively containing naphthalene is R. The particular mixture separated had a melting point of approximately F. The filtrate had a melting point of approximately F. Naphthalene and anthracene may also be separated from a mixture thereof by emulsifying the mixture with a suitable non-solvent liquid and chilling the resulting emulsion to a temperature at which the anthracene solidifies the melting point of anthracene is F. Separation of mixtures of other aromatic compounds such as mixtures of phenol melting point F. Mixtures of the chlorotoluenes melting point of ortho-chlorotoluene 34 F. In each case it is necessary only to select a suitable non-solvent, inert emulsifying fluid, whether liquid, gas, or both, whereby an at least temporarily stable emulsion is formed so that the desired separation can be effected in a centrifugal device or the like. The principal advantage of the invention is that the materials are separated by their melting points rather than by their boiling points, and constant boiling mixtures or tarry decomposition products caused by distillation are avoided. This method of emulsification with a non-solvent fluid is applicable to virtually all separations where fractional distillation or the like is now used. The process is far quicker and more economical than the usual methods of crystallization since it makes possible a better separation with truly continuous operation and accurate temperature control. In addition, the use of the process is not limited to the separation of crystallizable materials; for, with amorphous materials, it is possible to use a freezing and crystallizing nonsolvent liquid so that the resultant crystalline mass obtained upon cooling facilitates the desired separation. Where the freezing point curve of such a mixture has a eutectic or minimum point, it will be appreciated that the composition of the filter cake, whether composed principally of one substance. The method of separating a mixture of at least one of said components in greater concentration than in the initial mixture. The method of separating a mixture of at least two aromatic compounds having different melting points, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a non-solvent, non-reactive liquid, cooling said emulsion to a temperature such that at least one of the components of the initial mixture is partially solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to obtain a fraction containing at least one of said components in greater concentration than in the initial mixture. The method of separating a mixture of at least two aromatic compounds having different melting points, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that at least one of the components of the initial mixture is partially solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to obtain a fraction containing at least one of said components in greater concentration than in the initial mixture. The method of separating a mixture of at least two aromatic compounds having different melting points, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that one of the components of the initial mixture is partially solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to obtain fractions respectively containing alpha naphthol and beta naphthol in greater proportion than in the initial mixture. The method of separating a mixture of anthracene and naphthalene, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that one of the components of the initial mixture is partially solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to obtain fractions respectively containing anthracene and naphthalene in greater proportion than in the initial mixture. The method of separating a mixture of phenolic compounds, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a

non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that at least sion thereof with a non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that the material desired to be separated is solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to separate said solidified material from the remaining liquid. The method of separating a mixture of alpha and beta naphthols, which comprises maintaining said mixture in liquid condition, forming an emulsion thereof with a non-solvent, non-reactive liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that one of the components of the initial mixture is partially solidified, and thereafter effecting a liquid-solid separation of the chilled emulsion to obtain a fraction containing at least one of said components in greater concentration than in the initial mixture.

## Chapter 3 : Melting Points of the Elements - alphabetical and periodic table

*Boiling point - Documents giving boiling point of elements and different kind of chemical species at varying conditions; Related Documents. Alloys of Metals - Melting Points - Alloys of metals and their melting points; Boiling Points for common Liquids and Gases - Boiling points of some common liquids and gases - acetone, butane, propane.*

