PH 221 Week 2

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This activity is Problem 22 of Chapter 2 from the *Student Workbook* for *Physics for Scientists and Engineers.*

Activity

A toy rocket is launched straight up with constant acceleration a. It runs out of fuel at time t.

(a) Is the rocket at its maximum height the instant it runs out of fuel? Explain briefly.

(b) What assumptions would you make in order to solve this problem?

(c) What is the name of motion under the influence of only gravity? How would you write the vector for acceleration due to gravity?

(d) Draw a motion diagram for this problem. You should have three identified points in the motion: launch, out of fuel, maximum height. We'll call these points 1, 2, and 3 to have consistent definitions.

- Using subscripts, define quantities: y, v_y, and t at each of the three points,
- Describe the acceleration a_1 during the interval from point 1 to point 2, and acceleration a_2 during the interval from point 2 to point 3.
- Identify each quantity as Unknown or Known:
  - Was it given numerically?
  - Was it given symbolically?
  - Can we reason that it must be zero?
  - Be careful with signs!

(e) Draw qualitatively accurate graphs of the acceleration vs. time and the velocity vs. time.

Suppose we want to know the maximum height of the rocket.

(f) This is a two-part problem. Use your knowledge of calculus and motion to write *kinematic equations* for the first part of the motion. Use the given (symbolic) values for a_1 and t_2 to determine—again symbolically—the two unknown quantities at point 2.

(g) Use your knowledge of calculus and motion to write similar *kinematic equations* for the second interval of the motion. Just write the equations; don't solve it yet.

(h) Now, substitute the known information from previous parts of the question into your equations from part (g). Find y_3 in terms of quantities given in the problem and the constant g.