1. Which of the following is a correct implementation of the producer-consumer problem?

(a) 
```c
#define N 100
semaphore A=1; /*semaphore type already defined */
semaphore B=N;
semaphore C=0;

void producer(void)
{ int item;
  while(TRUE) /*TRUE is the constant 1*/
  {item=produce_item(); /*Get an item*/
   down(&A)
   down(&B)
   insert_item(item); /*Put item in shared buffer*/
   up(&C);
   up(&A);
  }
}

void consumer(void)
{ int item;
  while(TRUE) /*TRUE is the constant 1*/
  {down(&A)
   down(&B)
   item=remove_item(); /*Get item from shared buffer*/
   up(&C);
   up(&A);
   consume_item(item); /*Do something with item*/
  }
}
```

(b) 
```c
#define N 100
semaphore A=1; /*semaphore type already defined */
semaphore B=N;
semaphore C=0;

void producer(void)
{ int item;
  while(TRUE) /*TRUE is the constant 1*/
  {item=produce_item(); /*Get an item*/
   down(&B)
   down(&A)
   insert_item(item); /*Put item in shared buffer*/
   up(&A);
   up(&C);
  }
}

void consumer(void)
{ int item;
  while(TRUE) /*TRUE is the constant 1*/
  {down(&C)
   down(&A)
   item=remove_item(); /*Get item from shared buffer*/
   up(&A);
   up(&B);
   consume_item(item); /*Do something with item*/
  }
}
```
#define N 100
semaphore A=1; /*semaphore type already defined*/
semaphore B=N;
semaphore C=0;

void producer(void)
{
    int item;
    while(TRUE) /*TRUE is the constant 1*/
    {
        item=produce_item(); /*Get an item*/
        down(&C)
        down(&A)
        insert_item(item); /*Put item in shared buffer*/
        up(&A);
        up(&B);
    }
}

void consumer(void)
{
    int item;
    while(TRUE) /*TRUE is the constant 1*/
    {
        down(&B)
        down(&A)
        item=remove_item(); /*Get item from shared buffer*/
        up(&A);
        up(&C);
        consume_item(item); /*Do something with item*/
    }
}

(e) None of the above!
2. Which of the following depend on the program execution characteristic of locality of reference?
   (a) Race conditions
   (b) Virtual memory
   (c) Translation lookaside buffer
   (d) All of the above
   (e) b and c

3. Which of the following are true for page faults?
   (a) The contents of the page is incorrect.
   (b) It is a result of a virtual memory translation operation.
   (c) It causes the process to be terminated.
   (d) b and c
   (e) All of the above

4. Which of the following are true about race conditions?
   (a) Race conditions have non-deterministic results.
   (b) Race conditions are used to increase performance.
   (c) Race conditions can be prevented with semaphores.
   (d) a and c
   (e) all of the above

5. For a system with a round robin scheduler and the following performance characteristics:

   • The average cpu time in seconds used by a process is $T$.
   • It takes $S$ seconds to switch processes.
   • The schedulers time quantum is $Q$ seconds.

   What is the cpu efficiency when $S < Q < T$. Efficency is the process $T$ time divided by the total time.

   (a) $T/(S + T)$
   (b) $T/Q$
   (c) $Q/(Q + S)$
   (d) almost zero
   (e) almost 100%

6. Which of the following should be allowed only in the kernel mode?

   (a) disable all interrupts
   (b) write the time-of-day clock
   (c) change the virtual memory tables
   (d) read the time-of-day clock
   (e) a, b, c
7. For the following virtual memory page table what is the physical address for the virtual address, 20.

<table>
<thead>
<tr>
<th>Virtual Memory Address</th>
<th>Physical Memory Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>40K-44K</td>
<td>X</td>
</tr>
<tr>
<td>36K-40K</td>
<td>5</td>
</tr>
<tr>
<td>32K-36K</td>
<td>X</td>
</tr>
<tr>
<td>28K-32K</td>
<td>X</td>
</tr>
<tr>
<td>24K-28K</td>
<td>X</td>
</tr>
<tr>
<td>20K-24K</td>
<td>3</td>
</tr>
<tr>
<td>16K-20K</td>
<td>4</td>
</tr>
<tr>
<td>12K-16K</td>
<td>0</td>
</tr>
<tr>
<td>8K-12K</td>
<td>6</td>
</tr>
<tr>
<td>4K-8K</td>
<td>1</td>
</tr>
<tr>
<td>0K-4K</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) 800
(b) 8104
(c) 8212
(d) 220
(e) none of the above

8. A computer has a 48 bit virtual address and 32 bit physical address. Each page is 8K (2^13). How many entries in its page table. It has a single level page table.

(a) 48
(b) 2^35
(c) 8K
(d) 2^8
(e) 48 * 32

9. A computer system has enough room to hold four programs in main memory. Each program is blocked on I/O half of the time. What is the cpu utilization?

(a) 20.5
(b) 1 - 1/16
(c) 50%
(d) 100%
(e) Cannot be evaluated

10. Paged virtual memory systems do not perform memory compaction because:

(a) related pages are all located in adjacent page frames.
(b) there is more than enough memory.
(c) pages are all the same size.
(d) a and c
(e) all of the above