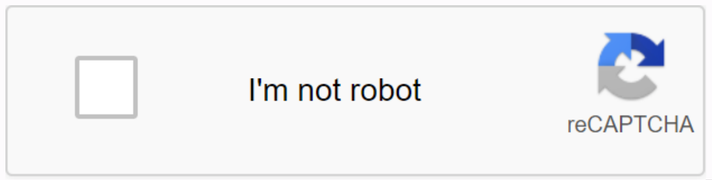

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Heating cooling curve worksheet chemistry

The learning goals are listed for state changes. Link a change in state to a change in temperature. How is it that steamships contain so much energy? During the time of Mark Twain (real name Samuel Langhorne Clemens, 1835-1910), the steamer was the primary means of transportation on the rivers and lakes of the United States. Twain himself was a steamer pilot on the Mississippi River for a period of time and took his alias from measuring the depth of the water (twelve feet, which was a safe depth for boats). Boats got their energy from steam - liquid water is converted into gas at high temperatures. The steam will push the pistons of the engine, causing the paddle wheels to turn and propel the boat. Heating curves Imagine that you have a rotten ice that is at -30 degrees Celsius, well below the melting point. The ice is in a closed container. As heat is steadily added to the ice gel, water molecules begin to vibrate faster and faster, absorbing kinetic energy. Eventually, when the ice warms up to 0 degrees Celsius, the added energy will begin to disintegrate into hydrogen bonds, which keeps water molecules in place when it is in solid shape. As the ice melts, the temperature does not rise. All the energy that is being put into the ice goes into the melting process, not any temperature increase. In the process of melting, these two states - solid and liquid - are in balance with each other. If the system had been isolated at that time and energy was not allowed to enter or leave, the ice mixture at 0 degrees Celsius would have remained. The temperature is always constant when the condition changes. Continued heating of water after the ice melts completely will increase the kinetic energy of liquid molecules and the temperature will increase. Assuming that atmospheric pressure is standard, the temperature will rise steadily until it reaches 100 degrees Celsius. At this point, the added energy from the heat will cause the liquid to begin to evaporate. As with the previous change in condition, the temperature will remain at 100 degrees Celsius, while water molecules go from liquid to gas or vapor. Once all the liquid is fully boiled, the continued heating of the steam (remember, the container is closed) will raise its temperature above 100 degrees Celsius. The experiment described above can be summarized in a graph called the heating curve (picture below): Figure 13.23 In the water heating curve, the temperature is shown as heat is constantly being added. Changes in condition occur during the plateau, because the temperature is constant. Changes in the behavior of the state of all substances can be represented by the heating curve of this type. The melting and boiling points of the substance can be determined by horizontal lines or plateaus on the curve. Other substances, of course, melting and boiling points that are different from Water. One exception to this exact form for heating will be for a substance such as carbon dioxide, which is sublime rather than melting at standard pressure. The carbon dioxide heating curve will have only one plateau at CO2 sublimation. The whole experiment can be run backwards. Steam above 100 degrees Celsius could be steadily cooled to 100 degrees Celsius, after which it would condense to liquid water. The water can then be cooled to 0 degrees Celsius, after which the continued cold snap will freeze the water to the ice. The ice can then be cooled to below 0 degrees Celsius. This can be a diagram in the cooling curve that will reverse the heating curve. Summary of Government Changes All state changes that occur between solid, liquid and gas are summed up in the chart in the figure below. Freezing is the opposite of melting and both represent a balance between solid and liquid states. Evaporation occurs when the liquid turns into gas. Deposation is the opposite of sublimation and both represent a balance between solid and gas states. Figure 13.24 Solid, liquid and gas states with conditions for each state change that occurs between them. Key Takeaways Summary State change can be caused by inserting heat into the system or removing it from the system. The temperature of the system will not change as long as the substance undergoes changes from solid to liquid or liquid to gas, as well as the reverse. You can experiment with pressure, temperature and phases using this change temperature, pressure and substance and record your observations. The questions are, what happens when the ice reaches 0 degrees Celsius? What is sublimation? What happens to steam if it cools to 100 degrees Celsius? Glossary condensate: the process of turning gas into liquid. The opposite of evaporation and both represent a balance between liquid and gas states. Deposition: The process of turning gas into a solid. The opposite of sublimation both represent a balance between solid and gas states. Evaporation: Occurs when the liquid turns into gas. The opposite of melting and both represent a balance between solid and liquid states. Gas: A state of matter that fills all available space. Liquid: The condition of the matter with a certain volume and takes the form of a container. melting: The process of solid transformation into liquid. Solid: a state of matter with a certain shape and volume. sublimation: a hard turn Gas. The learning goals are listed for state changes. Link a change in state to a change in temperature. How is it that steamships contain so much energy? During the time Mark Twain (real name Samuel Langhorn Clemens, 1835-1910), the steamer was the main means of transportation on the rivers and lakes of the United States. 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