Application September 20, 1. This invention relates to a method for the partial separation of various melting point materials from mixtures thereof and more particularly to the concentration of higher melting point materials from lower melting point materials in a mixture thereof. It is, in a sense, a fractional solidification and separation by the aid of an emulsion whereby separation is facilitated. It is a continuation-in-part of my co-pending application, S. The principal object of my invention is to provide an improved method of separation of mixtures of materials which have separate melting points and of which at least one will solidify when cooled. Such separation of many materials is normally very difficult because of the tendency of the initially solidifying material to obstruct the flow of the liquid medium or the tendency of the liquid component to adhere to the solid matter. Filter rates, or settling rates are frequently very low, and therefore a liquid-solid separation is often impracticable. I have discovered that I can obtain a highly effective separation of mixtures of materials having different melting points by forming an emulsion of said mixture with a non-solvent material and thereafter cooling said emulsion to such a point that one of the materials to be separated becomes filterable or separable by liquid solid separation from the other. In this case the non-solvent surrounds the crystals or solid particles and the liquid particles and produces a free settling, free draining and free filtering system. I then separate the liquids from the solids and thereafter separate out the non-solvent material. As an example of the materials on which I have had considerable success, I have separated wax from lubricating oils to materially improve the cold test thereof; and I have also been able to separate crude scale wax or finished high melting point wax from slack wax while producing a relatively low melting point foots oil. In my prior copending application, I have noted that I can separate certain mixtures of animal and vegetable oils, the constituents of which have various melting points, and particularly mixtures of fatty acids such as a mixture of stearic and oleic acids and a mixture of linoleic and oleic acids with water as the non-solvent. A M resent invention relates more particularly tillate, aromatic hydrocarbon, or the like as the non-solvent. In accordance with a preferred form of embodiment of my invention, as shown on the attached drawing, which represents a general or typical flow sheet, it will be noted that I conveniently provide a plurality of tanks it and ii, in one of which I provide a suitable source of non-solvent liquid and in the other of which I provide the mixture of materials having different melting points. This mixer is of any suitable type of emulsifier or homogenizer, but I find that in many cases a rotary pump is adequate it provided with a by-pass l8 and a relief valve it. It will be appreciated that by adjusting the capacity of the mixer ll it will be possible to recycle the material through the mixer as many times as may be desirable so that the resulting material discharged through line Eli is suitably emulsified. I may find it desirable to add a gas through line 2i to the mixture in manifold iii to aerate or otherwise expand the emulsion, and in some cases, I can use the gas to the exclusion oi a liquid non-solvent material. I prefer to directly cool the emulsion as by the direct introduction of a coolant at 22 into the by-pass line iii, where this is possible, otherwise indirect cooling may be applied satisfactorily. Both direct and indirect cooling may be used, if desired. Having established a suitable emulsion with a large interfacial area between the crystallized material and the non-solvent, I am able to obtain a very high rate of separation in the liquid-solid separator Although this is indicated as of the centrifugal type, it may be either a centrifugal filter, having a foramlnous filter basket, or it may be of a clarifler type, having a solid bowl. It is, of course, in the contemplation of my invention, that the separator, the primary function of which is to separate liquids from solids, may be of any desired type, including pressure or vacuum filters of the continuous or other type, and having filter discs or a drum as may be desired. In some cases gravity settling may be practicable. In the preferred form of embodiment of my invention and for some types of mixtures to be separated, I find a centrifugal basket filter having a perforated, rotating basket lined on the interior with a foraminous filter medium to be most effective. This is rotated at such a speed that a high separating force is obtained, which

