

Session G08: PER: Conceptual Inventories: Part 1

Location: Constitution DE **Time:** 2–3 p.m. **Date:** Tuesday, Aug. 5, 2025 **Moderator:** Harish Moni Prakash

G08-2: 2:12–2:24 p.m. Problem-Property Dependence of Student Responses to Thermodynamics Problems

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We analyzed interview data along with students' responses to multiple-choice assessment items in introductory thermodynamics to investigate the relationship between students' responses and the specific properties of the individual assessment items. These items incorporated a wide variety of problem types, designed such that 2-5 different problems all targeted the same physics concept; 13 different thermodynamics concepts served as the targets. The problems differed from each other by using diverse physical settings and scenarios, as well as various types of potentially distracting features. (Examples: gas compressions and expansions; isothermal, adiabatic, and isochoric processes; with and without PV diagrams; diagrams that display or do not display temperatures or process types explicitly.) Collectively, we refer to these different settings, scenarios, and features as problem "properties." We found numerous instances in which very minor changes in problem properties were associated with very large changes in correct-response rates even on problems that targeted identical concepts. Among our findings was that specific features of PV (pressure-volume) diagrams as well as specific terms such as "adiabatic" and "reversible" often triggered unproductive lines of reasoning, distracting students from the features of the problem most relevant to finding a solution. In general, students were prone to focus undue attention in predictable ways on the "most salient" variable (such as heat or work) while ignoring other variables that were essential to solving the problem. We discuss implications for instruction and offer suggestions for addressing these issues.