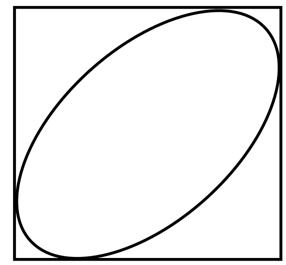
The textbook is always right!

1. The textbook states in problem 63 of section 3.6 (Implicit Differentiation) that $x^2 - xy + y^2 = 3$ is the equation of a "rotated ellipse." `Maple` and I both believe the ellipse looks like this:



What are the dimensions and the location of the box containing the ellipse?

Note: the sides are vertical and horizontal and also tangent to the ellipse. Maybe you could find the slopes of lines tangent to the ellipse and check which lines are either horizontal or vertical.

2. Example 2 in section 3.10 (Related Rates) analyzes the following problem:

> A ladder 10 ft long rests against a vertical wall. If the bottom of the ladder slides away from the wall at the rate of 1 ft/s, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is 6 ft from the wall?

a) The textbook response to this question is $-\frac{3}{4}$ ft/s. The minus sign means the top of the ladder is sliding *down*. Please check that the textbook's answer is correct.

b) The speed of sound at sea level is 340.29 meters per second. There are 3.280840 feet in one meter. Using the assumptions of this model, find the angle between the ladder and the ground at the time that the top of the ladder breaks the speed of sound.

c) The speed of light seems to be about 299,792,458 meters per second. There are still 3.280840 feet in one meter. Using the assumptions of this model, find the angle between the ladder and the ground at the time that the top of the ladder moves at the speed of light. Optional assignment: write a 500 page essay on the use of mathematical models.*

3. a) If you enter 5 in your 10 digit calculator, and then hit the square root button 20 times, you'll probably get: 1.00000 15348 and if you then subtract 1 and multiply by 1,048,576 you'll get: 1.60943 91475 but on the other hand, the same calculator will tell you that ln 5 is: 1.60943 79124 and I wonder, is this a coincidence? **Well, is it?** Hint: 1,048,576 is 2^{20}.

b) Suppose a is a positive number. Outline a strategy for computing $\ln a$ only with the "primitive" arithmetic operations $(+, \times, -, /)$ and square root $(\sqrt{})$. Your strategy should involve asserting (and verifying) that a certain sequence which can be easily computed with the listed operations always converges to $\ln a$.

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* Here is my favorite math story. Several people are in a hot-air ballon, trying to land over a fog-shrouded countryside at the end of a long day. The balloon dips low and they see the ground faintly. One of them calls down to the ground, "Where are we?" Some minutes later the wind is carrying them away and they hear faintly, "You're in a balloon!" One person in the balloon gondola says thoughtfully to the other, "It's so nice to get help from a mathematician." The other says, "How do you know that was a mathematician?" The first replies, "There are three reasons: it took a long time get the answer, it was totally correct, and, finally, it was absolutely useless."