1. What is the difference between synchronous I/O and asynchronous I/O, and in what way is asynchronous I/O “better”? (10 points)

2. One of the states in the five-state process model is the “blocked” state (sometimes called the “waiting” state).
   
   a. A process or thread may go into the blocked state when it is waiting on an I/O operation to complete. Give an example that illustrates this situation. (5 points)
   
   b. Besides waiting on an I/O operation to complete, why else might a process or thread be in the blocked state? (10 points)
3. Consider the various possible types of message-passing.
   a. Using direct communication, is it possible for a process to receive messages from more than one sender? Explain. (5 points)

   b. What is the major benefit that indirect communication provides over direct communication? (10 points)

4. Suppose three threads are all part of the same process.
   a. What resources do the three threads share? (8 points)

   b. What resources are associated with each individual thread? (7 points)
5. Semaphores can be used for both mutual exclusion and synchronization.
   a. In this context, what is meant by mutual exclusion? (8 points)
   b. In this context, what is meant by synchronization? (7 points)

6. There are many of similarities between semaphores and condition variables.
   a. What are the major differences between semaphores used for synchronization and condition variables, with respect to their operation inside a critical section of code? (10 points)
   b. When used for synchronization, suppose a semaphore V operation occurs before a semaphore P operation. What happens when the P operation executes, and why? (5 points)
c. Suppose a condition variable signal operation occurs before a condition variable wait operation. What happens when the wait operation executes, and why? (5 points)

7. What is the relationship between monitors, classes, and locks? (10 points)