1. Please fill in the blank. (each blank : 2%)

a. Each process has a segment of _____, called a critical section, in which the process may be changing _____ variables, updating a table, writing a file.

b. A semaphore S is an _____ variable that is accessed only through two standard _____ operations: wait and signal.

c. One protocol that ensures serializability is the _____ locking protocol. In _____ phase, a transaction may obtain lock, but may not _____ any lock.

d. At system boot time, the hardware starts in monitor mode. The operating system is then loaded, and starts user processes in user mode. Whenever a _____ or _____ occurs, the hardware switches from user mode to monitor mode.

e. A deadlock situation can arise if the following four conditions hold simultaneously in a system: _____, _____, _____, _____.

f. If a resource-allocation graph does not have a _____, then the system is not in a _____ state. The resource-allocation graph is not applicable to a resource-allocation system with _____ of each resource type.

g. One way to ensure that the circular-wait condition never holds is to impose a _____ ordering of all resource types, and to require that each process requests resources in an _____ order of enumeration.

h. A thread, sometimes called a Lightweight process (LWP), is a basic unit of CPU utilization, and consists of a _____, a _____ set, and a _____.

i. Files can be allocated space on the disk in three ways: through _____, _____, or _____ allocation. _____ allocation can suffer from external fragmentation. Direct-access files cannot be supported with _____ allocation.

j. A distributed system is a collection of processors that do not share _____ or a _____.

k. The FIFO page-replacement algorithm has a _____. The _____ rate may increase as the number of allocated memory frames increase.

l. Consistency semantics is an import criterion for evaluation of any file system that supports _____ of files. Currently there are three semantics : _____, _____, _____.

m. A process can be thought of as a _____ in execution.

2. Giving three process P1, P2, P3. Assume that: **(10%)**

P1 has burst time(interval) **a**, P2 has burst time **b**, P3 has burst time **c**

and

a < b < c

There are 6 scheduling sequences (for example P1 P2 P3 , P1 P3 P2, ...), please prove the sequence P1 P2 P3 has the minimum average waiting time by **mathematical** method.

3. Assume C language has a semaphore type. The readers/writers programs are shown below. Each statement has assigned a statement number. **(10%)**

```
1   semaphore mutex = 1 ;          /* control access to rc counter
2   semaphore db = 1;              /* semaphore for accessing database
3   int rc = 0;                    /* no. of reader process

4   void reader(void)
5   {
6           while (TRUE) {
7                   wait(&mutex);
8                   rc = rc + 1;
9                   if (rc == 1) wait(&db);
10                  signal(&mutex);
11                  read_database( );          /* access the database
12                  wait(&mutex);
13                  rc = rc - 1;
14                  if (rc == 0) signal(&db);
15                  signal(&mutex);
16                  use_data_read( );          /* noncritical section
17          }
18  }

19  void writer(void)
20  {
21          while (TRUE) {
22                  think_up_data( );          /* noncritical section
23                  wait(&db);
24                  write_database( );         /* update the database
25                  signal(&db);
26          }
27  }
```

Please answer the following question with **statement number**.

a. When a *writer* process is updating the database, at which statement is the *first reader* process waiting? At which statement all *other readers* (except *first reader*) are waiting?

b. In problem **a**, at which signal( ) statement is the *first reader* awaken ? Which process, and at which signal( ) statement, wakeup one of the *other readers* process?

4. In an UNIX system, a C program is shown in the following : **(10%)**

```
if (fork( ))
{
    /* code-section-A
}
else
{
    /* code-section-B
}
```

Please select the correct answer.

a. code-section-A is executed by
   ① parent-process　② forked child process　③ both processes

b. code-section-B is executed by
   ① parent-process　② forked child process　③ both processes

c. if execve( ) system-call used, the system call can be inserted into
   ① code-section-A　② code-section-B　③ both code-sections

d. What is execve( ) used for ?