1. 某进程中有3个并发执行的线程thread1、thread2和thread3，其伪代码如下所示。

```
//复数结构类型定义
typedef struct{
  floata;
  floatb;
}cnum;
cnum x, y, z; //共享变量

//计算两个复数和
cnum add( cnum p, cnum q ){
  cnum s;
  s.a =p.a + q.a;
  s.b =p.b + q.b;
  returns;
}
thread1{
  cnum w;
  w = add( x, y );
  ……
}

thread2{
  cnum w;
  w =add( y, z );
  ……
}

thread3{
  cnum w;
  w.a= 1;
  w.b= 1;
  z = add( z, w );
  y = add( y, w );
  ……
}
```

请添加必要的信号量和wait( )、signal( )操作，要求确保线程互斥访问临界资源， 并且最大程度地并发执行。

简答题 (26 分)　7分

```
semaphore mutexy = 1;
semaphore mutexz = 1;
semaphore wrty = 1;
semaphore wrtz = 1;
int readcounty = 0;
int readcountz = 0;
```

答案解释:

semaphoremutex_y1=1；//mutex_y1用于thread1与thread3对变量y的互斥访问。

semaphoremutex_y2=1；//mutex_y2用于thread2与thread3对变量y的互斥访问。

semaphoremutex_z=1；//mutex_z用于变量z的互斥访问。

互斥代码如下：

```
thread1{
cnum w;
wait(mutex_yl );
w = add(x, y );
signal(mutex_yl );
......
}
thread2{
 cnum w;
 wait( mutex_y2 );
 wait( mutex_z);
 w =add( y, z);
 signal( mutex_z );
 signal( mutex_y2 );
 ......
}
thread3{
 cnum w;
 w.a = 1;
 w.b = 1;
 wait( mutex_z );
 z = add( Z, w);
 signal( mutex_z);
 wait( mutex_yl );
 wait( mutex_y2);
y = add(y, w);
signal( mutexyl );
signal( mutexy2);
......
}
```

2. In a system, there are multiple producer processes which produce numbers to a buffer and multiple consumer processes which consume numbers from the buffer, where the buffer is shared among all producers and consumers. The following variables are shared among all processes:

int nextc=0, nextp=0,buf[10];

semaphore full; empty;mutex;

Producer and consumer processes are given in thefollowing C++-like pseudo programs

```
Producer Process:                          ConsumerProcess:
int itemp;                                  int itemc;
while(1){                                  while(1){
1    itemp = rand(); // Generate a number   1    P(full);
2    P(empty);                             2   P(mutex);
3    P(mutex);                             3   itemc=buf[nextc];
4    buf[nextp]=itemp;                     4    nextc=(nextc+1)%10;
5    nextp=(nextp+1)%10;                    5    V(mutex);
6    V(mutex);                             6    V(empty);
7    V(full);                              7    cout<< itemc << endl;
}                                              }
```

(1) What are the critical sections in the givenproducer and consumer processes?

(2) How should the semaphores **full, empty**, and **mutex** be initialized?

(3) If we switch the order of 2 and 3 in the producer process and the order of 1and 2 in the consumer process,would the system still work properly? Justify your answer.

```
Producer Process                          ConsumerProcess
…                                                 …
1 itemp = rand(); // Generatea number      1 P(mutex);
2 P(mutex);                               2P(full);
3 P(empty);                               3itemc=buf[nextc];
…                                           …
```

简答题 (12 分)　12分

```
1) Producer:
  buf[nextp]=itemp;
  nextp=(nextp+1)%10;
  Consumer:
  itemc=buf[nextc];
  nextc=(nextc+1)%10;
```

答案解释:

(1) Producer: Lines4 and 5.

Consumer: Lines 3 and4.

(2) empty = 10,mutex = 1, and full = 0.

(3) No, the systemmay be deadlocked. For example, if a producer gets mutex semaphore but there isno more empty item, no consumers can continue and the system is deadlocked.

3. In the producer-consumer problem, the orderof wait operations cannot be reversed, while the order of signal operations can be reversed.

判断题 (4 分)　4分

A. TURE

B. FALSE

正确答案: A

4. As to semaphores, we can think an execution of signal operation as applying for a resource.

判断题 (4 分)　4分

A. TURE

B. FALSE

正确答案: B

5. Critical section can be enforced with ageneral semaphore whose initial value is greater than 1.

判断题 (4 分)　4分

A. TURE

B. FALSE

正确答案: B

6. Suppose 9 producers and 6 consumers share a buffer with size of 8. In order to use the buffer properly, the semaphore mutex of critical section of the buffer is initialized to _____ 。

单选题 (5 分)　5分

A. 1

B. 6

C. 8

D. 9

正确答案: A

7. Suppose 5 processes share mutual exclusive sections. If 3 processes are permitted to enter the mutual exclusive sections at the same time, then the semaphore of mutual exclusion sections should be initialized to _____。

单选题 (5 分)　5分

A. 0

B. 1

C. 3

D. 5

正确答案: C

Which of the following Critical Section problem solutions results in busy-waiting?

8.

单选题 (5 分)　5分

A. Monitor

B. Special machine instruction

C. Semaphore

D. critical region

正确答案: B

9. Suppose that a process is executing “counter=counter+1” while another process is executing concurrently and independently “counter=counter-1”, where the counter is a variable shared between the two processes. Given that the value of counter is five before execution,the possible value(s) after both processes finish their statement are .

单选题 (5 分)　5分

A. Four

B. Five

C. Six

D. All of above

正确答案: D

10. The mutual exclusion semaphore of two concurrent processes has the value 0 (zero) at this moment. It indicates that_____.

单选题 (5 分)　5分

A. no process has entered the critical-section

B. a process has entered the critical-section, and no process is being blocked

C. a process has entered the critical-section,another process is waiting to enter the critical-section

D. two processes have entered the critical-section

正确答案: B

11. The initial value of semaphore S is 2. if the value is -3 at present, how many processes are blocked on this semaphore .

单选题 (5 分)　5分

A. 1

B. 2

C. 3

D. 4

正确答案: C

12. Three processes are synchronizing on a shared code segment which is protected by a semaphore. If at most two processes are allowed to enter the code segment simultaneously, which of the following results shows the possible values that the semaphore may have?

单选题 (5 分)　5分

A. 2, 1, 0, -1

B. 3, 2, 1, 0

C. 2, 1, 0, -1, -2

D. 1, 0, -1, -2

正确答案: A

13. 有两个进程P1和P2描述如下:

```
shared data:
int counter = 6;
P1 :
    Computing;
    counter=counter+1;
P2:
   Printing;
   counter=counter-2;
```

两个进程并发执行，运行完成后，counter的值不可能为_____。

单选题 (5 分)　5分

A. 4

B. 5

C. 6

D. 7

正确答案: C

14. 下列哪一个问题只包含进程互斥问题?

单选题 (5 分)　5分

A. 田径场上的接力比赛

B. 两个进程都要使用打印机

C. 一个生产者和一个消费者通过一个缓冲区传递产品

D. 公共汽车上司机和售票员的协作

正确答案: B

15. 假设一个正在运行的进程对信号量S进行了P（WAIT）操作后，信号量S的值变为-1，此时该进程将_____。

单选题 (5 分)　5分

A. 转为等待状态

B. 转为就绪状态

C. 继续运行

D. 终止

正确答案: A