Tutorial Instructor's Guide

Electrostatic Potential

<u>Equipment:</u> *None.*

I. In this part students recall key ideas about gravitational potential energy and apply those same ideas to electric potential energy.

A. Students usually answer these questions correctly. They often have trouble with #3 on their own, but #4 and #5 help them to correct themselves. The main issue is failing to recognize that some of the energy the astronaut gives to the rock might be kinetic, or mistakenly thinking that the formula *mgh* is universally appropriate for gravitational potential energy.

B. Students may have trouble with #3 – that is, they may agree with the statement, when in fact it's not the point in space that has potential energy but the object at that point in space. Try asking, *What if you had a heavier (or more strongly charged) object at the same point – would it have the same potential energy?*

<u>Checkpoint:</u>

C. This is hard for some students **and TAs.** Questions 2-5 help them assess their answer to question 1 and usually correct it. Initially, though, some feel that since the field lines are parallel there's nothing to "push against" and the potential energy would be equal everywhere. Others (students, not TAs) think it matters whether you're closer to the center of the diagram, making E different from D. In general the issue is with people trying to "read" potential energy from the geometry rather than recognizing its relationship to work, and therefore force. Questions to ask besides those on the worksheet: *What electric force would be acting on a charged particle at each point? If you moved from D to E would you be pushing against any force? What if you moved from F to D?*

<u>Checkpoint:</u>

II. In this part the students go from thinking about electric potential energy to electric potential.

A. – D. Students usually do well with these questions.

E. Students should be able to defend the idea that electric potential, unlike electric potential energy, is associated with a point in space rather than an object at that point, and explain how they know that. A good answer would be something like, "The electric potential tells you what the electric potential energy would be for each unit of charge that you put there. You could put any amount of charge there that you want; the electric potential would tell you what's going on electrically at that point in space."

F.

III. This part introduces electric potential "maps" (equipotentials).

A. Students find this part pretty easy.

Checkpoint:

B. People have a much harder time with this part. It is very tempting for them to treat the source as a point charge and therefore draw force arrows radially outward rather than perpendicular to the field lines. Have the TAs check this attentively (if students draw short arrows, it can be hard to tell from a glance which one they meant).

In general the analogy with gravity should serve students very well, and TAs should use that analogy as the basis for their questions, the way the tutorial does. However, students have trouble sticking to the analogy; instead, they slip into intuitions about electric phenomena, or just slip out of trying to make sense of the whole thing. Trying to help them see the parallels with gravity seems to be the most useful strategy.