

Name: _____

“Squishability” of Water Vapor

Working in small groups (2 or 3 people), solve as many of the problems below as possible. Try to resolve questions within the group before asking for help. Each group member should then write up solutions in their own words.

Estimate: The plot represents measurements on a kilogram of water vapor in an insulated piston (a cylindrical thermos with a moveable top).

Imagine a thermodynamic quantity, the “*squishability*”, which is the negative rate of change of the volume of a fluid as the pressure changes.

Pick a point on the plot and estimate the squishability of water vapor:

- (1) with *temperature* held constant
- (2) with *entropy* held constant

Need a plot P vs V with level curves for T and S , or one of the plots from the other activities.

Experiment: Design an experiment to measure the squishability of water vapor at constant *temperature* and describe your experiment precisely. What data would you collect and how would you use it to calculate the squishability?

Students should describe what they are going to change, measure, and hold constant and the physical method they would use for each of them.

In your experiment, what variables are you considering to be independent? What variables are dependent?

Students typically will say that the independent variable is the one that you change, and the dependent variable is the one that you measure. In thermodynamics, variables that are held constant are often considered independent. Because you may be able to perform the experiment again at a different constant value.

Explore: What would happen if you tried to measure the squishability with *both* temperature and entropy fixed? Alternatively, what would happen if you tried to measure the squishability in a container that cannot change size?

WCD: Does the squishability depend on how much water vapor you have? Yes - it is extensive. Note: we’ve invented squishability, but it is similar to *compressibility*, $-\beta = \frac{1}{V} \frac{dV}{dP}$, an intensive quantity.

Activity Evaluation

What was the main point of this activity?

Describe one thing you understand as a result of this activity.

Describe one thing that is confusing after completing this activity.