Dear Ms. Majestica,

I am glad that we could be of help to you, and even more glad that the vendor is trustworthy and the world will get to see Lead Head McCann's dive into the jello. I am checking my mailbox daily, waiting for your ticket to arrive! For the meantime, though, I believe I can help you decide when it is best to pour the ice water into the hot jello.

Getting down to business (or rather calculus), your bowl holds 2112 gallons of jello (wow! Does the Jello company give you a good bulk price?). You mix the jello powder into 1056 gallons of boiling water, or half the capacity of the bowl. It takes five minutes to dissolve. Now you want to know when to add the 1056 gallons of cold water so that your electric bill won't be higher than the national deficit when you put the jello into the chiller three hours before the show.

I recommend that you pour the ice water into the jello shortly before you wheel the bowl into the chiller, and the simple reason is that the jello will have cooled down much in the open air, so when you add the ice water, the temperature of the jello will drop almost to the temperature of the chiller. This is true as long as the hot jello does not heat up the air inside the circus tent, the shape and glass of the bowl do not affect the cooling of the jello, and the temperature of the outdoor air is between freezing and boiling and the temperature of the ice water is right about at freezing. Do you have any high power fans to create some circulation in the tent?

I found mathematical reasons to support my answer on pages 513-515 in our calculus textbook, *Single Variable Calculus, Second Edition*, Hughes-Hallett Gleason, et al. My fellow calculus students Elizabeth Moyer and Karen Hippe aided me, as well as my professor, Dr. Annalisa Crannell, Ph.D, who patiently continues to straighten us out when we become kinked out of frustration over problems! I would really like for you to meet her some day; you two would probably have a lot in common. If you ever visit Lancaster, stop by and I will introduce you to her.
I will go about explaining my answer by first showing you Isaac Newton's Law of Heating and Cooling from our textbook, telling you how it works, and then I will apply it to your jello!

Newton did a lot more than play with apples - he found a way to describe mathematically how the temperature of an apple just taken out of a refrigerator rises. He also knew how to describe the way hot apple sauce cools down to room temperature when taken off the stove. What he actually said was that the hotter an object is relative to its surroundings, the faster it will cool down. So as the temperature of an object gets closer to the temperature of the surrounding air, it cools more and more slowly. The best way to picture the cooling of the object is by using a graph, which I have provided on the next page. There is a mathematical equation on page 514 of Single Variable Calculus if you would like to learn more about temperature change. By the way, as I am typing this I am waiting for a big mug of orange herbal tea to cool . . . yum . . .

We can use this graph to see how the temperature of the jello will be affected over time, including the way it would be affected if you were to put the cold water in right after the powder dissolves, halfway through the day, or right before you put the bowl in the chiller, as I suggested. What we are aiming for is for the jello to be as cold as possible before you put it in the chiller. What we expect will happen when you add an equal amount of cold water to an amount of warm jello is that the temperature will drop to halfway between the temperature of the warm jello and freezing, or the temperature of the cold water. It is also important to realize that if the jello is ever cooler than the outside air, it will warm up. We can use this to predict the graphs of temperature as time passes.

Graph of Cooling of an Object According to Newton's Law
Demonstration of Water Temperatures

One amount of cold water and an equal amount of hot water yields warm water at a temperature halfway between the cold and the hot.

Graph of Cooling of Jello as Affected by Addition of Cold Water
Notice that the blue line (where the cold water is added immediately before the jello is put into the chiller) shows the jello being the coolest when it is put into the chiller. So it is best for you to add the cold water then.

Good luck, Matilda! I am looking forward to the show. If you have further questions or problems in need of my help, I would be glad to be of assistance to you. Please give Snavely my best wishes.

Like the French say,
Avec toutes mes amitiés,

_Erin Anna Sipe_

Erin Anna Sipe
Orange tea Drinker extraordinaire, Franklin & Marshall College