STEP II, 2020, Q2 EC

This was a popular question and candidates in general achieved good marks. Most candidates approached part (i) with reasonable confidence and followed the question's intended path of separating variables and integrating directly. Of these, the majority failed to consider the integral of $\frac{1}{x}$ as $\ln|x|$. This was entirely understandable for work on C1 as the question specifies that it lies entirely in the first quadrant. While $\ln(xy)$ was okay to deal with in the case where both x and y were negative, it would be good for candidates to be clear about the way in which the modulus function is being dealt with here.

Around 1 in 5 candidates took the alternate route of differentiating the given answer to show that it fitted the differential equation in the question. Unfortunately, not only is this much more demanding work, but almost all such attempts failed to realise the need to check the initial condition $x = y = 1$ as part of the solution. Candidates should be clear about the distinction between "show" and "verify" in such questions.

In part (ii), the sketching of two fairly straightforward functions caused unexpected difficulties when it came to putting them together suitably on the same diagram; it was important to show that the two curves intersect twice and many sketches failed to have them crossing more than once, if at all. This made the subsequent reasoning and sketch of C1 very awkward. Even for those who got this far entirely successfully, it was a common problem to find the sketch of C1 drawn without the helpful guidance supplied within the question and any results arising from correct working to date. In particular, it was important for candidates to demonstrate the symmetry in the line $y = x$ and the restrictions provided by the lines $x + y = 2$ and $x + y = 4$, all of which really should have appeared on the diagram.

Many attempts petered out by the time of part (iii), and very few candidates attempted to consider a graphical method (directly analogous to the method promoted in part (ii)) to show that the curve of C2 was constrained by the line $x + y = -2$. By the time they came to draw this second solution to the original differential equation, many candidates had forgotten either or both of the given bits of information; namely, that there was symmetry in $y = x$ and that C2 existed only in the 3rd-quadrant. Many candidates just assumed that C2 was the reflection of C1.

Candidates should be advised not to attempt to sketch curves by plotting points, as was seen in a number of cases. Instead, the information established in earlier parts of the question should be used to ensure that the key points are marked and that the shape is correct.

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