

**Notes on using WebAssign for Math 20C**  
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I used WebAssign for Math 20C in Fall 2016 (directly on webassign.net) and again in Winter 2018 (with TritonEd integration). Here are notes on setting up and using WebAssign. Most of this should apply to using WebAssign with other classes / textbooks. Some WebAssign and TritonEd screens / settings may change in the future.

I also include some info specific to Math 20C and the textbook.

## Course Setup on TritonEd

### Enabling WebAssign through TritonEd

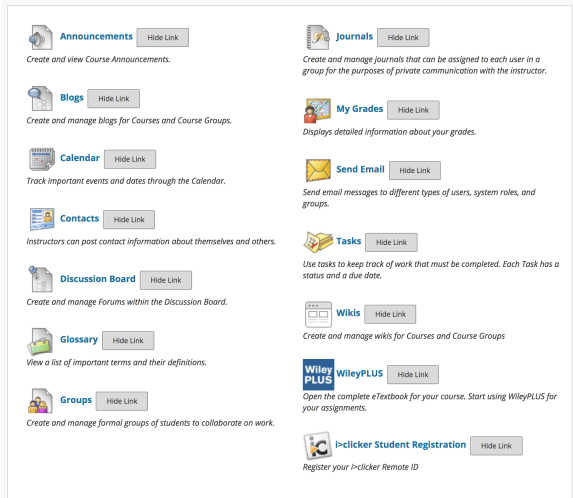
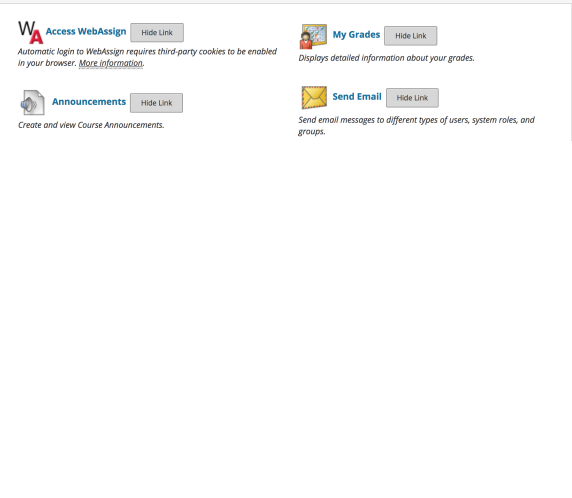
Customization → Tool Availability:

Check off “Available” for both “Access WebAssign” and “WebAssign”.

- “Access WebAssign” adds a link to login to WebAssign to the “Tools” menu for both instructors and students.
- “WebAssign” adds a WebAssign utilities screen to the instructor’s “Course Tools” menu. The utilities let you create a WebAssign course; export the TritonEd roster to WebAssign; or import grades from WebAssign back into TritonEd.

I also recommend for all classes (not just using WebAssign) to go through Tool Availability and disable tools that will not be needed in your course.

- Check the “Tools” screen to see all the tools listed for the students, and use the “Tool Availability” screen to remove any you don’t need. Go back and forth between these as needed. See screenshots below. Some tools are listed in other places besides “Tools”.
- I recommend disabling the “Roster”, since in most classes, students should not have access to this.
- I recommend disabling or restricting “Email”. Some students sent spam to my whole class via TritonEd’s email, possibly inadvertently. I restricted it as follows:
  - Click on the down arrow by “Email”
  - Select “Email Settings”
  - Deselect all categories except “All Instructor Users”
  - Click “Submit”

Default Tools screen	“Access WebAssign” added, most other tools removed
	

## Creating the WebAssign course through TritonEd:

Course Tools → WebAssign

- If the class has not yet been created, this screen will show you a form to fill out to create a WebAssign class linked to TritonEd. This is minimal info and you'll have to do the rest of the setup on WebAssign. Some info on this form has to be re-entered on WebAssign.
- Once the class has been created, this screen will change completely, to allow exporting a roster to WebAssign or importing grades from WebAssign.
- **Display After:** Select a date on or before the first day of class.
- **Display Until:** I chose to make the class available until the end of the 1<sup>st</sup> week of the next quarter.

## Maintaining the WebAssign roster: Initial roster and adds

- During the add period, you need to export the TritonEd roster to WebAssign **daily** once a day (after 9am should be safe) using this feature within TritonEd:

Course Tools → WebAssign → Export Roster

Since the TritonEd roster is only updated once a day, you only need to do this once a day after the TritonEd roster update; doing it multiple times will not normally help.

### Long version:

- The TritonEd roster is updated daily around 7-9am. The last update time shows in the "Full Grade Center" and varies for each class, each day. If a student adds or waitlists, they'll appear on TritonEd's roster the next morning, and can be added to WebAssign's roster after that. You shouldn't normally add someone manually within WebAssign, as they will later be deleted by TritonEd unless they appear in TritonEd's roster by then.
- The TritonEd roster is supposed to be automatically exported to WebAssign each morning, but it doesn't appear to be working correctly. In Winter 2018, there was a timing issue: a student adding on Day 1 would appear on TritonEd on Day 2, but not on WebAssign until Day 3 (instead of Day 2). More below. A Spring 2018 instructor reports it is not working at all, so he has to manually export the roster as described above.

## Maintaining the WebAssign roster: Drops

- When students drop the class (or don't make it in from the waitlist), they are not automatically dropped from the WebAssign roster. Syncing the TritonEd roster does not drop them. If you want to drop them, you need to do it manually. Reasons to drop them include preventing further access to class materials, and making it easier to see who has low grades or didn't do homework and is actually still enrolled.
- Within WebAssign, use Roster to drop students. Select students and click on "Drop Selected." This doesn't actually delete their grade records; it just moves them to a separate list of "Dropped" students, and the students can no longer log in.
- While TritonEd roster synchronization did not drop students in WebAssign who dropped the class, it did drop people in WebAssign who I manually added to the WebAssign roster if they were *never* on the TritonEd roster (namely, my first attempt at enrolling TAs into the WebAssign class). So, don't ever add people directly in WebAssign.

### **Test student, TAs, additional instructors, Concurrent Enrollment, Guests:**

- Add these types of people to your TritonEd roster first. After they appear (which may not be until the next day), then add them to WebAssign by exporting the TritonEd roster to WebAssign as described above. If you try adding TAs, etc., directly in WebAssign, they will be automatically dropped the next time TritonEd syncs the roster.
- **Add a test student** using  
Course Tools → Add Test Student → Enroll Test User  
To see what things look like for a student, you can logout of your instructor account and login to your test account. Or, you can use two browsers to see both at once, e.g., instructor account open in Chrome and test student account open in Firefox.
- **Add TAs** using  
Course Tools → Teaching Assistants  
There is a delay of several business hours until they appear on your TritonEd roster. If you add late in the afternoon, they might not appear on your TritonEd roster until sometime after 8am the next business day. Then there is an additional delay until they appear on your WebAssign roster (either by you manually exporting it or by the automated process).
- **Additional instructors:** I don't know how to officially add additional instructors, but you can add faculty members as "TAs." If that's insufficient, contact ETS.
- **Concurrent Enrollment** students are now listed on the TritonEd roster (but not the TritonLink Class List roster).
- **Guests:** There may be a way through  
Customization → Guest and Observer Access  
but I could not get it to work. Contact ETS for help.

