Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	OPERATING SYSTEMS
COURSE CODE	:	BIT 20403
PROGRAMME CODE	:	BIT
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

SECTION A
Instruction: State either TRUE (T) or FALSE (F) for each of the following statements.

Q1 If a process is fully used its allocated time slot, a timer interrupt occurs and the process is placed in a blocked queue.

(1 mark)

Q2 A process can be terminated due to normal exit, fatal error or killed by another process.

(1 mark)

Q3 The First Come First Serve (FCFS) scheduling algorithm allocates the Central Processing Unit (CPU) to the process that requests the CPU first.

(1 mark)

Q4 In priority scheduling algorithm, when a process arrives at the ready queue, its priority is compared with the priority of all processes.

(1 mark)

Q5 A system has 3 processes sharing 4 resources. If each process needs a maximum of 2 units then, deadlock can never occur.

(1 mark)

Q6 Priority swapping is when a higher priority process arrives and wants service, the memory manager can swap out the lower priority process to execute the higher priority process. As the higher priority process finishes, the lower priority process is swapped back in and continues execution.

(1 mark)

Q7 Page fault occurs when a program tries to access a page that is mapped in address space but not loaded in physical memory.

(1 mark)

Q8 The invalid bit indicates the page is in buffer.

(1 mark)

Q9 The bit will be `1` if the block of free-space list is free.

(1 mark)

Q10 In the linked allocation, the directory contains a pointer to the first and last block.

(1 mark)

SECTION B

Q11 Based on **Table Q11**, a uniprocessor computer system has 3 processes P1, P2 and P3 each execute a loop of 100 iterations. In each iteration of the loop, a process performs a single computation that requires CPU-t milliseconds and then initiates a single I/O operation that lasts for IO-t milliseconds. It is assumed that the operating system of the computer assigns different I/O devices to each process. The processes P1, P2 and P3 are started at times 0, 5 and 10 milliseconds respectively, in a pure time sharing system (round robin scheduling) that uses a time slice of 50 milliseconds.

Table Q11

Process ID	CPU-t	IO-t
P1	100ms	300ms
P2	350ms	300ms
P3	200ms	300ms

(a) Draw **FOUR (4)** possible Gantt charts to illustrate the process execution.

(8 marks)

(b) Calculate the time in milliseconds at which P3 would complete its first I/O operation.

(2 marks)

Q12 Assume every process requires 3 seconds of service time in a system with single processor. If new processes are arriving at the rate of 10 processes per minute, then estimate the fraction of time CPU is busy in system.

(3 marks)

Q13 Three processes P1, P2 and P3 are going to be scheduled on a uniprocessor system. The priorities, CPU time requirements and arrival times of the processes are shown in **Table Q13**.

Table Q13

Process	Priority	CPU-t	Arrival time (hh:mm:ss)
P1	10(highest)	20 sec	00:00:05
P2	9	10 sec	00:00:03
P3	8 (lowest)	15 sec	00:00:00

Calculate the turnaround times of P2 using:

(a) preemptive scheduling

(3 marks)

(b) non-preemptive scheduling

(3 marks)

Q14 A system has 4 processes and 5 resources. The current allocation and maximum needs are shown in **Table Q14**. Show your works to identify the smallest value of n to make sure the system is in safe state.

Table Q14

Process	Allocated					Maximum					Available				
Process A	1	0	2	1	1	1	1	2	1	3					
Process B	2	0	1	1	0	2	2	2	1	0	0	0	n	1	1
Process C	1	1	0	1	1	2	1	3	1	1					
Process D	1	1	1	1	0	1	1	2	2	1					

(7 marks)

Q15 Consider a system with 4 types of resources R1 (3 units), R2 (2 units), R3 (3 units) and R4 (2 units). A non-preemptive resource allocation policy is used. At any given instance, a request is not entertained if it cannot be completely satisfied. Three processes P1, P2 and P3 are executed independently and request the resources as in **Table Q15**.

Table Q15

```
Process P1:
t=0 : requests 2 units of R2
t=1 : requests 1 unit of R3
t=3 : requests 2 units of R1
t=5 : releases 1 unit of R2 and 1 unit of R1
t=7 : releases 1 unit of R3
t=8 : requests 2 units of R4
t=10: Finishes

Process P2:
t=0 : requests 2 units of R3
t=2 : requests 1 unit of R4
t=4 : requests 1 unit of R1
t=6 : releases 1 unit of R3
t=8 : Finishes

Process P3:
t=0 : requests 1 unit of R4
t=2 : requests 2 units of R1
t=5 : releases 2 units of R1
t=7 : requests 1 unit of R2
t=8 : requests 1 unit of R3
t=9 : Finishes
```

If all the three processes run concurrently starting at time t=0,

(a) Draw the resource allocation graph at time:

(i) t=8

(ii) t=9

(iii) t=10

(6 marks)

(b) Determine whether deadlock occurs or not. If yes, which processes are in deadlock?

(2 marks)

Q16 (a) Given a paging model of 32 byte memory with 2 byte pages as in **Figure Q16(a)**.

Logical Memory

Page 0	c d
Page 1	a b
Page 2	
Page 3	p q
Page 4	r s
Page 5	
Page 6	x y
Page 7	

Page Table

0	7
1	2
2	4
3	5
4	1
5	6
6	0
7	3

Figure Q16(a)

(i) Based on the page table and logical memory in **Figure Q16(a)**, draw a suitable diagram of physical memory using paging scheme.

