Physics 122MA/Math 221PH
Spring 2002 Project 5 Name ______________________

Instructions: We encourage you to work with others in your assigned group on this project. You should write your solution neatly using complete sentences that incorporate all symbolic mathematical expressions into the grammatical structure. Include enough detail to allow a fellow student to reconstruct your work, but you need not show every algebraic or arithmetic step. It is required that you do your own writing, even if you have worked out the details with other people. All graphs should be done carefully on graph paper or drawn by a computer. This project is due at the beginning of class on Tuesday, April 2.

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1. *This is the infamous dreaded resistor cube problem.*

   (a) Section 21.3 problem 5, page 734.

   (b) Section 21.3 problem 6, page 734.

2. Consider the following problem: A business produces a product using two types of raw material. The quantity Q of product produced is related to the amount of the raw materials that are used. Let x denote the amount of the first raw material and y denote the amount of the second raw material. A common type of model for the relation between Q, x, and y is

$$Q = f(x, y) = Dx^a y^b$$

   where D, a, and b are positive constants determined by the specific nature of the product and materials. (Conditions under which this is a good model and reasonable values for these constants are questions you might study in an economics or business course.) One goal of the business is to maximize Q but, of course, there is a constraint on how much the business can spend on the raw materials. Let C (in dollars) be the total capital available for materials. Suppose the first material costs p dollars per unit and the second material costs q dollars per unit. The constraint can be expressed as

$$px + qy = C.$$

   Use the method of Lagrange multipliers to find the values of x and y that maximize Q subject to the given constraint.