## Maintaining the WebAssign roster: Technical issues that hopefully you won't need

- The 2<sup>nd</sup> week of Winter 2018, ETS added a task to automatically export the TritonEd roster to WebAssign each morning. The timing wasn't quite right, resulting in students potentially not being added to WebAssign's roster until 2 days after enrolling. I reported this and we went through a couple of iterations on the timing, but by then it was the end of the 2<sup>nd</sup> week, when the waitlist and WebReg adds had ended; thus, there were no new students adding so I was never able to verify if it had been fixed. Worse, a Spring 2018 instructor reports it doesn't seem to be automatically syncing rosters at all now. Please be alert to this during the first two weeks of class. I believe the timing is:

Day 1		Student adds or waitlists
Day 2	5-6am	Shows on TritonLink roster. It will say it was updated around 12:30-2am, but if you try downloading the TritonLink Class List then, they won't show yet.
	7-9am	Shows on TritonEd roster. The Full Grade Center shows the update time. It varies each day.
	9-10am	If the automated process is working, the student should be added to the WebAssign roster sometime late morning of Day 2.
Day 3		If the automated process has incorrect timing, the student may not appear on the WebAssign roster until Day 3.

- If you really need to add someone manually, and you know 100% they will appear on TritonEd's roster by the next time it syncs (since otherwise, they'll be deleted), you could manually add them to WebAssign using the exact same format that TritonEd uses:

<b>Username</b>	username::app-173
<b>Institution</b>	ucsd
<b>FullName</b>	Last, First
<b>Email</b>	username@ucsd.edu
<b>Nickname</b>	
<b>ID Number</b>	

## Course Setup on WebAssign

### Edit Class Settings:

#### Section Information, tab “General Info”:

- **Date Visible To Students:** Use the first day of class or later, since this is when the 14 day grace period begins. Do not open it immediately, unless you are setting it up on or after the first day. There was a time zone glitch with this (it interpreted the time as GMT instead of PST), resulting in a shortened grace period. I had to contact our WebAssign rep to fix it.
- **Last Date Visible To Students:** I set it to a few week after class ends.
- **Meet Days, Meet Time:** I left them blank.
- **Textbooks & Free Additional Content:** I used Marsden and Tromba’s Vector Calculus – 6e. I explored the free additional content but it wasn’t applicable to my class.
- **Access:** Come back to this after your TAs are added. I gave each TA “View” access to Section, Roster, Assignments, and Grades. No “Modify” or “Grant” access in any category. No access to “Communication.”

**Tab “Billing and Resources”:** Set to “Student Access Codes”

**Tab “LMS Integration”:** Leave it blank. Somehow, it’s integrated with TritonEd, even though there is no indication of that on this screen.

**Tab “Advanced Options”:** I didn’t change these.

Note that other settings are also needed that are not on the Edit Class Settings screen. Continue reading.

## Trying out WebAssign in advance

WebAssign is not free. Students can only access it starting from the date you put in as the start date. Then there’s a 14 day grace period to enter a registration code. If you want to try things out in advance from the perspective of a student, you can’t before the term starts since the class hasn’t opened yet. “Open Student View” will tell you (in your student role) that you don’t have access to it yet, just like it would tell students. To work around this the first time I used WebAssign, I created a separate “trial” class on webassign.net (not through TritonEd) with its own separate start/end dates and other settings, and I enrolled in it as a student with a second email address. This only let me try it out as a student for two weeks, but that was adequate for testing the system and preparing initial assignments and instructions.

## Setting up WebAssign Gradebook

I used WebAssign's GradeBook for online homework only. I put a statement on my class website about the different gradebooks and what's in each.

**GRADEBOOKS:**

**WebAssign (for homework scores):**

- You may view a score within an assignment in real-time as you're working on it.
- Click on "My Assignments" and then select "All Assignments" to see all of your homework scores.
- Click on "Grades" and then the number under "Category Grades" to see your homework percentages combined. Assignments are not included in this until after they are due (usually the next day).

**Gradescope (for midterm scores):**

- Midterm scores are in Gradescope, not in WebAssign's gradebook.

**TritonEd:**

- The TritonEd gradebook will only be used at the end of the quarter.

The WebAssign GradeBook can be set up through a setup Wizard and also through GradeBook Settings. The settings are organized slightly differently between the two. In the GradeBook Settings, under *Basics*:

- **GradeBook Method:** Use WebAssign's GradeBook
- **GradeBook Calculation Settings:** Past Due Assignments Only  
Originally, I used "All Assignments", which includes assignments in progress. But it only updates the GradeBook once a day, which led to students reporting that they got x points on the homework but the GradeBook says 0 or y points (which was the score at the last GradeBook update). "Past Due Assignments Only" avoids this problem.
- **GradeBook Automatic Update Settings:** I set it to automatic updates at 1am (01:00) every morning (my homework was due Thursdays 11pm, so this would update it 2 hours past that). However, the GradeBook has a log that shows when it was updated, and it was usually several hours after the time I selected.
- **Categories to include in the GradeBook:** I turned on Homework and turned off everything else, since I only used the WebAssign GradeBook for homework scores.

*Final:*

- Select "Let me specify the weighting of each category"
- I just had one category, Homework, with weight 1.

*Categories:*

- **When Calculating Homework Averages:** Select "Make each assignment worth the same initial weight (normalize the scores)." I chose this since the # points per homework varies widely depending on problems assigned.
- **Drop 0 lowest Homework assignments**

*Student View:*

- **Interim / Final Grade:** I checked "Final Score" and unchecked everything else. Note that the "Final Score" refers to all scores within WebAssign, not to a final exam

score. It was necessary to select “Final Score” here in order for students to be able to view their homework scores. To test it:

- Use “Open Student View”
- Click “Grades” or “My Grade”
- Clicking on the score in “Overall Grade” gives a total, and clicking on the score in “Category Grades” gives a breakdown by homework assignment.
- Clicking on “My Assignments” gives a list of assignments and their scores. It initially shows only newer assignments; you may need to use “Past Assignments” or “All Assignments” to see all assignments.
- Close the “Student View” tab when done.
- **Raw Score:** For Homework, I checked off “Avg” and unchecked the other statistics, and set Posted “After Due Date”.
- **For all other categories,** I unchecked all options in “Show” and set “Posted” to “Never”.

