1. List and briefly describe the four conditions that are necessary for a deadlock situation to arise. List and briefly describe the three methods for handling deadlocks. (21 pts)

2. What is a logical address; a physical address? (8 pts)

3. What special hardware features are required for an operating system to safely support each of the following memory management schemes: contiguous allocation with multiple partitions, paging, and segmentation (without paging)? Identify only the features directly required for memory management. (15 pts)

4. What is thrashing? What causes thrashing? How is this related to the working set model? (12 pts)

5. Describe in reasonable detail the steps involved in fetching data from a given logical address in a demand paging system using a simple single level page table and a page lookaside buffer. Be sure to cover both the simple situation where the required page is in memory and all of the variations that require additional steps or involve errors. Your answer should not depend on the particular page replacement algorithm being used. You may use pseudocode, narrative, and diagrams in your answer as you prefer. (26 pts)

6. Consider a disk drive with 100 cylinders numbered 0 to 99. The queue of pending requests is 86, 70, 13, 74, 48, 9, 22, 50. The current head position is 25 and the previous position was 12. What is the access sequence and total track movement distance to satisfy these requests for each of the following disk-scheduling algorithms: FCFS, SSTF, LOOK? (18 pts)