may be in the range of: The cake formed is normally a fine-grained, free-filtering, porous type; and, inasmuch as the filtering force is gravitational by nature, the entire cake is submitted to the filtering force without an external crushing action. It is, of course, possible and usually desirable to wash such cake with a wash liquid from line 26; such wash liquid will readily permeate the cake, and uniform drying and washing of the cake are thus possible. The wash liquid may be either a diluent for the liquid material of the emulsion, or a liquid which is inert and non-reactive therewith. In the method of dewaxing an oil as disclosed in my patent, No. However, it may be preferable to use an inert and non-solvent wash liquid as set forth in my patent, No. With the proper temperature control the liquid that is removed from the filter cake is withdrawn through the line 25 either into the wash tank 21 or into the filtrate tank 28, each of which is suitably heated to assure continuity of flow. If the quality of the material in the wash tank 21 is found to have substantial value, it can be conveniently recycled through the line 29 back through the multiple melting point mixture tank H. The tanks 21 and 28 have discharge lines 11 and 3 and a steam condensate drain indicated at The filter cake, which is the high melting point material, may be removed from the separator and placed in the tank 34 and heated so that the higher melting material may be withdrawn as a liquid at My process is applicable to the concentration and dehydration of aqueous solutions of the lower fatty acids. The concentration of aqueous acetic acid comprises an important application of my invention. By means of my process a high strength acetic acid solution or substantially water-free acetic acid can be obtained. The desired separation can be accomplished by suitably forming an emulsion of the aqueous acetic acid preferably with the aid of an acetic acid contacted liquid hydrocarbon as the non-solvent fluid. The liquid hydrocarbon non-solvent may comprise a petroleum distillate such as a light or heavy gas oil, an aromatic hydrocarbon such as benzol, or the like. Such a non-solvent should have a sufficient viscosity so that the resulting emulsion is at least temporarily stable and can be fed to a centrifugal device or the like to effect the desired separation; otherwise, if the non-solvent is not sufficiently viscous, the emulsion will break, and no separation can be effected. Upon separation, a free-filtering, porous cake is obtained. Recycling of the filtrate may be found desirable in order to obtain the desired purity and the maximum yield of acetic acid concentrate according to my process. Accordingly, it will be appreciated that the composition of the filter cake, whether composed principally of ice crystals or solidified acetic acid, will depend on which side of the eutectic point the composition of the starting mixture I falls. If a dilute aqueous solution is being concentrated, glacial acetic acid, for example, may be added to the solution when its composition approaches the eutectic so that the resulting solution can be further concentrated for the ultimate production of glacial acetic acid. Separation and concentration of aqueous solutions of other lower fatty acids including formic, propionic, and butyric acids and the like can also be accomplished in accordance with my invention. In each case it is necessary only to select a suitable non-solvent, inert emulsifying fluid, whether liquid, gas, or both. My process may also be applied to the concentration of an aqueous solution containing more than one of the lower fatty acids. While I have shown and described a preferred form of embodiment of my invention, I am aware that modifications may be made thereto; and I, therefore, desire a broad interpretation of my invention within the scope and spirit of the disclosure herein and of the claims appended hereinafter. The method of concentrating an aqueous solution of at least one of the lower fatty acids, which comprises forming an emulsion of such a solution while in liquid condition with a nonsolvent, non-reactive hydrocarbon fluid, cooling said emulsion to a temperature such that at least the highest melting point material partially solidifies, and thereafter effecting a liquid-solid separation of the chilled emulsion whereby a fraction is obtained containing at least one of said fatty acids in greater concentration than in the initial solution. The method of concentrating an aqueous solution. The method of concentrating an aqueous solution of at least one of the lower fatty acids, which comprises forming an emulsion of such a solution while in liquid condition with a nonf solvent, non-reactive hydrocarbon liquid and an inert, non-solvent gas, cooling said emulsion to a temperature such that at least the highest melting point material partially solidifies, and thereafter effecting a liquid-solid separation of the chilled emulsion whereby a fraction is obtained containing at least one of said fatty acids in greater concentration than in the initial solution. The method of concentrating an aqueous solution of acetic acid, which comprises forming an emulsion of the aqueous acetic acid while in liquid condition with a hydrocarbon liquid, cooling said emulsion to a temperature such that at least the highest

melting point material partially solidifies, and thereafter effecting a liquid-solid separation of the chilled emulsion whereby a fraction is obtained containing the acetic acid in greater concentration than in the initial solution. The method of concentrating an aqueous solution of acetic acid, which comprises forming h melting point material partially solidifies, andthereafter efecting a liquid-solid separation of the chilled emulsion whereby a fraction is ob tained containing the acetic acid in greater concentration than in the initial solution. The method of concentrating an aqueous solution of acetic acid, the proportion of acetic acid in which is lower than that in the eutectic, which comprises forming an emulsion of the aqueous acetic acid while in liquid condition with a hydrocarbon liquid and an inert, non-solvent gas, cooling said emulsion to.

### Chapter 4 : BBC Bitesize - KS2 Science - Melting metals

*The melting point of a pure substance is always higher and has a smaller range than the melting point of an impure substance or, more generally, of mixtures. The higher the quantity of other components, the lower the melting point and the broader will be the melting point range, often referred to as the "pasty range".*

All the materials around you can be described as solids, liquids, or gases. Melting Points Different materials melt at different temperatures. The chart shows the melting points of some materials you know. You might find some of these materials in your kitchen. Chocolate feels good to eat because it melts in your mouth! A material with a melting point lower than this will be a liquid. Olive oil and water are liquids at room temperature. Boiling Points Different materials also boil at different temperatures. Liquids such as milk and fruit juice are mostly water. This means they should boil at about the same temperature as water does. It is turned into a liquid. Heating an egg makes it turn from a liquid to a solid. This happens because the heat is changing the chemicals that the egg is made from. It is not the same as a change of state. Is Sugar a Solid or a Liquid? Solids have fixed shapes. Liquids flow and take the shape of the container you put them into. The surface of a liquid is flat. Sugar has some of the properties of a liquid. You can pour it from one container into another. It will take the shape of the container you put it in. It also has some of the properties of a solid. These can be pumped and sprayed, just like a liquid. Sugar also has some of the properties of a solid. You can make a pile of sugar. But it does not end up with a flat surface unless you smooth it out. Look closely at the sugar. You can see that it is made of tiny crystals. The crystals are solid. Solid materials sometimes act like liquids if the pieces are very small. Other solid materials that can act like liquids are salt and sand. Mixtures of States Many things around you are combinations of materials in different states. Some hairspray comes in a spray can. Hairspray is a mixture of tiny drops of liquid and a gas. The liquid is a chemical that keeps your hair in place. The gas helps spray the drops of liquid over your hair. A mixture with drops of liquid in a gas is called an aerosol. Fogs and mists are also aerosols. They are just clouds that reach the ground! Foam rubber is solid rubber with lots of air bubbles in it. Foam rubber is soft and squashy. It is used for cushions and toys. A foam cream on top of an emulsion milk. Some foods are also mixtures. Milk is a mixture of water and droplets of liquid fat. Mixtures of two liquids are called emulsions. Whipped cream is a foam of air bubbles in a liquid. Content on this website is from high-quality, licensed material originally published in print form. Paste the link into your website, email, or any other HTML document.

