1 Instructor's Guide

1.1 Students' Task

Students observe the motion of a puck tethered to the center of the airtable. Then they plot the potential energy for the puck on their small whiteboards. A class discussion follows based on what students have written on their whiteboards.



1.2 Introduction

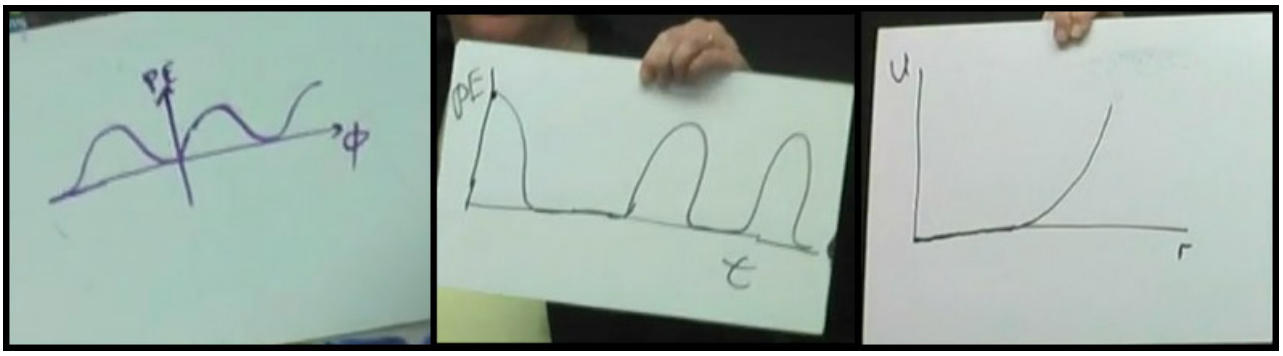
Students begin this activity by observing the motion of the puck on the airtable. The puck is pushed so that it passes close to, but does not strike, the pin in the center of the table. Students are asked to observe the motion of the puck. Then students are asked to respond, "On your small white board, make a plot of the potential energy." Don't give a more precise prompt.

1.3 Student Conversations

After students have made their plots, the class discusses a variety of student responses.

This question is deliberately ambiguous to encourage a diversity of answers. This elicits responses that reveal information about what the students think is important about what they observed and what they expect to be thinking about with this type of problem.

Since the question is worded ambiguously, students draw a variety of plots including:



- The most common example of potential energy that students see in an introductory course is gravitational potential energy, for which energy and height are proportional. Some students may need to think about the fact that they can plot potential energy on the vertical axis when the puck stays on the surface of the table.
- Many students will make a plot of U as a function of both r and ϕ.
- A few students will make a plot of U vs. time or angle.
- A number of students may plot the canonical variables (U vs. r) but will draw a parabola with the vertex centered at the origin, forgetting that the piece of thread means that there is constant potential energy out to some fixed radius. Only beyond that radius does the potential energy increase.

This activity is a good opportunity to remind students of the arbitrariness of the zero of potential energy.

After discussing several student responses, it is useful to ask the students whether or not they think the force acting on the puck is a central force and to justify their answer. This typically leads to a review of the properties of a central force.

1.4 Wrap-up

While confirming that many different representations are correct, and may be useful in certain circumstances, there is a conventional representation that is commonly used, with which they should be familiar.

It is important to mention that for central force problems, physicists typically write down the potential energy as a function of r since the force between the particles is only a function of the distance between them. Make sure that the students have the opportunity to see this graph and think about which parameters are shown.