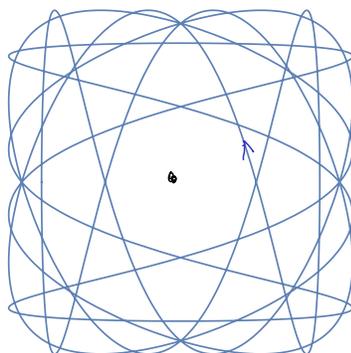


Comprehension questions

PROBLEM 12.1. *What's the winding number of this loop around the dotted point? (Here, you can assume that the loop proceeds in the obvious way indicated in the picture, and goes around its image once.)*



PROBLEM 12.2. *Write down the formula for a smooth loop whose image in the plane is the interval $\{-1 \leq x \leq 1, y = 0\}$.*

PROBLEM 12.3. *Given a loop $c(t)$ with period T , define another loop with the same period by $d(t) = c(-2t)$. How are the winding numbers of c and d (around any point) related?*

PROBLEM 12.4. *Compute the winding number of $c_s(t) = (\cos(t) - s, \sin(t))$ ($T = 2\pi$) around the origin, for all values of the parameter s for which that winding number is defined.*

PROBLEM 12.5. *What's the winding number of the loop $c(t) = (\cos(10 \cos(t)), \sin(10 \cos(t)))$ ($T = 2\pi$) around the origin? (Hint: if the formula in an otherwise simple problem looks crazy, that's probably because only its overall form is relevant to the answer, while the details aren't.)*

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