## Chapter 5 : What Makes Ice Melt Fastest? - Scientific American

*Different solids turn into liquids (melt) at different temperatures. This temperature is described as the melting point. Some solids are made up of molecules that bind together tightly and others are made up of molecules that bind together loosely - the tighter the binding, the higher the temperature needed to make them melt.*

Links Determination of Melting Point Determining the melting point of a compound is one way to test if the substance is pure. A pure substance generally has a melting range the difference between the temperature where the sample starts to melt and the temperature where melting is complete of one or two degrees. Impurities tend to depress and broaden the melting range so the purified sample should have a higher and smaller melting range than the original, impure sample. Fill a capillary tube with crystals about 3 mm high. Put the capillary tube open end down into the crystals and tap it on the bottom of the crystallization dish to get the crystals into the tube. Force the crystals to slide to the bottom of the tube using one of the following methods: Observe the melting process through the magnifying lens. This time, make sure that the increase in temperature is no more than 2°C per minute. Again, observe through the lens. A Fisher-Johns melting point apparatus. Place a lens cover in the circular well and scoop crystals onto the lens cover see Figure 2. Place another lens cover on top of the crystals and move the magnifying glass over the well. Set the temperature by using the dial and turn on the apparatus by flipping the switch. Watch the compound through the magnifying glass and record the temperature at which it melts see Figure 3. Crystals on the lens cover Figure 3. Compound after being melted Set up a ring stand with a bunsen burner which should be attached to a gas valve using rubber tubing, a ring above it, and wire gauze on the ring see Figure 4. Place a beaker of mineral oil on the wire gauze. Place a sample of the compound into a capillary tube and use a thin piece of rubber tubing as a rubber band to attach the capillary tube to a thermometer see Figure 5. Insert the thermometer through a hole in a cork, and clamp the cork to the ring stand as shown. The set-up for the procedure Figure 5. The thermometer with a capillary tube attached using rubber tubing Use the bunsen burner to heat the mineral oil slowly. Record the temperature at which the solid in the capillary tube melts. Make a homogeneous mixture of equal amounts of the unknown and the known substances. Grind them together using a mortar and pestle or a fire polished glass stirring rod and then fill a capillary tube with the mixture. Determine the melting point of the mixture. If the unknown sample is identical to the known sample, the melting point will remain unchanged. If the two samples are different, the melting point will be depressed.

### Chapter 6 : Melting Points - Heat & Cool Solids & Liquids - Science Games & Activities for Kids

*For most refractory materials, the melting point is, under specified conditions, reproducible and definite enough to be worth determining. Factors & Conditions Affecting Observed Melting Point Chemical Composition. It is evident that the chemical composition of a refractory material will affect, to a large extent, the observed melting point.*

All of these liquids look, smell and feel different. How do the melting, freezing and boiling points of liquids differ? What is it about them that does this? As many different liquids as you can find. A cooking or candy thermometer A small pot to use on the stove A freezer Notebook and pencil to record observations

**Experimental Procedure:** Note observations of each item at room temperature. Is it liquid or solid? Determine the freezing point if it is a liquid by placing it in the freezer with a thermometer inside. Check it every 10 minutes to see if it has solidified, and note the temperature when it has. Measure the melting temperature for each of the frozen items. For those that are solid at room temperature, slowly heat in a double-boiler a bowl inside of a pot with water at the bottom will work: Determine the melting point of each item. Heat each liquid in the pot until it just starts boiling. Measure the temperature with the thermometer. Record all results and make a chart comparing each liquid. Note which liquids have the highest and lowest points overall for freezing, melting and boiling. Note whether the lowest and highest points are the same items for freezing, melting and boiling. In addition, your access to Education. Warning is hereby given that not all Project Ideas are appropriate for all individuals or in all circumstances. Implementation of any Science Project Idea should be undertaken only in appropriate settings and with appropriate parental or other supervision. Reading and following the safety precautions of all materials used in a project is the sole responsibility of each individual. In this science fair project, kids observe the expansion of liquids when frozen and determine if some liquids expand more than others in the freezing process.

