Two Stage vs. One Stage Rocket Problem

P.Chao, M. Yu

May 2015

This problem is slightly easy for a problem of the month because Patrick came up with it.

Problem: Consider two model rockets A and B, each of mass M and each carrying fuel of mass $2m$. Rocket A will use all of its fuel in one continuous burn and then continue forwards and be slowed down by gravitation until it reaches a final maximum height. Model rocket B is slightly different. It will use half of its mass of fuel in the first burn and then wait until it runs out of upwards momentum. Then, it will use the remainder of its fuel in a second burn and continue upwards until it reaches it maximum height as well. Find with proof which rocket goes higher? In addition, consider how this set up of a model rocket differs from how actual rockets are launched into space.

Assumptions: The fuel is ejected at the same rate for both rockets at all times. Ignore air resistance of course and assume the distance upwards which the rockets fly is negligible compared to the radius of the earth.