Middlebury College

Multivariable Calculus: Spring 2018

Homework

Due March 2, 4pm

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Some thoughts and advice:

- You should expect to spend at least $1-2$ hours on problem sets. A lot of practice problem-solving is essential to understand the material and skills covered in class. Be organised and do not leave problem sets until the last-minute. Instead, get a good start on the problems as soon as possible.
- When approaching a problem think about the following: *do you understand the words used to state the problem? what is the problem asking you to do? can you restate the problem in your own words? have you seen a similar problem worked out in class? is there a similar problem worked out in the textbook? what results/skills did you see in class that might be related to the problem?*

  If you are stuck for inspiration, use the course `piazza` forum (accessible via the course Canvas site). However, don't just ask for the solution - provide your thought process, the difficulties you are having, and ask a coherent question in complete English sentences. Remember the 3RA approach to asking questions outlined in the course syllabus.
- Form study groups - get together and work through problem sets together. **This will make your life easier!** However, you must write your solutions *on your own* and *in your own words*.

⋆ ⋆ ⋆ You **are not allowed** to use any additional resources (e.g. solution manuals, `stackoverflow` etc). If you are concerned then please ask.

- The problems in parentheses are for extra practice and optional (in particular, they do not need to be submitted). **Problems for submission are underlined**.

  To gain mastery of a topic you should expect to attempt a significant proportion of the problems in the textbook ($> 60\%$(!)).
- Answers to odd-numbered exercises are at the back of the textbook. However, you need to submit a worked solution and provide justification for how you determined the answer.

- **Read/recap:** §3.1
- **Problems:** §$X.y$ refers to Chaper X, Section y of *Vector Calculus*, by Colley (4th Edition). All problems are taken from the 4th Edition.

  §3.1: (1), 2, 3, (4), 9, (15), 16, (17), 26, 34,

  Problem A:

  1. Sketch the image curve of the path $\underline{x}(t) = (t, t^4 - 2t^3 + 1)$.
  2. Calculate the line tangent to $\underline{x}$ at $\underline{x}(3)$.
  3. Determine a function f so that the image of $\underline{x}$ equals the graph $y = f(x)$ in the xy-plane.
  4. Let g be a differentiable function defined for every $\mathbb{R}$. Give a path $\underline{x}(t)$ whose image curve equals the graph of g.

  Problem B:

1. Recall the **cycloid** from February 14 video (or see p.14 of the textbook). The cycloid can be realised as a parameterised curve $\underline{x}(t)$.

   Determine the velocity vector $\underline{v}(t)$ of the cycloid. For which t is $\underline{v}(t) = \underline{0}$? Which points on the image of $\underline{x}(t)$ satisfy $\underline{v}(t) = \underline{0}$?

2. Determine a parameterised curve $\underline{x}(t)$ whose image is the **hypocycloid** defined on p.80 of the textbook, with $a = 6, b = 5$. Which points on the image of $\underline{x}$ satisfy $\underline{v}(t) = \underline{0}$?