

CS 116 Final Examination  
University of Waterloo  
Term: Winter      Year: 2020

Date: Monday, April 1, 2020  
Time: 9:00 – 11:30 am (150 minutes)  
Instructors: A. Able, B. Baker, C. Charlie  
Lecture Section: 001-003  
Exam Type: Closed book  
Number of exam pages (includes cover page): 10  
Additional Materials Allowed: Reference Sheet

*Please Print*  
UWaterloo Quest ID \_\_\_\_\_  
Last Name \_\_\_\_\_  
First Name \_\_\_\_\_  
Username \_\_\_\_\_  
Section \_\_\_\_\_

Question	1	2	3	4	5	6	7	8	9	10	Total
Points	10	10	10	10	10	10	10	10	10	10	100

**Instructions**

1. This instruction area on the cover page will be seen by students. Change or add any instructions you like. Or, change the content of this area to something else. The following items are only suggestions and will not apply in every case.
2. Print your UWaterloo username, name and ID number at the top of this page.
3. Check for questions on both sides of each page.
4. Answer the questions in the spaces provided. If you require additional space to answer a question, please use the second last page and refer to this page in your solutions. You may tear off the last page to use for rough work.
5. Do not write on the Crowdmark QR code at the top of each page.
6. Use a dark pencil or pen for your work.
7. Answer multiple choice and true-false questions on the bubble page, the last page of the test.

..... Last line on cover page. Space below this line is used by Odyssey for page numbers. ....

---

Second page. Some sample questions.

- [4] 1. Suppose that  $\mathbf{F} = \nabla \times \mathbf{G}$ , for some vector field  $\mathbf{G}$ , where  $\mathbf{G} = (G_1, G_2, G_3)$ ,  $G_i : \mathbb{R}^3 \rightarrow \mathbb{R}$  and  $G_i \in \mathcal{C}^2$ ,  $i = 1, 2, 3$ . Show that  $\nabla \cdot \mathbf{F} = 0$ .

- [4] 2. Let  $\mathbf{F} = \frac{\mathbf{r}}{r^4}$ , where  $\mathbf{r} = (x, y, z)$  and  $r = \|\mathbf{r}\| = \sqrt{x^2 + y^2 + z^2}$ . Compute  $\nabla \cdot \mathbf{F}$ .

---

Alternative statements to students about blank pages in their answer books:

This page is intentionally blank.

This page intentionally left blank for scratch paper. Return it with your test.

This page is for rough work and will not be graded.

Extra pages for answers. Please specify the question number here and the use of this page on the question page.