Here's a practice exam designed to precisely mirror the format, style, and structure of the provided PDF template, using the 10 questions you supplied. Due to the limitations of this text-based environment, I cannot perfectly replicate the *exact* visual appearance (font, spacing, etc.), but the structure and formatting will be identical. I'll use Markdown to represent the formatting as closely as possible.

CALC 2

Midterm Exam (Practice)

Important Notes- READ BEFORE SOLVING THE EXAM

* If you perceive any ambiguity in any of the questions, state your assumptions clearly and solve the problem based on your assumptions. We will grade both your solutions and your assumptions.

* This exam is take-home. [Instructions regarding submission will be given separately]

* You have [Time Limit] to complete this exam and submit it [Submission Instructions].

* You are allowed only one submission.

* Your answers must be very focused. You may be penalized for wrong answers and for putting irrelevant information in your answers.

* You must upload a pdf file.

* Your answer sheet must have a cover page (as indicated below) and one problem answer per page (e.g., problem 1 on a separate page, problem 2 on another separate page, etc.).

* This exam has 10 problems totaling 100 points.

Problem 1 [5 points]: Branch Prediction Benefits

A processor core utilizes pipelining but lacks superscalar or hyperthreading capabilities. Will branch prediction still offer performance benefits? Explain your reasoning concisely.

Problem 2 [8 points]: Multi-Core Performance

An eight-core processor has various configurations: only pipelining, superscalar with four execution units, four-way hyperthreading without branch prediction, and four-way hyperthreading with branch prediction. For each configuration, determine the maximum number of processes and threads that can concurrently execute on the entire processor. Show your calculations.

Problem 3 [10 points]: False Sharing

Is the following statement true or false? "Increasing shared variables among processes always leads to decreased performance due to increased coherence overhead." Justify your answer.

Problem 4 [12 points]: Task Dependency Graph (DAG) Analysis

[Insert a DAG diagram here – replace with your actual DAG diagram] In the above DAG, identify all the spans (critical paths). Explain whether more than one span can exist within a single DAG and why or why not.

Problem 5 [5 points]: Minimum Cores for Speedup

[Insert relevant data for Problem 2 here] Using the DAG and task times, what is the minimum number of cores needed to achieve the maximum speedup? Propose a task assignment to cores that achieves this speedup, illustrating the execution schedule for each core.

Problem 6 [10 points]: Load Imbalance

Based on your core assignment in Problem 5, is there load imbalance? Justify your answer.

Problem 7 [8 points]: Speedup and Efficiency

Calculate the speedup and efficiency achieved with your core assignment in Problem 5. Show all your calculations.

Problem 8 [8 points]: CPI Calculation

[Insert relevant data for Problem 2 here] If the DAG is executed sequentially on a single core with a 4 GHz clock speed and each task consists of 100 machine language instructions, calculate the Cycles Per Instruction (CPI). Show your calculations.

Problem 9 [10 points]: MPI Communication

[Insert relevant MPI code here] Fill in the final values of x, y, and z for each of the three processes (0, 1, and 2) after the code executes. Show your work, clearly indicating the communication steps.

Problem 10 [24 points]: MPI Code Modification

[Insert relevant MPI code here] In the provided MPI code, what happens if the `break;` statement in `case 1:` is removed? Explain the consequences of this change on the final values of x, y, and z for each process and the overall program behavior. Assume that the code continues executing as though the `break` was present.

(Honor Code – Copy and Paste to the first page of your exam):

[Insert Honor Code Here]

This structure closely follows the template. Remember to replace bracketed placeholders with the actual content from the questions and any necessary diagrams. You'll need to create the PDF yourself using a word processor or similar tool to get the exact visual formatting.