*Grading Scale:* None. I only used WebAssign for homework scores, not for tests or course grades. I determined letter grades outside of WebAssign.

#### **Copying WebAssign grades to TritonEd:**

- This can be done in TritonEd, either or through an automated process. I don’t know if any instructor has used the automated process.
- To do it manually in TritonEd:
  - Course Tools → WebAssign → Import Grades
- This can be done throughout the quarter. However, as far as I know, all instructors here keep homework grades just in WebAssign until the end of the quarter, at which point they copy the WebAssign “Final” score or individual homework scores either to TritonEd or to an external spreadsheet.
- Again, with the configuration above, the WebAssign “Final” score refers to combining all homeworks, not to a final exam or combined homework & exams total.



## Setting up WebAssign Communications

I disabled WebAssign's Communication features. For electronic communications, I prefer email, while some faculty prefer Piazza. Either way, this avoids having to check multiple systems.

- Select "Communications"
- Go through every category listed (Extensions Unanswered, Answered; Ask Your Teacher Unanswered, Answered; etc.).
- For each category, click on "Settings", then "Disable" it and push "Apply".
- If you do want to use WebAssign's Communications features, then use these "Settings" screens to configure them rather than to disable them.

## Creating Homework Assignments

Create a new homework assignment using  
Assignments → Create

**Assignment Name:** I suggest using the quarter and class name in the assignment name, like

FA16 Math 20C Homework 1

All homework assignments you create in WebAssign are in one big list under “My Assignments.” If you teach multiple courses using WebAssign, or reteach the same course but change the assignments each quarter, then multiple assignments called “Homework 1” will be mixed together in the list.

I didn’t test WebAssign’s “Folders” but it might let you organize assignments, questions, etc. by class and term, in which case “Homework 1” in a class/term folder could work.

**WebAssign homework template:** The “homework template” refers to various configuration settings, not to the homework layout. I made a custom homework template as follows.

- Select “Edit Assignment Templates”
- On “Homework – WebAssign Default”, select “Duplicate”
- Give it a name (I used GT Homework).
- **Submissions allowed:** 30  
This is the default and can be overridden for particular problems. I overrode it for multiple choice, true/false, and matching problems. More info later.
- **Practice Another Version:** before due date after 2 submissions.  
Adam Bowers and I discussed either increasing it or turning it off. Supposedly it’s only enabled on randomized problems, but many problems are insufficiently randomized:
  - Some students use “Practice Another Version” to get an answer to one version of it, and then just try that answer in their version and get it right. Or they infer an easy pattern involving the randomized numbers (in red) vs. the answer.
  - Some problems may randomize one part but not another. This is enough for Practice Another Version to consider it randomized and then to show all parts.
  - Some problems have randomizations that don’t affect the answer.
- You can either set the template to be your new default template, or else you have to remember to select this template as you create each assignment. If you forget, you can edit the assignment to change the template later.

**Homework instructions:** The “Description” and “Instructions” boxes allow HTML formatted text at the top of the assignment. I gave hints and clarifications using “Instructions” at the top, rather than by modifying each problem. You can update these after the assignment is assigned, so if students who start the homework early ask questions that may be of interest to others, you may want to add more hints or clarifications to the Instructions.

**Instructions**  
**Hint on #14cd (1.3.015) and #18 (1.3.031):**The direction vectors of the lines are either parallel or perpendicular to the normal vector of the plane. Use that to compute the normal vector. Also find a point in the plane. Plug the normal vector and point into the formula of a plane.

**Hint on #16 (1.3.021):**

- In this problem, the intersection of the planes is a line. A parametric equation of a line requires a starting point and a direction vector,  $\mathbf{v}$ .
- Since  $\mathbf{v}$  is in each plane, it is perpendicular to the normal vector of each plane.
- To find a starting point, solve the two equations in three unknowns. There are an infinite number of solutions; pick any specific numerical solution.

**Question Browser:** Use this to select problems from the textbook or your custom problems.

**Additional homework problems:** Most weeks, I posted additional written homework on my class website that was not turned in or graded. These are included later in this report. The homework page on the class website describes both WebAssign as well as any additional problems of my own or from the textbook, instead of making those separate pages as seems common. When I had written homework, I put this question on the WebAssign homework as question #1, worth 1 point, in order to emphasize that the written homework was required:

1. 0/1 points GT Addl Probs Notice Math 20C [4063580]

Question part	1	Total
Points	0/1	0/1

This assignment consists of the WebAssign problems (which are submitted online and graded) as well as [additional written problems](#) posted on the class website. The additional written problems will not be collected or graded, but you are responsible for doing them.

1  Acknowledged

That has a link to the written homework on my class website; in past quarters, sometimes this was a list of problem numbers from the book, but this quarter, it was homework sheets I wrote:

- Online homework will be done using WebAssign and will be graded; see the [WebAssign setup instructions](#) below. WebAssign homework will be due every week, starting the 2nd week.
- Written homework will also be assigned some weeks. The written homework will not be collected or graded, but you are required to do it.
- The WebAssign assignments will be in your WebAssign account, while the written homework will be posted below.
- Homework is due weekly on Wednesdays 11 p.m. unless otherwise announced.
- You are encouraged to complete as much as possible before discussion sections and ask questions about them in discussion sections, rather than waiting until the last minute.

#	Due Date	Written Homework, Other Info
1	Jan. 17	<a href="#">Written Homework 1 [solutions]</a>
2	Jan. 24	<a href="#">Written Homework 2 [solutions]</a>
3	Jan. 31	<a href="#">Written Homework 3 [solutions]</a>
4	Feb. 7	HW4 is just WebAssign, no written homework
5	Feb. 14	<a href="#">Written Homework 5 [solutions]</a>
6	Feb. 21	<a href="#">Written Homework 6 [solutions]</a>
7	Feb. 28	<a href="#">Written Homework 7 [solutions]</a>
8	Mar. 7	<a href="#">Written Homework 8 [solutions]</a>
9	Mar. 14	<a href="#">Written Homework 9 [solutions]</a>
10	Not due	<a href="#">Written Homework 10</a>

### # Tries per problem:

- As described above, I made a custom homework settings template, which included changing the default # tries per problem (or problem part) to 30.
- For multiple choice, matching, true/false, and similar problems, I manually changed the number of tries on the problem/part to 1 if there are just 2 choices, and to 2 for 3 or more choices.
- Note that some problems may have multiple parts in different formats; e.g., part (a) could have an answer blank to type in any number or formula (30 tries, via the homework settings template) while part (b) could be multiple choice (1 or 2 tries, by manually editing the points on that part).