## Chapter 7 : Melting Point of Refractory Materials

*It is a continuation-in-part of my copending application, S. N. , filed May 18, , and entitled Separation ofv different melting point materials. 1 1.*

This holds true for materials as well. With the core of the planet being molten, the surface largely water, and even organic beings almost exclusively liquid in nature, the liquid state is a common state for matter of Earth. Melting is the process through which heat changes a substance from solid state to liquid state. Some substances are more easily converted than others and are said to have a lower melting point than those that require more heat to cause this change. These theoretical melting points are generally spoken of assuming an air-pressure equal to that at sea-level. Melting and boiling points change with increases or decreases in pressure. That is the reason that water does not turn to steam as easily in a pressure cooker or an autoclave. Water is the most common liquid state substance on the surface of the planet, but even metals can be easily found as liquids. Mercury is used in thermometers because of its ability to stay liquid at low temperatures and because of its high boiling point. True Metals are chemical elements that generally exhibit traits of high electrical conductivity, luster, and or malleability. When so combined, the result is said to be alloyed. These alloys take on interesting characteristics, unique to the proportions combined. Some alloys will actually melt at a lower melting point than either of their component substances alone. Lead typically melts at C and Tin at C. Most lead solders have either been outlawed or are avoided because of the toxic properties of Lead. For brazing joints, as in plumbing, Hard solder, is used. They melt at higher temperatures than the lead-tin variety, and turn back solid more slowly. Eutectoid Steel contains 0. This is a two-phase microstructure is found in some steels and cast irons. With that in mind, here is a potentially useful table of melting points, for common substances often used in soldering, brazing, welding and jewelry or shop craft, as applies on Earth at sea level.

### Chapter 8 : Melting Point of an Organic Compound. (Theory) : Class 11 : Chemistry : Amrita Online Lab

*Melting and boiling points change with increases or decreases in pressure. That is the reason that water does not turn to steam as easily in a pressure cooker or an autoclave. Water is the most common liquid state substance on the surface of the planet, but even metals can be easily found as liquids.*

**Introduction**[ edit ] The melting temperature of a bulk material is not dependent on its size. However, as the dimensions of a material decrease towards the atomic scale, the melting temperature scales with the material dimensions. The decrease in melting temperature can be on the order of tens to hundreds of degrees for metals with nanometer dimensions. Changes in melting point occur because nanoscale materials have a much larger surface-to-volume ratio than bulk materials, drastically altering their thermodynamic and thermal properties. This article focuses on nanoparticles because researchers have compiled a large amount of size-dependent melting data for near spherical nanoparticles. A normalized melting curve for gold as a function of nanoparticle diameter. The bulk melting temperature and melting temperature of the particle are denoted TMB and TM respectively. Experimental melting curves for near spherical metal nanoparticles exhibit a similarly shaped curve. Melting point depression is a very important issue for applications involving nanoparticles, as it decreases the functional range of the solid phase. Nanoparticles are currently used or proposed for prominent roles in catalyst , sensor , medicinal, optical, magnetic, thermal, electronic, and alternative energy applications.

**Measurement techniques**[ edit ] Two techniques allow measurement of the melting point of nanoparticle. The electron beam of a transmission electron microscope TEM can be used to melt nanoparticles. This method allows direct viewing of nanoparticles as they melt, making it possible to test and characterize samples with a wider distribution of particle sizes. The TEM limits the pressure range at which melting point depression can be tested. More recently, researchers developed nano calorimeters that directly measure the enthalpy and melting temperature of nanoparticles. A narrow size distribution of nanoparticles is required since the procedure does not allow users to view the sample during the melting process. There is no way to characterize the exact size of melted particles during experiment.

**History**[ edit ] Melting point depression was predicted in by Pawlow. Diffraction patterns changed from characteristic crystalline patterns to liquid patterns as the small particles melted, allowing Takagi to estimate the melting temperature from the electron beam energy.

