

You receive an e-mail from your favorite cousin/uncle/sycophant/creditor.

Subject: Business Proposal

Dearest cousin/nephew/niece/to whom it may concern:

I have a brilliant—no, a CRAZY-BRILLIANT idea for growing pharmaceutical plants that will make us (me) fabulously wealthy. I won't tell you what I'm growing, but it may as well be money. *Money plants*. The plan is as follows: (1) Build a greenhouse. (2) Fill every inch of it with plants. (3) Maserati.

Now, with a normal greenhouse, only the plants on top would get sunlight, and the rest would wither and die. But I have a plan for a new type of greenhouse that will avoid that problem. We'll cover the walls with mirrors! Then light will reflect to every corner of the room, and no light will go to waste! It's a great idea and it's totally really going to work.

To ensure my success, I will use mirrors of the highest quality, normally only available for deep-space optical equipment: mirrors back-silvered with pure 24 karat gold! Now, I know what you're thinking: "OMG that's crazy—*crazy awesome*." You're absolutely right, but you're forgetting that it's also crazy expensive. And this is where you come in. I need you to help me design a greenhouse.

It will be a rectangular building, with a curved roof, sort of like this:



http://www.djc.com/stories/images/20090831/RedBarn_big.jpg

Ignore the windows, doors, & other architectural flourishes—just the walls and the roof.

Rare exotic woods will be used for the walls—probably an endangered species! ;) The walls will be covered with 22 karat gold-and-glass mirrors on the inside. The cost of the

mirrors, including installation, is \$500/square meter. The roof will be cheap plastic sheeting. I want to put 20000 plants in it, and I need one cubic meter of space per plant.

Design the greenhouse so that we minimize the amount of gold-covered surface area, and calculate the total cost of the mirrors.

But I have additional ideas about how the building might look. I want you to solve the problem for each of these cases:

1. Instead of a curved roof, use a “pitched roof”: two flat pieces that form an upside-down “V”. I want the building to be 15 meters tall, with the bottom of the roof 10 meters from the ground.
2. Again, use a “pitched roof”, but this time, I want the footprint of the building to be a 25 meter by 25 meter square. No restrictions about the height of the roof, though—you decide what is best (cheapest).
3. After you have finished your calculations, which of the two previous possibilities would you recommend? Please, if you think of any additional factors that I may have overlooked, please include them in your evaluation.
4. Now I want a greenhouse with a curved roof. Assume that the front edge of the roof forms a parabola. Beneath the parabola, we’ll have straight, vertical walls that are 10 meters high, and the horizontal distance between those walls should be 20 meters.

Part II

The wood is pretty expensive, too. It comes in rectangular planks, so with a curved roof, there will be some wood wasted.

Figure out how much wood will be wasted (using your answer from #4).

Wood planks are available in any length, but only in three widths: 2 meters wide, 1 meter wide, or 25 cm wide.

5. Find or estimate the smallest amount of wasted wood when using 2m wide planks. Do it again for 1m wide planks, and again for 25cm wide planks.
6. We might be able to custom-order wooden planks with whatever width we want. What width would reduce the waste to less than 1 square meter?

Instructor's addendum:

You haven't yet been taught the techniques needed to solve *all* of these problems yet, but you know enough to get started.

You can work with another student. Each pair of students submits one (shared) project.

This is a *writing project*. In addition to solving the problems, you must write a short report, giving your conclusions and explaining them in a way that the "farmer" can understand. (It seems like he hasn't taken calculus recently, if ever.)

Initial due date: November 4. This is worth 50% of the writing assignment grade.

Revisions: I will grade and return your assignments. You will get a chance to revise and resubmit your assignment—and depending on how quick you are, maybe more than one chance. With each revision *you must also re-submit the previous, already-graded, version*.

Each subsequent version must be a lot better than the last: all of my comments should be addressed, carefully and thoughtfully, and then you should proofread, etc. (If I don't think you've put much effort into it, I'll be angry, and I will give it back to you ungraded.)

Revision is a critical part of the writing process; the other 50% of the writing assignment grade will be for revisions. One exception: if you get an "A" on your original assignment, you get an "A" overall, and revisions are optional.

There might be a small bonus for particularly excellent writing projects.

IIT has a Writing Center in Siegel Hall.

The Writing Center is open M-F, with different hours for the different tutors. Sign-up sheets are posted on the faculty office doors of Siegel Hall Rooms 232 and 233. This fall the appointments have been filling up quickly but the tutors will make every effort to accommodate all students who wish to make appointments. The writing center tutors are all ESL trained, so they are especially good with students whose native language is not English, but they work with all graduate and undergraduate students in need of writing assistance.

As the writing center has been quite busy, you might ask your faculty to alert students who wish writing assistance not to wait until the last minute to try to make an appointment. Sessions are generally limited to 30 minutes, but students can come as many times as they wish.

If you take advantage of the Writing Center, let me know if it is helpful.