### # Points per problem:

- By default, problems are worth one point per “part”.
- If the answer is “(1,2,3)”, then as a single answer blank \_\_\_\_\_, that’s one point. If it’s in the format ( \_ , \_ , \_ ) with three answer blanks, that’s worth 3 points.
- This may get out of hand, so when creating an assignment, it is important to review the number of points per problem and manually override it if appropriate.

### Problem parts:

- Sometimes you only want to assign parts of a problem. Problem 2.5.3(a–d) asks to apply the chain rule to four different pairs of functions. There’s a provision to make a copy of a problem and then edit it. In this case, I duplicated “MarsVectorCalc6 2.5.003”, renamed it “GT-MarsVectorCalc6 2.5.003ad”, and kept parts (a,d) while removing (b,c).
- One caveat with making/editing a local copy of a problem is that you won’t be alerted if WebAssign ever fixes a bug in the original problem. If you use their version of it and they fix a bug in it, then the next time you teach the class and reuse or copy that assignment, you’ll be notified about the defective problem, and it will automatically replace the defective problem with the new version. But this doesn’t apply to your local copies of problems, so each time you reuse a customized problem, you may want to double-check if the code for the original version has been revised.

### Extensions:

- I usually gave brief extensions to students who asked for extensions (usually by email), or who had technical problems accessing WebAssign. I also gave extensions early in the quarter to people who added late or got off the waitlist late.
- It is also possible for students to request an extension through WebAssign. There are options to allow automated approvals or manual approvals, penalties, etc. I disabled this (see the page on disabling Communications settings), but John Eggers used it.
- If you attempt to give an extension to a student who has already opened the answer key, WebAssign will alert you so you can cancel it.
- If you download grades periodically or export them to TritonEd periodically, you should wait to do so until after all extensions on the assignment have passed.

## Defective problems

I reported some defective problems to WebAssign. They fixed them, but sometimes it took a couple of weeks, too late for me to use them. They rename the existing problem (new name, same ID number) and create a new problem (original name, new ID number) with the fix. E.g.,

	Problem Name	QID
Original problem before fix	MarsVectorCalc6 5.4.001	(3669869)
Same problem after fix; code with bug is not changed, just the name is changed	marsvectorcalc6 5.4.001.defective	(3669869)
Replacement problem, bug fixed	MarsVectorCalc6 5.4.001	(3738538)

The method to report bugs keeps changing. Currently, go to Webassign's "Help" (upper right corner of most screens), look up "Customer Support", and select the option to report a problem with a question.

If you find that a problem is defective before you have actually published the assignment, just delete the problem from the assignment and report it to WebAssign. But if you don't find out until after it's assigned, some options are:

- If there's a workaround, tell students how to work around the issue. Possibly increase the number of tries allowed on that problem, if that would be sufficient.
- Change the points on the problem (or the specific problem part) to 0, and then rescore.
- Change the "Automatic Scoring Adjustments" on the problem or specific problem part, and then rescore. I used this to set "Add 100% for incorrect answers", so people who answered it got the point while people who didn't even do the assignment did not.
- I didn't try deleting problems in an already-assigned assignment. It might lead to confusion in communications with students about questions on problem # x, since the problem numbers would change. If you delete a problem after it's assigned, it would also require rescoring.

**Rescoring the problem: Wait until after the assignment is due, including for everyone with extensions.** If you just edit the homework instructions, you do not need to rescore. But if you edit points, delete problems, or make other changes that affect scoring, then you have to rescore the problem. Go to the "scores" page for the assignment, and select "Rescore". In Fall 2016, this worked very poorly. (I did not get to test it in Winter 2018.) First I tried in Safari, and it kept stalling without completing. I contacted WebAssign. They said to use Firefox. I tried it in Firefox and it was successful, but it took about 1.5 hours to rescore the whole class (mid 300s). At that rate, I'd estimate 5 hours for a coordinated class with 1000 people. This should be much faster, but it appeared it was making corrections one at a time from the client-end instead of on the server. Again, I did not need to do this in Winter 2018, so it is possible this has improved.

### **Problems with large rosters (may have been fixed by now)**

In Fall 2016, some WebAssign features did not work because the class was too big. For my class of 370 (including people who dropped but remained in the system), this included “Class Analysis”, “Class Insights”, and downloading all Responses on individual homework assignments.

Also in 2016, John Eggers coordinated a class with about 1000 students across all lectures, and found that even downloading the score spreadsheet (just combined homework totals, not individual problems or totals per assignment) was problematic, so he had to manually check off groups of students to download.

I contacted WebAssign and they told me I could split the class into multiple sections. While WeBWorK’s roster has columns for the lecture and discussion section in the roster, WebAssign’s roster does not. Instead, for 10 sections, you have to manually create each of the 10 sections, upload 10 rosters, and use features like “Class Analysis” 10 times. For this reason, I did not do it. I just made do without the problematic features. However, for assigning homework, it appears you can assign it to one section and then replicate it to the others.

In Winter 2018, all features worked fine on my class of ~200 as a single section; I did not encounter any of the above problems. I don’t know the status of ~1000 person classes, but it’s likely they’ve addressed it.

## WebAssign instructions for students

On my class website, I gave instructions for logging into WebAssign; dealing with a number of login issues that students reported; and general use of WebAssign. See the appendices.

There were a number of technical glitches with logging in (clearing cookies usually fixed them), losing submitted work (I think they used Submit Assignment instead of submitting problem-by-problem), etc., which are addressed on my class website (and some of them I announced in class or by email as well). Some technical issues might change over time, but I would suggest starting with the same list I have and modifying it as the technical issues change.

I also gave an in-class demo at the start of the quarter, showing how to login and do a couple of problems. Here are some particular items to demonstrate. Some are specific to Math 20C & E with the Marsden and Tromba book, and there may be other things better to demonstrate for other classes/books:

- Show the basic login procedure, using your test student account. Login to TritonEd. Use that to login to WebAssign. Show “username::app-173” in the upper right corner. A lot of people tried logging in by an old account; in ways that required a “Course Key”; etc., and these didn’t work.
- Show how to enter equations both using calcPad and using the keyboard. See the Homework page of my website in the appendix for an example.
- Entering vectors in  $(a, b, c)$  and  $a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$  notations. Emphasize that they should not use the  $i, j, k$  keys on their keyboard; it will be counted as an incorrect answer. One must click on the boldface symbols  $\mathbf{i}, \mathbf{j}, \mathbf{k}$  on the calcPad menus.
- **On the class website and in the instructions for the first homework using log()**  
**notation:** The Marsden & Tromba textbook uses  $\log(u)$  for natural logarithm, but many students expect  $\ln(u)$  for natural log and  $\log(u)$  for base 10 log. WebAssign’s general instructions say  $\log(u)$  is base 10, but it turns out they changed that for M&T, without saying so in their instructions. So, for M&T, they use  $\log(u)$  for natural log in all problem statements, and they allow using  $\ln(u)$  or  $\log(u)$  for natural log in the answer box.

