Suppose you don’t know anything about $D \subset \mathbb{R}^2$, but I tell you that there is a vector field $\mathbf{F} = \langle P, Q \rangle$ with $Q_x - P_y = 0$, but which is not conservative.

What can you say about $D$?

(a) It must be all of $\mathbb{R}^2$.
(b) It must be simply connected.
(c) It must not be simply connected.
(d) It must be bounded.
(e) I can’t say anything.
The underlying math:

The more holes that $D$ has, the more different vector fields $\mathbf{F}$ we can find which are not conservative but still satisfy $Q_x - P_y = 0$.

So “counting” these vector fields tells us how many holes are in $D$.

Going up one dimension, look at $D \subset \mathbb{R}^3$:

- We count vector fields which are **irrotational** ($\text{curl} \mathbf{F} = 0$) but not conservative.
  This tells us how many “one-dimensional holes” are in the solid $D$.

- We also count vector fields which are **incompressible** ($\text{div} \mathbf{F} = 0$) but not irrotational.
  This tells us how many “two-dimensional holes” are in the solid $D$.

This is called studying the **cohomology** of the space $D$, and is a technique used in **topology**.
Announcements

- Final exam is this Friday.
  - Locations have been posted on the final exam webpage. Please read carefully, as they are different from the previous assignments.
- Grades on Moodle.
  - I will try to upload all i-clicker scores (as well as excused absences) this week, or over the weekend. **I will post an announcement on the course webpage once I have done so.** If you see this announcement, but you think one of your grades is missing or wrong, please email me as soon as possible. If you don’t see the announcement, hold tight.
More announcements

- Office hours/review session this week:
  - Extra office hours Wednesday evening (5–7pm—it’s fine with me if you bring your dinner). AH 443
  - Extra office hours Thursday 12–12:50pm. AH 314
  - Also office hours on Friday 9:30–10:30am. AH 341
  - Come with questions (or you can listen to other people’s questions). You can also post questions in advance on Piazza (there’s a folder called “questions-for-review-sessions” or something like that).
  - Please bring your i-clicker.
  - You can bring food. Don’t bring nuts, peanuts, or fish. Do clean up after yourself.

- TA help room—AH 147.
  - Wednesday: 4–8pm.
  - Thursday: 12–8pm. (AH 445 and 447)
  - Friday: 11am–3pm. (AH 445 and 447)
Please change your selection to describe your feelings about the problem as we go.

(a) I’m following.
(b) Wait, I got lost on that step!
(c) That sort of made sense, can you explain it again?
(d) I don’t understand, but your explanations aren’t helping right now, so I think you should move on. I understand that this means that I should try to figure this out after class. I understand that there are resources available to me, such as

- reading the textbook, looking through lecture notes and old worksheets
- coming to office hours (Wednesday! Thursday! Friday!)
- coming to the TA help room (Wednesday! Thursday! Friday!)
- asking a friend
- asking on Piazza

I understand that if I don’t take responsibility for my learning, and a similar problem shows up on the final, I may regret my inaction.

If you’re not paying attention, don’t bother clicking any buttons.