

Problem Set 13: Planetary Motion and Energy Diagrams, Bohr Atom, Applications of Mechanics to Everyday Life

Design Engineering Challenge: “The Big Dig” 2.007 Contest Pneumatic Energy Storage *Concept*

For the Spring 2004 contest (“The Big Dig”, see <http://pergatory.mit.edu/2.007>) you have determined that the large plastic syringes can be compressed and stored just prior to the contest for use as air-springs. The goal here is to develop a strategy for storing the energy and then for releasing it. Assume you seal the end of the syringe and then compress it so the volume is reduced by a factor of four, and then when the contest begins, you want to use this stored energy:

1. Will the friction of the piston’s O-ring seal against the cylinder wall cause significant losses? Is there anything you can do to reduce these losses?
2. How can you estimate this loss, OR how can you design an experiment to determine how much energy you can store and use?
3. How much of the steady state stored energy do you think you can actually harvest and use? Hence what is the efficiency of the air-spring energy storage system?
4. Given all the above, how does the syringe air-spring compare to the constant force springs in the kit?
5. Do you think an “air-spring” would be a good way for automobiles to store energy that would otherwise be dissipated as heat in the brakes?