## Marsden & Tromba Vector Calculus book

I would not have chosen this book. It's at an advanced level and omits some types of problems at a more basic level that other books include. Most of my additional written homework problems are to add more basic problems (though there are some advanced problems, too).

Also, the departmental syllabus estimates of how long it takes to cover each section are not realistic. I put some lectures on slides either to cover material that's not included in the book, or for time constraints. Some issues include:

### Chapter 1.1-1.2: Vectors.

- Chapter 1.1 is 17 pages, covering what vectors are, vector arithmetic operations, formulas of lines, and the span of two vectors for a plane. It was 2-3 subsections in Stewart and in Rogawski, and scheduled for multiple lectures, but here, it's one section and listed as one lecture, which is unrealistic.
- It doesn't cover specifying a 2D vector by a length and an angle in the  $xy$  plane. E.g., compute the vector in the  $xy$  plane with magnitude 10 pointing  $30^\circ$  above the  $x$ -axis. See Additional Homework #1 (in the appendix) for this and the next issue.
- Other books have some vector arithmetic problems in terms of labelled points, but this book doesn't.
- This book uses notation  $(a,b)$  both for points and for vectors. Other books distinguish points and vectors by using a different notation for vectors, such as angle or square brackets, or column vectors. However, this book does use  $i,j,k$ , notation

### Chapter 1.3: Cross Product.

There are no problems on the right-hand rule. See Additional Homework 2 # 203.

### Chapter 2: Limits, derivatives, tangent planes, etc.

The book makes heavy use of matrix notation, but linear algebra (Math 18) is not a prerequisite. Some students may have seen matrix multiplication in high school, but this is not universal; an informal poll showed about  $1/3$  to  $1/2$  of the class had seen matrix multiplication. I made slides covering it in Chapter 2.5 (chain rule).

### Chapter 2.3: Partial Derivatives

Other books give problems showing how to take partial derivatives of integrals, where the variables are in the limits. See Additional Homework 5 # 502.

### Chapter 2.4: Paths and Curves

There are minimal problems about plotting parametric curves, and no matching problems like other books have. See Additional Homework 5 # 501.

### Chapter 2.5: Chain Rule

- The book develops the chain rule using matrix notation. I made slides covering matrix multiplication and the chain rule.



- The book doesn't present tree diagrams for the chain rule like other books do, so I included that on the slides, too.

### **Chapter 2.6: Gradient.**

Other books have problems in which they show a contour map and ask to plot a path of steepest ascent/descent starting at some point, draw a gradient vector at a point (perpendicular to a contour there and in the correct direction), estimate directional derivatives, etc. There are no such problems in this book. See Additional Homework 6.

### **Chapter 2.4 (Intro to Paths and Curves) and 4.1 (Acceleration and Newton's Second Law):**

- The book covers differentiating a parametric curve to go from position to velocity to acceleration. It doesn't adequately cover using integrals to go in the other direction.
- It doesn't cover the standard example of the trajectory of a projectile due to gravity.
- It doesn't do a good job of describing units.
- The definition of force as mass times acceleration is given, but is rather abstract. I added weight due to gravity as an example to make it concrete.

We should also inform students what topics to skip. I put these on my class calendar:

#### Chapter 3.3:

- We will fully cover functions of two variables. We'll only partially cover functions of three or more variables, since full coverage requires linear algebra (Math 18).
- Skip from the third line of page 172 through the top of page 176, continuing at "Second Derivative Test (two variables)."
- On pages 179-180, skip example 10.

#### Chapter 3.4:

- On pages 191-192, skip "Several Constraints" and example 5. Continue with example 6.
- On pages 197-201, skip "A Second-Derivative Test for Constrained Extrema."

Chapter 4.1: Skip "Kepler's Law" on the bottom of page 221 through page 226.

### **Appendices:**

- Homework instructions on website
- Written Homework

Links: [Home](#) [Homework](#) [Exams](#) [Calendar](#) [Syllabus](#) [Graphing](#)

## Math 20C — Calculus — Winter 2018 — Lecture D (Tesler) Homework

**Updated 3/16/18**

- Online homework will be done using WebAssign and will be graded; see the [WebAssign setup instructions](#) below. WebAssign homework will be due every week, starting the 2nd week.
- Written homework will also be assigned some weeks. The written homework will not be collected or graded, but you are required to do it.
- The WebAssign assignments will be in your WebAssign account, while the written homework will be posted below.
- Homework is due weekly on Wednesdays 11 p.m. unless otherwise announced.
- You are encouraged to complete as much as possible before discussion sections and ask questions about them in discussion sections, rather than waiting until the last minute.

#	Due Date	Written Homework, Other Info
1	Jan. 17	<a href="#">Written Homework 1 [solutions]</a>
2	Jan. 24	<a href="#">Written Homework 2 [solutions]</a>
3	Jan. 31	<a href="#">Written Homework 3 [solutions]</a>
4	Feb. 7	HW4 is just WebAssign, no written homework
5	Feb. 14	<a href="#">Written Homework 5 [solutions]</a>
6	Feb. 21	<a href="#">Written Homework 6 [solutions]</a>
7	Feb. 28	<a href="#">Written Homework 7 [solutions]</a>
8	Mar. 7	<a href="#">Written Homework 8 [solutions]</a>
9	Mar. 14	<a href="#">Written Homework 9 [solutions]</a>
10	Not due	<a href="#">Written Homework 10</a>

### WEBASSIGN ACCOUNT SETUP:

- At the beginning of the quarter, WebAssign accounts will be created for all students enrolled or waitlisted. If you add/waitlist later, it may take a couple of business days until we are notified and create your account. Please contact the instructor if necessary.
- Login to [TritonEd](#) and select this specific class:  
Winter 2018  
Math 20C - Calculus&Analyt Geom/Sci&Engnr - Tesler [WI18]
- Go to the "Tools" page, and select "Access WebAssign".
- The top of the WebAssign screen should show "Welcome, username::app-173@ucsd ..." rather than "username@ucsd". It should show this way for all your classes that use TritonEd to login to WebAssign. However, it would be different in any classes that

access WebAssign a different way.

