STEP II 1995 Comments

Question 1

Not bad. The link between the first two parts and the final part of the question felt a bit tenuous, the only similarity being diving the problem into the even and odd case for n. Nothing too tricky, I don't think.

Question 2

Quite tricky, I think. Not particularly long with no difficult algebra but it requires some careful thought to connect the different r and s. It seems a bit of a shame that the solution for r_n is given rather than being able to derive it but I can't see a straightforward way to do that.

Question 3

Quite different form usual! It felt more like a logic puzzle than a maths problem. It's one of those questions that you can do very quickly if you try the right things or could be staring at for ages trying to figure out what to do!

Question 4

A nice question, leading to a nice result. I think perhaps giving the method to do the integration is a bit kind, as I would expect that it is something spottable. Sketching the graph requires some thought, but all the values are between 0 and 1 so increasing the value of n pulls all the points closer to the x axis.

Question 5

Quite short, which is nice. It all seems quite straightforward, up until when you have to justify that option c will never be used. Actually trying to solve some inequalities would be very hard as you have $\sin\frac{\theta}{2}$ and θ in there. The final sentence of the question suggests there might be another way to prove that this option is never optimal, which is indeed what we need to do.

Question 6

I have no strong feelings about this one. A reasonable amount of algebra to get through and confidence needing dealing with roots of unity. Spotting the solutions for A and B should be OK if you are looking for it. You can also eliminate B to find the value of A which will take slightly longer.

Question 7

I really liked this one. Heron's formula is not really taught in schools (because there are not many situations where it is particularly useful) but it's quite neat and this is a nice proof of it. I worked backwards from the answer a couple of times – this was fine mathematically as each step was an "if and only if" argument but a bit unsatisfying. I couldn't see any ways to proceed in the other direction.

Question 8

No big leaps of intuition to make here, but quite a lot of algebra to work through. When I first got the solution to the first differential equation, I thought I had made a mistake as the answer wasn't in the form specified in the question. But a bit of algebra and I got where I needed to be.

Question 9

A reasonably straightforward statics question. I don't know if I needed to keep track of the friction at both Y and Z all the way through, but they do end up giving the same value which is reassuring! I liked the last bit of the question which is a nice reassurance that you have got the hard bit correct.

Question 10

Very doable, and also I think you can tell from the question that it will be doable. There is quite a bit of algebra to be careful with, but you are just following a procedure – if there were numbers instead of letters, this could be a fair A Level question.

Question 11

Yuck! I ploughed through a lot of algebra on this one. No great leaps of intution but a lot of places to slip up! I suspect a more efficient method might be to combine the differential equations for both of the particles to solve for $x_1 - x_2$. When I subtracted the two displacements at the end a few things cancelled out so this would have happened earlier on.

Question 12

This is a fairly standard problem in probability, although the precise probability of each player hitting can vary. The bun-throwing is the more family friendly version – usually it's an actual duel. It's a neat result that seems counterintuitive at first, but if Algernon shoots to miss, then he probably gets the first shot once it goes down to head-to-head.

Question 13

A nice problem, although it is unsatisfying to not be able to give an explicit formula for k at the end. I perhaps could have included some explanation for where v_0, v_1, v_2, v_3 come from but the question just says "write down" so I think my answer is OK.

Question 14

I liked this one – it requires a good understanding of what is actually going on when you perform a hypothesis test, rather than just being able to use standard methods. I thought it was a bit generous giving you that $E(Z^4) = 3$ – this is not a hard result to establish using intergation by parts, but it saved me some time.