Dear Calculus Student,

Of course I am exceedingly distressed to discover that my engineer, Pete, was guilty of violating the law. As sorry as I was to get your letter informing me of his transgression, I must nonetheless thank you for your assistance in clarifying the situation for me. This is a most unfortunate blemish on the fine name of F.A.R. Trains, and I have accordingly fired Pete.

In the meanwhile, I am afraid I shall have to impose upon your good will once more for a bit of mathematical help. Perhaps I mentioned to you that I bought this railroad from a sucker man by the name of Walt Moss, the cousin of Officer Kovalevskia. Part of our agreement was that the F.A.R. Trains continue to transport his papier-mâché creations between the two cities of Shoe Chew and Sugar, in order that he can display them and attempt to sell them at craft fairs. This we have done, quite faithfully, in a specially designed flatbed rail car toward the back. We place the little baubles in a huge crate (8 feet high, 10 feet wide, and 16 feet long) on top of the flat bed car, and hook this car up to the passenger cars.

Nonetheless, Mr. Moss is beginning to make a nuisance of himself, complaining of breakage (although the breakage has been minimal) and also whining about terms of the agreement. My own interpretation is that he is in a snit because we had to terminate his son Pete, but he claims that the point of the matter is a little clause in the contract that says that the "center of mass of the crate" which we place on the rail car "shall be kept as low as possible." This is, of course, silly. Rail cars are exceedingly stable, and they almost never tip over. Nonetheless, Mr. Moss insisted on including this clause in our contract, as he is under the mistaken impression that it will help to minimize breakage.
This "low as possible" clause, frankly, I do not understand, and neither does Mr. Moss. That is, he pretends to know enough to make himself a blasted nuisance, but he cannot tell me exactly how to pack the stupid crate. Still, he is willing to accept your interpretation, as a neutral third party, about the best way to proceed. Your help will save us extremely expensive arbitration, so I hope that you can explain the matter to both of our satisfaction.

The crate itself weighs 736 pounds. I know enough to understand that the center of mass of the crate is exactly halfway up, at least if the crate is empty. The papier-mâché creations of the oh-so-artistic Walt Moss are very light: only 0.65 pounds per cubic foot, so that when the crate is filled to the top (as we prefer to pack it), the crate weighs slightly more than double its empty weight. And in this case, it is easy to see the center of mass must again be halfway up: 4 feet high.

If we do not fill the crates--say, if we pack the creatures in only halfway up--then of course we have to make more trips, which is expensive for us. After all, we only have two engines. But Mr. Moss claims that in this case, because the contents of the box are lower, the center of mass must be lower too. How much lower? He in his infinite wisdom cannot tell me. How high should I pack the crate so that the center of mass is as low as possible? He cannot tell me that, either.

So once again I turn to you. Could you please explain, in a way that would make sense both to the Rocket Scientist Moss, and also to a mere mortal like me, how high I can fill the crate?

The next shipment goes out October 24, so please get back to us by then.

Yours truly,

G. Olson Overby-Fitzpatrick

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