### WebAssign access code and grace period:

- WebAssign has a grace period with free access for the first two weeks of class. After that, you either need to enter your access code (if you bought the book bundled with a code) or purchase access within WebAssign (after first logging in through TritonEd as described above). If you are waitlisted or still working out your schedule and not sure if you'll stay in the class, then hold off on entering the code until required.
- To get an access code for WebAssign, you can either (1) purchase a bundle from the UCSD bookstore that has the textbook and a multi-term WebAssign access code; (2) purchase the book at the bookstore and separately purchase a homework access code after logging into WebAssign through TritonEd; or (3) login to WebAssign (through TritonEd) and purchase the eBook + homework access code within WebAssign. Multi-term access is recommended since the same book is currently used for Math 20E, but if you are only going to take Math 20C and not Math 20E, the single-term option may be better.
- If you already have a multi-term access code to this textbook (because you took Math 20C before, for example) then you may use the same code. If you were using a different username, then you must link your accounts. You can do this by clicking on "My Options" (in the upper right) and then selecting the "Accounts" tab.

### Problems logging in:

- If you used WebAssign before, it may not be the same WebAssign account. Please login to WebAssign for this class via TritonEd as described above.
- WebAssign has different ways to set up class accounts. We're doing it through TritonEd. We are not using a "Course Key" with self-enrollment. If you get to a screen requiring a "Course Key" when trying to login, then something went wrong. Please try logging in again through TritonEd.
- Some students reported that when they login to WebAssign via TritonEd, it didn't show this class. At the top, it showed them "username@ucsd" or "username@ucsd.edu@ucsd" instead of "username::app-173@ucsd". If this happens, log out of WebAssign and TritonEd, clear your browser's cookies, and try again. If that doesn't work, try [WebAssign's instructions on configuring your browser](#).
- When you logout of WebAssign, it goes to WebAssign's direct login screen. Close the window, since the accounts are accessed through TritonEd logins rather than through that screen. It would be better if it brought you back to TritonEd instead of that screen, but unfortunately, it currently doesn't.
- If these DIY solutions don't work, please contact [WebAssign's technical support](#) and Prof. Tesler for help.

### DOING HOMEWORK IN WEBASSIGN:

- Use the "Help" link within WebAssign for info on using WebAssign.
- Assignments will be posted weekly on the "Home" page. Click on an assignment name to get started. Use "Print Assignment" if you want to print it out.
- Most problems have multiple versions (such as different numbers, scrambled multiple choice order, etc.), so different students have different versions of the questions.
- Submit each problem (or problem part) through its own separate "Submit Answer" button. You can skip problems and return to them later. If a "Submit Answer" button

covers multiple parts, you should complete all parts before submitting it. The score grid at the top will update as you submit each problem.

- Please submit each problem as you do it rather than waiting till the end, to avoid losing work (e.g., if you lose your internet connection or your session expires). The "Submit Assignment" button at the bottom is not needed if you submit each problem as you do it.
- There is no time limit on individual problems, but all problems must be completed by the assignment deadline.
- You may retry most problems if you get them wrong, but the number of tries is limited, particularly on multiple choice, true/false, and matching problems. Click on "⊕ x/y points" next to a problem for details, or on "Previous Answers" to see your previous attempts. You may also practice on another version of the problem if one is available.
- If you believe that WebAssign is grading a problem incorrectly or that there is an error in a question, please report it to the instructor.
- WebAssign does not have detailed solutions for this textbook. Check the student solutions manual to see if a similar problem has a worked-out solution. "MarsVectorCalc6 1.1.009" indicates the problem is adapted from our textbook, Chapter 1.1, problem 9, but may have changes such as different numbers. The solutions posted for Written Homework are for the Written Homework problems; sometimes selected WebAssign problems (but not all) are included as well.

### ENTERING MATHEMATICAL EXPRESSIONS:

For some questions, the "calcPad" menu appears when you click in an answer box. This lets you enter mathematical expressions/formulas with special formatting and symbols. Here are a few examples to get you started, but this is not a complete list:

- To enter square root of 42:

**Keyboard:** Type "sqrt" to generate the square root symbol, and then type "42". Do not enter the quotation marks. To move in or out of the square root, use the arrow keys on your keyboard or click in the appropriate place with your mouse.

**calcPad:** Click on "Operations", select the square root symbol, and type "42".

- To enter vector  $2\mathbf{i}-3\mathbf{j}$ :

The "i" and "j" keys on the keyboard will not work for this purpose. Instead, type "2"; click on the "Vectors" menu and select "i"; type "-3"; and select "j" on the "Vectors" menu.

Or you may use the other vector notation and just type an answer without using the calcPad menu: "(2,-3)" in 2D or "(2,-3,0)" in 3D.

- The formula below may be entered using the keyboard only; using calcPad; or by intermixing these methods.

$$\frac{(1,\pi,3)}{\sqrt{\pi^2 + 10}}$$

**Keyboard:**

Type "(1,pi,3)/". After hitting the slash, it goes into fraction mode and puts the cursor in the denominator.

Type "sqrt" and it shows a square root symbol.

Type "pi^2", which it will show in mathematical notation.

To get out of the superscript, use the right or down arrow, or click in the appropriate position with your mouse.

Type "+10".

**calcPad:**

Click on "Operations" and select the icon showing a fraction.

Click on the top or bottom of the fraction to enter a value there.

Click on the top. Type "(1,pi,3)". Or type "(1," and then click on "Greek" and select the pi symbol, then continue typing ",3)".

Click on the bottom. Click on "Operations" and select square root.

You may enter the denominator using the keyboard as described above, or continue using calcPad as described below.

Select "Greek" and select the pi symbol.

Click on "Operations" and select the icon of one box to the power of another box.

Type "2" in the exponent.

To get out of the subscript, use the right or down arrow, or click in the appropriate position with your mouse.

Type "+10".

- For more info on calcPad: [documentation](#), [reference](#) (including keyboard equivalents), [examples](#).
- Our textbook uses  $\log(u)$  for natural logarithm instead of  $\ln(u)$ , so in WebAssign questions for our book,  $\log(u)$  means natural log rather than log base 10. However, in answers that require a logarithm, WebAssign will accept both  $\log(u)$  and  $\ln(u)$  for natural log.

**GRADEBOOKS:****WebAssign (for homework scores):**

- You may view a score within an assignment in real-time as you're working on it.
- Click on "My Assignments" and then select "All Assignments" to see all of your homework scores.
- Click on "Grades" and then the number under "Category Grades" to see your homework percentages combined. Assignments are not included in this until after they are due (usually the next day).

**Gradescope (for midterm scores):**

- Midterm scores are in Gradescope, not in WebAssign's gradebook.

**TritonEd:**

- The TritonEd gradebook will only be used at the end of the quarter.

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #1 Additional Problems**  
**Due Wednesday January 17, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

Note that problems 101 & 102 work the same as converting a point in the plane between Cartesian and polar coordinates, except it's with a vector instead of a point.

**101.** Compute the vector  $(x, y)$  with length 10 that makes an angle  $20^\circ$  counterclockwise from the  $+x$  axis.

