Seat No: _____ Student ID: _____

CITY UNIVERSITY OF HONG KONG

Course Code & Title: **CS3103 Operating Systems**

Session: **Semester A, 2009-2010**

Time allowed: **Two hours**

This paper has nine pages (including this page) and 8 questions in total.

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1. **Answer ALL the questions.**
2. **Write down your answers in the spaces provided.**
3. **Do NOT remove the staple or try to separate the paper.**
4. **This question paper should NOT be taken away**

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question	1	2	3	4	5	6	7	8	total
marks									

Question 1 (5 marks) Given a disk with 15-gigabyte of storage capacity and block size of 1024-bytes, what is the size of the bit-map for the disk?

Answer

Question 2 (5 marks) Calculate the Effective Access Time for the following Translation look-aside buffer (TLB) configuration:
The TLB hit rate is 95%; and
The memory cycle time is 1 ms (1 ms = 10^{-6} second);
The TLB search time is 20 ns (1 ns = 10^{-9} second).

Answer

Question 3 (5 marks) Explain what access permissions of file1 are assigned to each class of users by a the following command in Unix:

```
chmod 744 file1
```

Answer

Question 4 (10 marks) Given the current disk head at cylinder 53 and a disk queue with requests for I/O to blocks on cylinders 98, 183, 37, 122, 14 , 124, 65, 67, in that order, use the FCFS, SSTF, and C-Look disk scheduling algorithms, respectively. What is the head movement sequence and what is the total head movement number for each algorithm. Which algorithm(s) can be chosen as the default algorithm for an operating system and why?

Answer

Question 5 (10 marks) The following are the reader process and the writer process for a solution of the reader-writer synchronization problem (which allows multiple readers to read at the same time but only one single writer to access the shared data at the same time). Mark up the problem(s) (errors) if there is any and provide the correction at a place close to each error.

The structure of a writer process is shown in the following answer box.

Answer

```
do {
      signal (wrt) ;

       //   writing is performed

      signal (wrt) ;

   } while (true);

do {
      wait (mutex) ;

      readercount ++ ;

      if (readercount == 1)
         signal (wrt) ;

      signal (mutex)

          // reading is performed

      readercount  - - ;

      if readercount  == 0)
         wait (wrt) ;

      wait (mutex) ;
   } while (true);
```

Question 6 (15 marks) Given the following reference string:

7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1,

(a) Run the FIFO page replacement algorithm on the above reference string with a **4** free frame physical memory and computing the number of page faults on that string,

(b) Run the Optimal page replacement algorithm on the above reference string with a **3** free frame physical memory and computing the number of page faults on that string.

(c) Is it possible to develop a real Optimal page replacement algorithm practically running in an OS? Why?

Answer to (a)

Answer to (b)

Answer to (c)

Question 7 (20 marks) Question 7 relates to CPU Scheduling. The arrival and processing times of four processes, A, B, C, and D are given in the following table:

Process Name	Arrival Time	Processing Time
A	0	4
B	1	2
C	2	8
D	3	3

Questions:

7(a) What effect does the size of time quantum have on the performance of a round robin (RR) algorithm? **(2 marks)**

Answer

7(b) Draw the schedule for each of the following three CPU Scheduling algorithms using squares (with each square representing one time unit); the name in the square refers to the currently-running process's name. **(9 marks)**

1. FCFS
2. SJF (preemptive)
3. RR (time quantum = 2).

Answer

7(c) Compute the finish time, response time, and turnaround time for each of the above algorithms and fill in the following forms. **(9 marks)**

Answer

Question 8 (30 marks) Question 8 relates to Deadlock.

8(**a**) **(3 marks)** What are the three general ways that a deadlock can be handled?

Answer to (a)

8(**b**) **(4 marks)** Describe the four conditions that must hold simultaneously in a system if a deadlock is to occur.

Answer

8(c) **(6 marks)** List a few methods to recover from deadlocks and how to execute each of these methods.

Answer

8(d) **(4 marks)** A system has 3 types of resources, A, B, C and D. There are a total of 3 number of resource A, 14 number of resource B, 12 number of resource C and 12 number of resource D. Given the following snapshot of a system, use the banker's algorithm to check if the system is in a safe state by giving the full steps of the algorithm.

	Allocation	*Max*
	ABCD	*ABCD*
P0	0212	0422
P1	1500	1750
P2	1354	2356
P3	0032	0652
P4	0314	0656

Answer

8(e). (13 marks) In the case of (d), if a deadlock happens, which processes should abort to recover from the deadlock? Explain your answer. Then prove that the state is safe after the process(es) is/are terminated using the banker's algorithm and give the full steps of the algorithm.

Answer

- END -