STEP I 1998 Comments

Question 1

A nice question to get warmed up with. A classic counting question, with one or two subtleties to be careful of – treating the pairs containing a 0 separately, and remembering to include 100,000 in the count.

Question 2

The substitution to use is hopefully clear from the question. The actual algebra is surprisingly long and fiddly for question 2 in a STEP I paper I think. The final part should be straightforward applying the previous result.

Question 3

It's unusual to have four unrelated parts to the question. I think the trickiest is probably part (iii), and part (iv) required some care to ensure that statements such as the continuity of the function are included.

Question 4

I liked this, and it feels like a solid STEP I question. It's an interesting result too. The same result for the third powers will also hold for higher powers (that to maximise the perimeter you choose the rectangle with zero area).

Question 5

Very short! Both parts of this could also quite reasonably be asked in an A Level Further Maths exam nowadays. So – a gift of a question, I think.

Question 6

Trig identities always seem rife for some sort of sequence of identities like this. I think the hardest thing here is coming up with the general form for a_n and b_n – but working out a few more values by hand should make this easier.

Question 7

A bit of a strange one, this. There are a lot of constants floating around, and also a bit of difficulty to parse the information in the question to create some equations. Once that is done, with careful algebra work, the rest should follow.

Question 8

The information in the question about the fluid dynamics context is interesting but entirely not needed when trying to solve the problem! I'm not sure why it was included – possibly as some misdirection? Anyway, actually solving the differential equation is fairly straightforward, as are finding the constants and doing the final integration.

Question 9

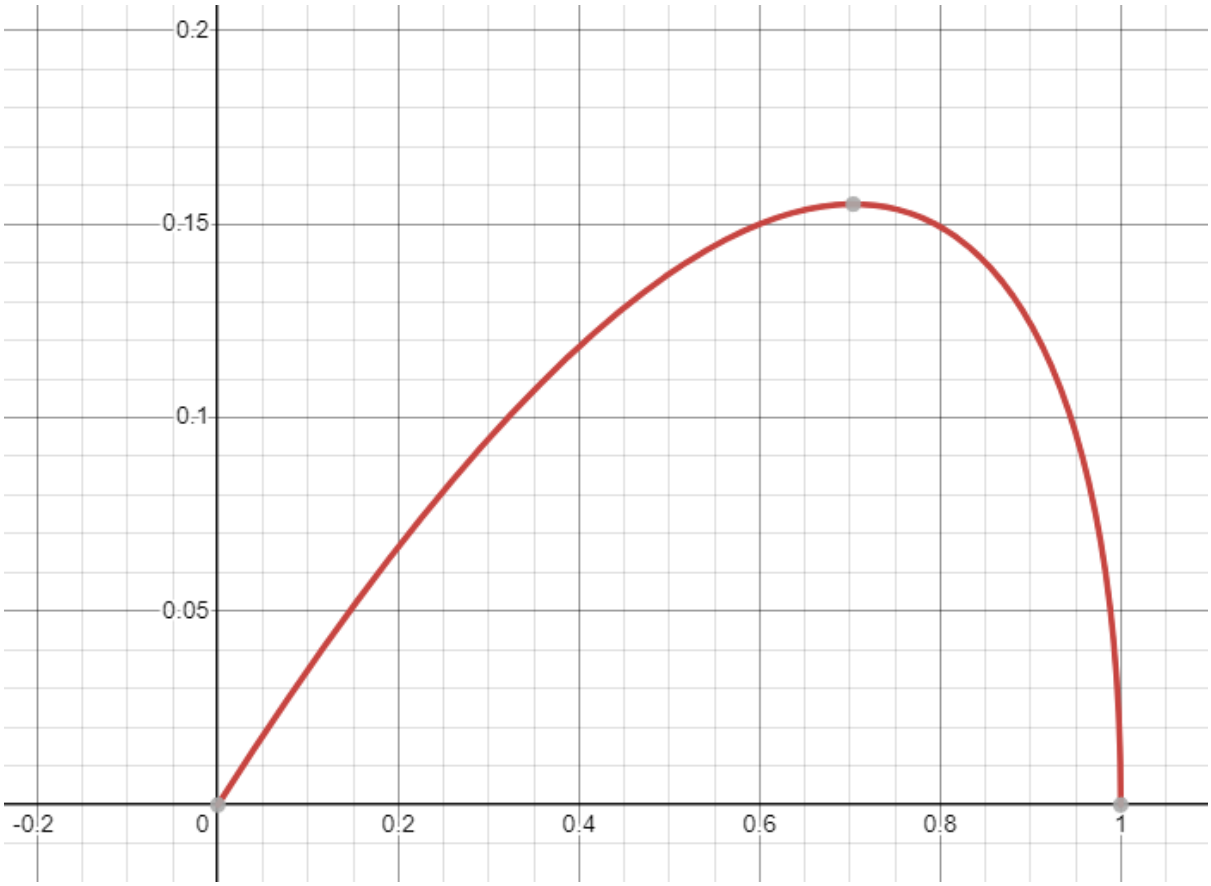
The context of the pendulums seems slightly odd, as after the initial explanation it can then be ignored and treated as a standard one dimensional collisions problem. Standard methods (made easier by the fact that the spheres have equal mass) then lead to the desired result.

Question 10

This style of projectiles question seems to come up every now and again – using the Pythagorean identity to eliminate sine and cos from the equations of motion. If you've seen it before, it's pretty doable, if not, then it is probably rather tricky.

Question 11

I like this one – it's a nice setup and the mechanics leads into a maximisation problem. You need to be careful to show that the maximum occurs at a stationary point and not at 0 or 1. In fact, the function looks like this.



Question 12

Quite tricky for STEP I I think, with a few subtleties with the counting to take care of. Figuring out how many pairs of values Y and Z can take based on the value of X is key here.

Question 13

A lot of algebra to fight through here! If you can get the first expression right, the rest is just persistence and confidence that you are doing the right thing.

Question 14

Another question which feels slightly too much for STEP I – all off the probability and statistics questions on this paper felt like that to me. Anyway, as is often the case a good diagram is important to find the first probability. To find the expectation at the end you need to notice that you still have a binomial expansion after including the 2^k.