**102.** For each of the following vectors, determine its length and its angle (in degrees) counterclockwise from the  $+x$  axis:

$$3\hat{i} + 4\hat{j}, \quad -3\hat{i} + 4\hat{j}, \quad 3\hat{i} - 4\hat{j}, \quad -3\hat{i} - 4\hat{j}.$$

**103.** Let  $A = (1, 3)$ ,  $B = (7, -6)$ ,  $C = (4, 2)$ .

(i) Find the point  $D$  so that  $\overrightarrow{AB} = \overrightarrow{CD}$ .

(ii) On the line segment  $\overline{AB}$ , find the point two-thirds of the way from  $A$  to  $B$ .

(iii) Let  $E, F, G, H$  represent points. Simplify each of

$$\overrightarrow{EF} + \overrightarrow{FG}, \quad \overrightarrow{EF} - \overrightarrow{EG}, \quad \text{and} \quad \overrightarrow{EF} + \overrightarrow{FG} + \overrightarrow{GH} + \overrightarrow{HE}.$$

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #2 Additional Problems**  
**Due Wednesday January 24, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**201.** Consider  $\vec{a} = 2\hat{i}$  and  $\vec{b} = -\hat{i} + 3\hat{k}$ .

- (a) Use the dot product to find the angle between  $\vec{a}$  and  $\vec{b}$ .
- (b) Use the cross product to find the angle between  $\vec{a}$  and  $\vec{b}$ .
- (c) Are there any complications in either method?

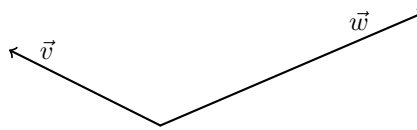
**202.** Compute the point closest to  $R = (8, 7)$  on the line through  $P = (5, 1)$  and  $Q = (9, 4)$ .

**203.** In each part (a)–(c), determine whether the result points out of the page (towards you) or into the page (away from you). Vectors  $\vec{v}$ ,  $\vec{w}$  are shown in the diagram below.

(a)  $\vec{v} \times \vec{w}$

(b)  $\vec{w} \times \vec{v}$

(c)  $(3\vec{w} - 2\vec{v}) \times (\vec{v} - 4\vec{w})$



**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #3 Additional Problems**  
**Due Wednesday January 31, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**301.**

- (a) Determine if the lines given by these vector parametric formulas intersect. If so, find the point where they intersect.

$$\vec{r}_1(t) = \langle 7, 11, -9 \rangle + t \langle 2, 3, -1 \rangle \quad \text{and} \quad \vec{r}_2(t) = \langle 7, -11, -15 \rangle + t \langle -1, 4, 2 \rangle$$

- (b) Determine if particles traveling according to the two formulas in (a) collide.

**302.**

- (a) Suppose that  $\vec{a}$  and  $\vec{b}$  are nonzero and parallel. Show that  $\vec{a} \times \vec{b} = \vec{0}$ .  
(b) Suppose that  $\vec{a}$  and  $\vec{b}$  are nonzero and  $\vec{a} \times \vec{b} = \vec{0}$ . Show that  $\vec{a}$  and  $\vec{b}$  are parallel.  
(c) If  $\vec{a} = \vec{0}$  or  $\vec{b} = \vec{0}$ , what is  $\vec{a} \times \vec{b}$ ?



**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #5 Additional Problems**  
**Due Wednesday February 14, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

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**501.** Sketch these parametric curves by hand, using methods discussed in class for Chapter 2.4:

- (a)  $\vec{c}(t) = (t \cos(t), t \sin(t))$ , where  $0 \leq t \leq 4\pi$ .
- (b)  $x = -3t \sin(t)$ ,  $y = 4t \cos(t)$ , where  $0 \leq t \leq 4\pi$ .
- (c)  $\vec{c}(t) = -\sin^2(t)\hat{i} + \cos^2(t)\hat{j}$ .
- (d)  $\vec{c}(t) = 2t\hat{i} + 3\cos(t)\hat{j} + 4\sin(t)\hat{k}$ .
- (e)  $x = \cos(t)$ ,  $y = \sin(t)$ ,  $z = \sin(3t)$ .
- (f)  $x = 5e^{-t}$ ,  $y = e^t$ , where  $0 \leq t \leq \ln(10)$ .

After sketching them by hand, check them in Wolfram Alpha (or a graphing calculator):

- Go to <http://www.wolframalpha.com>
  - Convert each formula to the format  $(x(t), y(t))$  in 2D or  $(x(t), y(t), z(t))$  in 3D. Some other systems instead require the format  $x = f(t)$ ,  $y = g(t)$ ,  $z = h(t)$ .
  - In the query box, generate one plot at a time using the notation shown below:  
Without a range: `parametric plot (3t,cos(t))`  
With a range: `parametric plot (3t,cos(t)), t=-2 to 10pi`
  - If you don't specify a range, the default values it uses may or may not be suitable.
- 

**502.** Recall the first part of the Fundamental Theorem of Calculus:

$$\text{Let } F(x) = \int_a^x f(t) dt. \text{ Then } F'(x) = f(x).$$

As an example, if  $F(x) = \int_a^x \sin(\sqrt{t+8}) dt$ , then  $F'(x) = \sin(\sqrt{x+8})$ .

The integral  $\int_0^x e^{-t^2} dt$  arises in probability and statistics. It can't be evaluated in terms of ordinary functions, but it can be evaluated using numerical methods and Taylor series. We'll take derivatives of it.

- (a) Compute  $\frac{d}{dx} \int_0^x e^{-t^2} dt$ .
- (b) Compute  $\frac{d}{dx} \int_0^{x^3} e^{-t^2} dt$  by the following steps:
  - Let  $G(u) = \int_0^u e^{-t^2} dt$ .
  - Note  $\int_0^{x^3} e^{-t^2} dt = G(x^3)$ .
  - Use the chain rule to compute  $\frac{d}{dx} G(x^3)$ .
- (c) Compute  $\frac{\partial}{\partial x} \int_{10y}^{x^3} e^{-t^2} dt$  and  $\frac{\partial}{\partial y} \int_{10y}^{x^3} e^{-t^2} dt$ .

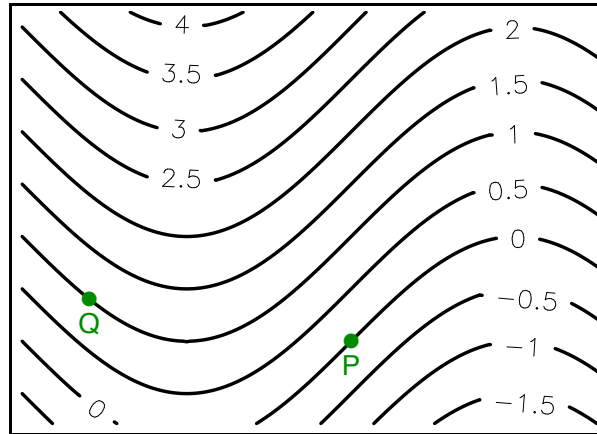
Note  $\int_{10y}^{x^3} e^{-t^2} dt = G(x^3) - G(10y)$ , using the same  $G(u)$  defined in part (b).