**Physics**[ edit ] Nanoparticles have a much greater surface to volume ratio than bulk materials. The increased surface to volume ratio means surface atoms have a much greater effect on chemical and physical properties of a nanoparticle. Surface atoms bind in the solid phase with less cohesive energy because they have fewer neighboring atoms in close proximity compared to atoms in the bulk of the solid. Each chemical bond an atom shares with a neighboring atom provides cohesive energy, so atoms with fewer bonds and neighboring atoms have lower cohesive energy. The average cohesive energy per atom of a nanoparticle has been theoretically calculated as a function of particle size according to Equation 1.

*The boiling point of a substance is the temperature at which the vapor pressure of the liquid is equal to the surrounding atmospheric pressure, thus facilitating transition of the material between gaseous and liquid phases.*

Helium can only solidify at pressures above 25 atmospheres, which corresponds to a melting point of absolute zero. Melting point measurements[ edit ] Main article: Melting point apparatus Kofler bench with samples for calibration Many laboratory techniques exist for the determination of melting points. Any substance can be placed on a section of the strip, revealing its thermal behaviour at the temperature at that point. Differential scanning calorimetry gives information on melting point together with its enthalpy of fusion. Automatic digital melting point meter A basic melting point apparatus for the analysis of crystalline solids consists of an oil bath with a transparent window most basic design: The several grains of a solid are placed in a thin glass tube and partially immersed in the oil bath. The oil bath is heated and stirred and with the aid of the magnifier and external light source melting of the individual crystals at a certain temperature can be observed. The measurement can also be made continuously with an operating process. For instance, oil refineries measure the freeze point of diesel fuel online, meaning that the sample is taken from the process and measured automatically. This allows for more frequent measurements as the sample does not have to be manually collected and taken to a remote laboratory. Techniques for refractory materials[ edit ] For refractory materials e. For the highest melting materials, this may require extrapolation by several hundred degrees. The spectral radiance from an incandescent body is known to be a function of its temperature. An optical pyrometer matches the radiance of a body under study to the radiance of a source that has been previously calibrated as a function of temperature. In this way, the measurement of the absolute magnitude of the intensity of radiation is unnecessary. However, known temperatures must be used to determine the calibration of the pyrometer. For temperatures above the calibration range of the source, an extrapolation technique must be employed. The constants in this equation are not known with sufficient accuracy, causing errors in the extrapolation to become larger at higher temperatures. However, standard techniques have been developed to perform this extrapolation. In this technique, the current through the filament of the pyrometer is adjusted until the light intensity of the filament matches that of a black-body at the melting point of gold. This establishes the primary calibration temperature and can be expressed in terms of current through the pyrometer lamp. With the same current setting, the pyrometer is sighted on another black-body at a higher temperature. An absorbing medium of known transmission is inserted between the pyrometer and this black-body. The temperature of the black-body is then adjusted until a match exists between its intensity and that of the pyrometer filament. The absorbing medium is then removed and the current through the filament is adjusted to match the filament intensity to that of the black-body. This establishes a second calibration point for the pyrometer. This step is repeated to carry the calibration to higher temperatures. Now, temperatures and their corresponding pyrometer filament currents are known and a curve of temperature versus current can be drawn. This curve can then be extrapolated to very high temperatures. In determining melting points of a refractory substance by this method, it is necessary to either have black body conditions or to know the emissivity of the material being measured. The containment of the high melting material in the liquid state may introduce experimental difficulties. Melting temperatures of some refractory metals have thus been measured by observing the radiation from a black body cavity in solid metal specimens that were much longer than they were wide. To form such a cavity, a hole is drilled perpendicular to the long axis at the center of a rod of the material. These rods are then heated by passing a very large current through them, and the radiation emitted from the hole is observed with an optical pyrometer. The point of melting is indicated by the darkening of the hole when the liquid phase appears, destroying the black body conditions. Today, containerless laser heating techniques, combined with fast pyrometers and spectro-pyrometers, are employed to allow for precise control of the time for which the sample is kept at extreme temperatures. Such experiments of sub-second duration address several of the challenges associated with more traditional melting point measurements made at very high temperatures, such as sample vaporization and reaction with the container. Thermodynamics[ edit ] Pressure

dependence of water melting point. For a solid to melt, heat is required to raise its temperature to the melting point. However, further heat needs to be supplied for the melting to take place: Melting phenomenon happens when the Gibbs free energy of the liquid becomes lower than the solid for that material. At various pressures this happens at a specific temperature. It can also be shown that: