Group Meeting Instructions – Weekly Homework

Group meetings are your opportunity to make sure you feel good about the individual weekly homework assignment you just turned in by discussing the solutions with your peers and improving your collective understanding before having the homework graded for correctness. No answer key will be posted for weekly homework, and we don't discuss it in class, so this is a key opportunity for you to reflect on your understanding of the assignment.

Teams will consist of 2-3 people, and each week members should take turns assuming different roles for the meeting – organizer, scribe, or director.
- The **organizer** schedules the meeting and sends details to all members in advance.
- The **scribe** is the person who generates the group homework submission based on discussion at the group meeting. The scribe is also responsible for submitting the group assignment on Brightspace by the due date.
- The **director** makes sure time is being used efficiently, keeps the team on task, and ensures that everyone is contributing to the discussion.
- If your group only has two members, choose an organizer and scribe each week. Both members can share the role of director.

Your team should schedule a one hour meeting outside of class – either in person or on Zoom – to discuss the weekly homework problems and generate the group homework submission together. You need to meet in a manner where you can share your work and can have a conversation in real time.

During your meeting, you should thoroughly discuss each exercise, ensuring that you build a consensus on what a valid solution looks like for each problem. You should absolutely compare your final answers, but more importantly you should discuss **how** you worked through the problems from start to finish and **why** you did what you did. It is also useful to consider whether multiple valid approaches exist for solving the problem, what the key ideas were used to formulate a solution, and what posed difficulties and how they were resolved.

Each group homework assignment will contain a cover page where the scribe will record those present/absent for the meeting and where the group will respond to a reflection question for the assignment. The cover page should be inserted as the first page in the PDF file containing the group homework solutions. If you have difficulty combining the cover page and homework solutions into a single PDF file, you may submit one PDF file for the cover sheet and another containing the homework solutions. However, you must clearly label both files, so it is clear to the grader what each file contains (ex, HW01_Group, HW01_Coversheet).

The scribe will compile the group homework submission, but all team members are ultimately responsible for the final product. Before your meeting ends, all members of the team should approve of the planned (if not complete) group assignment. Also confirm that the assignment meets the expectations for group homework submissions and that the group has addressed the reflection question for the assignment. The scribe will upload the completed assignment to Brightspace on behalf of the entire team by the due date. Since everyone will earn the same grade on the group portion of the weekly homework, I recommend that the scribe text the group to notify them once the group assignment has been submitted, and the other members of the group confirm the assignment submission on Brightspace.

Cover Sheet for HW07 - Group

Instructions: Submit the completed version of this page as the first page in your group homework submission. You do <u>not</u> need to include the instructions on the previous page.

Note: You may only participate in the group meeting and earn credit for the group portion of the assignment if you have completed the individual part of the assignment (and have it with you) before the group meets.

Who attended this group meeting? _____

Which group members, if any, were absent? _____

Identify the role each member played:

Organizer: _____

Scribe: _____

Director (only for teams of 3): _____

Reflection [5 pt]: Recently we have been discussing two vector products – dot and cross products. Given two vectors **a** and **b**, answer the following questions:

- Describe two different ways to determine if are **a** and **b** co-linear (i.e., either parallel or anti-parallel). For one approach, use a dot product. For the other, use a cross product. Explain your reasoning.
- Describe two different ways to determine if are **a** and **b** are orthogonal. For one approach, use a dot product. For the other, use a cross product. Explain your reasoning.

Before your group meeting ends:
- Make sure everyone feels good about the content of the assignment. If there are any lingering questions, make a plan to come to office hours.
- Identify who will be the organizer for the next group meeting.

Due Dates

Individual Submission: Tuesday, November 5th (end of day)

Group Submission: Saturday, November 9th (end of day)

Instructions: Weekly homework exercises provide an opportunity for you synthesize the content from past week of class and to stretch outside your comfort zone by tackling challenging problems. Here you will practice writing clear, coherent, correct, and plausible solutions.

Before you begin this assignment, make sure that you carefully review the **Weekly Homework** section in the **Syllabus** and read the **Homework Expectations & Grading Rubric** document included with this assignment.

I care most about your ability to carefully reason your way through a problem, so unless directed otherwise, you should always show your work and explain your reasoning. Unsubstantiated answers will not receive credit.

Weekly homework will be submitted on Brightspace. Before submitting your assignment, convert your written work to a <u>single</u> PDF file with Adobe Scan, ensuring that the pages are oriented properly, your name and assignment number are on the the first page, and the problems are labeled and in order. Assignments that do not meet these criteria will not be graded.


<u>Note:</u> Make sure you use proper vector notation. Either place a right pointing arrow over your variable to denote a vector or, if typesetting your work, make the variable bold faced.

1. Use what you know about cross products to answer the following questions.

   (a) Find the vector $\vec{\mathbf{p}} = (\hat{\mathbf{j}} - 3\hat{\mathbf{k}}) \times (\hat{\mathbf{k}} - 2\hat{\mathbf{i}})$, not with determinants, but by using properties of cross products. Show your intermediate steps, and assume only that you know the cross product of two unit vectors.

   (b) State whether each expression is defined if all the operations denote **<u>vector</u>** products. If it is not, explain why. If it is, state whether the result is a vector or scalar quantity.

      i. $\vec{\mathbf{a}} \times (\vec{\mathbf{b}} \cdot \vec{\mathbf{c}})$

      ii. $\vec{\mathbf{a}} \times (\vec{\mathbf{b}} \times \vec{\mathbf{c}})$

      iii. $\vec{\mathbf{a}} \cdot (\vec{\mathbf{b}} \cdot \vec{\mathbf{c}})$

      iv. $(\vec{\mathbf{a}} \times \vec{\mathbf{b}}) \cdot (\vec{\mathbf{c}} \times \vec{\mathbf{d}})$

   (c) Find <u>two</u> unit vectors that are orthogonal to $\vec{\mathbf{u}} = 4\hat{\mathbf{j}} - \hat{\mathbf{k}}$ and $\vec{\mathbf{v}} = -2\hat{\mathbf{i}} + \hat{\mathbf{j}}$. Do not use a guess-and-check approach. Rather, perform calculations that let you find the vectors. Show your work, and explain your reasoning.

Plausibility: Perform a calculation with your unit vectors in part (c) that confirms that they are indeed perpendicular to $\vec{u}$ and $\vec{v}$. Show your work, and explain your reasoning.

2. Consider a parallelepiped with adjacent edges PQ, PR, and PS with vertices located at P(3,0,1), Q(-1, 2, 5), R(5, 1, -1), and S(0,4,2).

   (a) Duplicate the sketch below and then lightly shade the parallelogram whose adjacent edges are PQ and PR.
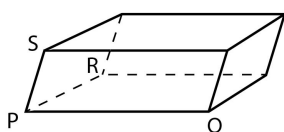
   (b) Starting with $\|\overrightarrow{PQ} \times \overrightarrow{PR}\|$, carefully explain why this corresponds to the area of the shaded parallelogram in your sketch. Add the appropriate angle to your sketch.

   (c) Now calculate the area of this parallelogram. Show your work.

   (d) Starting with the knowledge that the volume of a parallelepiped is given by the product of the area of the base and the height, explain why the volume of the parallelepiped is given by $|\overrightarrow{PS} \cdot (\overrightarrow{PQ} \times \overrightarrow{PR})|$. Add the vector $\overrightarrow{PQ} \times \overrightarrow{PR}$ and the appropriate angle to your sketch.

   (e) Finally, calculate the volume of the parallelepiped. Show your work.

   Plausibility: Choose a different parallelogram for the base of the parallelepiped and show that you get the same volume for the object. Show your work.

3. Consider the cross product $< 1, 2, 1 > \times \vec{v}$ for the following exercises.

   (a) Find all the vectors such that $< 1, 2, 1 > \times \vec{v} = <3, 1, -5 >$. Show your work.
   <u>Hint:</u> There is more than one.

   (b) Explain why there is no vector $\vec{v}$ such that $< 1, 2, 1 > \times \vec{v} = <3, 1, +5 >$.

   Plausibility: You do <u>not</u> need to include a plausibility assessment for this question.