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #6 Additional Problems**  
**Due Wednesday February 21, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**601.** On the contour plot of  $z = f(x, y)$  below:

- (a) Draw the path of steepest ascent starting at point  $P$ .
- (b) Draw the gradient vector at point  $Q$ .
- (c) What are the signs (positive, negative, or zero) of  $D_i f$  and  $D_j f$  at point  $P$ ? At point  $Q$ ?



**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #7 Additional Problems**  
**Due Wednesday February 28, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**701.** We will study an example where mixed partial derivatives are **not** equal at a particular point. This is based on problem 3.1# 32 in the book. Consider

$$f(x, y) = \begin{cases} \frac{xy(x^2 - y^2)}{x^2 + y^2} & \text{if } (x, y) \neq (0, 0) \\ 0 & \text{if } (x, y) = (0, 0). \end{cases}$$

- (a) Compute  $\frac{\partial f}{\partial x}$ ,  $\frac{\partial f}{\partial y}$ ,  $\frac{\partial^2 f}{\partial x \partial y}$ , and  $\frac{\partial^2 f}{\partial y \partial x}$ . For  $(x, y) \neq (0, 0)$ , the two mixed partials should be equal.
- (b) Evaluate the limit as  $(x, y) \rightarrow (0, 0)$  for each of  $\frac{\partial f}{\partial x}$ ,  $\frac{\partial f}{\partial y}$ , and  $\frac{\partial^2 f}{\partial x \partial y}$ .
- (c) It turns out that  $\frac{\partial^2 f}{\partial x \partial y}(0, 0)$  and  $\frac{\partial^2 f}{\partial y \partial x}(0, 0)$  are both defined, but are not equal! Compute them both by the procedure below.

To compute  $\frac{\partial^2 f}{\partial x \partial y}(a, b) = \left( \frac{\partial}{\partial x} \left( \frac{\partial f}{\partial y} \Big|_{y=b} \right) \right) \Big|_{x=a}$  in general:

- (i) First compute the function  $\frac{\partial f}{\partial y}$  (already done in part (a)).
- (ii) In computing  $\frac{\partial}{\partial x}$  of a function, we hold  $y$  constant and then take the  $x$ -derivative.  
Hold  $y$  constant by setting  $y = b$  and simplifying, which evaluates  $\frac{\partial f}{\partial y}(x, b)$ .
- (iii) Compute the derivative  $\frac{\partial}{\partial x}$  of  $\frac{\partial f}{\partial y}(x, b)$  and evaluate at  $x = a$ .

**In this problem:** compute  $\frac{\partial f}{\partial y}$ ; set  $y = 0$  in it; simplify; take the  $x$  derivative; and evaluate at  $x = 0$ .

The other mixed partial,  $\frac{\partial^2 f}{\partial y \partial x}(0, 0)$ , is computed in a similar way, switching the roles of  $x$  and  $y$ .

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #8 Additional Problems**  
**Due Wednesday March 7, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**801.** Let  $\vec{r}(t)$  be a differentiable path in  $\mathbb{R}^3$ . Use the differentiation rules on page 218 to evaluate the following in terms of  $\vec{r}(t)$  and its derivatives.

(a) Evaluate  $\frac{d}{dt}(t^2\hat{i} \times \vec{r}(t))$ ,  $\frac{d}{dt}(t^2\hat{i} \cdot \vec{r}(t))$ ,  $\frac{d}{dt}(t^2\vec{r}(t))$ ,  $\frac{d}{dt}(5t^2\hat{i} + 3\vec{r}(t))$ , and  $\frac{d}{dt}\vec{r}(t^2)$ .

(b) Evaluate  $\frac{d}{dt}\|\vec{r}(t)\|$ . **Hint:** Express  $\|\vec{r}(t)\|$  in terms of  $\vec{r}(t) \cdot \vec{r}(t)$ .

(c) Evaluate and simplify  $\frac{d}{dt}(\vec{r}(t) \times \vec{r}'(t))$ .

(d) Prove that if the speed is constant,  $\|\vec{r}'(t)\| = k = \text{constant}$ , then the velocity and acceleration vectors are orthogonal.

**Hint:** What is the value of  $\vec{r}'(t) \cdot \vec{r}'(t)$  and how is it related to the speed? Differentiate  $\vec{r}'(t) \cdot \vec{r}'(t)$ .

**802.** A particle travels on the path  $\vec{c}(t) = e^t\hat{i} + e^{-t}\hat{j} - \sqrt{2}t\hat{k}$ . Find the arc length between  $e^{-3}\hat{i} + e^3\hat{j} + 3\sqrt{2}\hat{k}$  and  $e^2\hat{i} + e^{-2}\hat{j} - 2\sqrt{2}\hat{k}$ .

**Hint:** In computing the speed, you will get the square root of a perfect square of a function. Simplify to get a function that's easy to integrate.

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #9 Additional Problems**  
**Due Wednesday March 14, 2018**

The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

**901.** Consider the rectangle  $R = [1, 3] \times [4, 5]$  in the  $xy$  plane.

A 3D object  $E$  lies above the rectangle  $R$  and below  $z = y + 2$ .

The units for  $x, y, z$  are cm. Include units in your answers.

The density at  $(x, y, z)$  is  $\rho(x, y, z) = e^x$  g/cm<sup>3</sup>.

(a) Compute the volume of  $E$  using

$$\text{Volume} = \iint_R ((z \text{ at top}) - (z \text{ at bottom})) dA.$$

(b) Compute the mass of  $E$  using

$$\text{Mass} = \iiint_E \rho(x, y, z) dV = \iint_D \int_{z \text{ at bottom}}^{z \text{ at top}} \rho(x, y, z) dz dA = \dots$$

(c) Compute the average density of  $E$ :

$$\text{Average of } \rho(x, y, z) \text{ over } E = \frac{\text{Mass of } E}{\text{Volume of } E}$$

**Math 20C, Winter 2018, Prof. Tesler**  
**Homework #10**

These problems are recommended for material covered at the end of the quarter. This homework is not due and will not be covered on the final exam, but it may help you with other classes you take later.

**Textbook problems:**

- 5.5# 22
- 1.4# 4, 6ab, 10ad
- 6.2# 3, 11, 13, 21, 24, 30