

## STEP II, 2011, Q8 EC

**Q8** This was the least popular of the pure maths questions, probably with good reason, as it included a lengthy introduction *and* a diagram. In the first part, despite showing candidates that the point where the string leaves the circle is in the second quadrant, the necessary coordinate geometry work provided a considerable challenge. The second part, finding the maximum of  $x$  by standard differentiation techniques, proved to be relatively straightforward and a lot of candidates managed to get full marks for this work. The third part presented the core challenge of this question, in the sense that not many candidates seemed to have understood how to set the limits of the parametric integral, and '*benefit of the doubt*' had to be fairly generously applied to those who switched signs when it suited them. The next part of the question involved applying integration by parts in order to evaluate the integrals but surprisingly few candidates managed to do so entirely successfully. Some of the common issues were the signs, that now needed to be fully consistent, and the application of parts twice after using double-angle formulae. The notion of the "total area swept out by the string" was also not so well understood, with only a very few realising that they needed to integrate from  $t = 0$  to  $t = \frac{1}{2}\pi$  as well. Most remembered to subtract the area of the semi-circle though.



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