

Math 203, Spring 2026 — Homework 2

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Due February 13

Instructions. This problem set contains problems from Week 2 of class. The problem numbers refer to the PDF version of our textbook, *Apex Calculus*, by Gregory Hartman.

Problem 1. Please do the following textbook problems:

- Section 10.3: 6, 8, 10, 28, 30, 32
- Section 10.4: 8, 10, 20, 24, 28, 36

Problem 2. Let $\mathbf{v} = \langle 5, 5 \rangle$, $\mathbf{w} = \langle 1, 3 \rangle$, and θ the angle between them. Find the following:

- a. $\cos \theta$.
- b. $\text{proj}_{\mathbf{v}} \mathbf{w}$.
- c. $\text{proj}_{\mathbf{w}} \mathbf{v}$.
- d. Sketch the vectors \mathbf{v} , \mathbf{w} , $\text{proj}_{\mathbf{v}} \mathbf{w}$ on the same axes, all with the same base point.

Problem 3. Let $\mathbf{v} = \langle 1, 0, 1 \rangle$, $\mathbf{w} = \langle 1, 1, 1 \rangle$, and θ the angle between them. Find the following:

- a. $\cos \theta$.
- b. $\text{proj}_{\mathbf{v}} \mathbf{w}$.
- c. $\text{proj}_{\mathbf{w}} \mathbf{v}$.

Problem 4. Let $\mathbf{v} = \langle 1, 1, 2 \rangle$, $\mathbf{w} = \langle 2, 0, 3 \rangle$, and θ the angle between them. Compute the following quantities.

- a. $\mathbf{v} \times \mathbf{w}$
- b. $\mathbf{w} \times \mathbf{v}$
- c. $\sin \theta$

Problem 5. Write vector equations of the lines given by the following descriptions.

- a. Passing through $P = (6, 1, 7)$ and parallel to $\mathbf{v} = \langle -3, 2, 5 \rangle$.
- b. Passing through the points $P = (1, -1, 1)$ and $Q = (4, 0, 1)$.
- c. Passing through the point $P = (0, 1, 2)$ and orthogonal to both $\mathbf{v} = \langle 2, -1, 7 \rangle$ and $\mathbf{w} = \langle 7, 1, 3 \rangle$.

Problem 6. The following two lines intersect:

$$\begin{aligned}\ell_1(t) &= \langle t, -2 + 2t, 1 + t \rangle \\ \ell_2(t) &= \langle 2 + t, 2 - t, 3 + 2t \rangle.\end{aligned}$$

Find their point of intersection by solving a system of three equations with two unknowns.

Problem 7. Consider the following two lines:

$$\begin{aligned}\ell_1(t) &= \langle 1 + 2t, 3 - 2t, t \rangle \\ \ell_2(t) &= \langle 3 - t, 3 + 5t, 2 + 7t \rangle.\end{aligned}$$

Determine whether they are the same line, parallel lines, intersecting lines, or skew lines.

Problem 8. If you liked the problems above or want more practice, our textbook has more great problems. Many odd-numbered ones have solutions in the back. Here are some that I recommend (as optional, not to be turned in):

- Section 10.3: 1-4, 5, 7, 9, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31
- Section 10.4: 1-6, 7, 9, 11, 13, 15, 19, 21, 23, 25, 27, 29, 35, 37
- Section 10.5: 1-4, 5, 7, 9, 11, 13, 15, 17, 19, 21

Feel free to try others, including the problems in the main sections, which include full explanations.