(8 marks)

(ii) Calculate the physical address for logical address 13.

(2 marks)

(b) **Figure Q16(b)** indicates a part of memory, available for allocation. The memory is divided into segments of fixed sizes. The size of Segment 2 is 230K and Segment 3 is 350K. The segments will be loaded into memory using the First-Come-First-Served basis with the Best Fit algorithm.

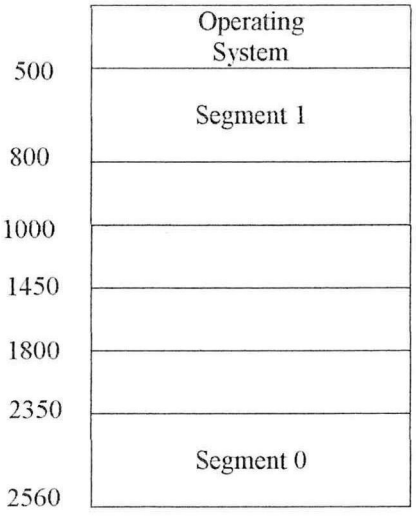

Figure Q16(b)

(i) Illustrate the results of the allocation by using appropriate diagram, after Segment 2 and Segment 3 successfully loaded into memory.

(4 marks)

(ii) Calculate the size of internal fragmentation, after Segment 2 and Segment 3 successfully loaded into memory.

(2 marks)

Q17 **Table Q17** shows 5 workers for ABC Development Sdn Bhd. Every week, a worker is randomly selected to work and need to stay in a room. However, there are only 3 rooms available at one time which cannot be shared. **Figure Q17** shows the schedule of worker for each week and available rooms. In week 1, worker's ID number 2 (Ali) is selected.

Table Q17

Worker's ID	Worker's Name
1	Abu
2	Ali
3	Mukmin
4	Muadz
5	Sofian

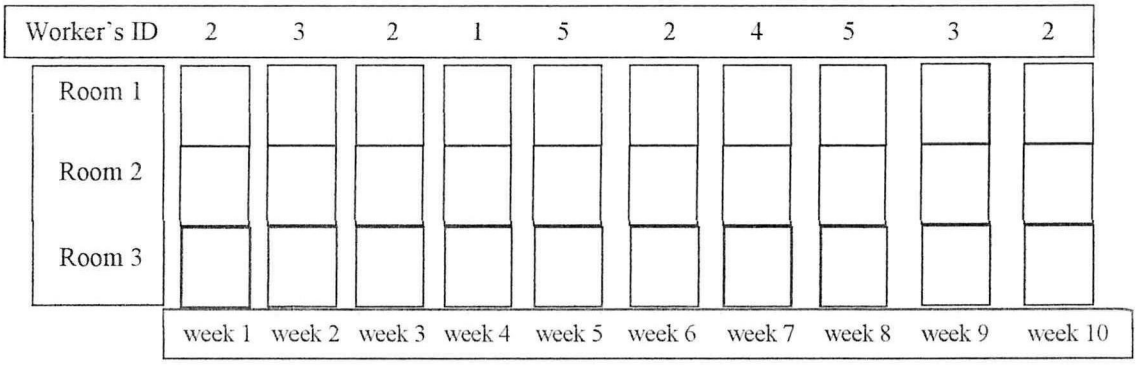

Figure Q17

Relate the above scenario with page replacement and illustrate the number of page faults using the following algorithms:

(a) Optimal Page Replacement (OPR) replacement algorithm.

(5 marks)

(b) Least Recently Used (LRU) replacement algorithm.

(5 marks)

Q18 **Figure Q18** shows a five-state process model. Answer the following questions.

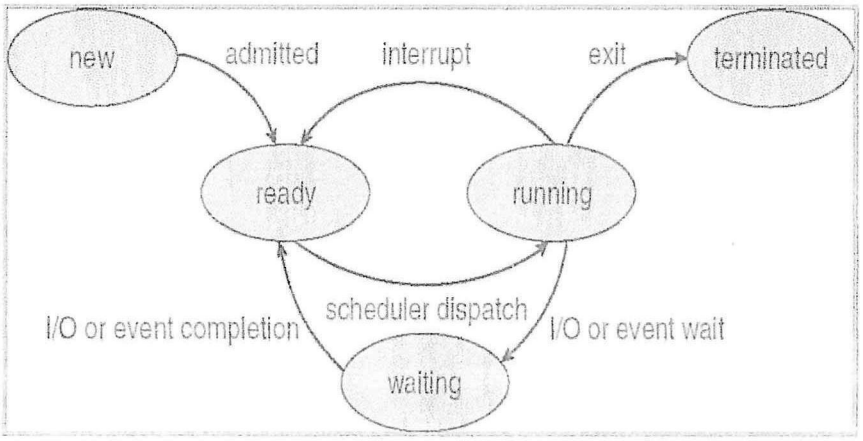

Figure Q18

(a) Discuss **THREE (3)** events that lead to the creation of a new process.
(6 marks)

(b) Elaborate **ONE (1)** important reason why a scheduler needs to distinguish between an I/O-bound process and a CPU-bound process.
(3 marks)

(c) **Figure Q18(c)** shows a simple C program. Answer the following questions.

```
#include <stdio.h>
#include <unistd.h>

int main()
{
      int i;
      for (i = 0; i < 3;  i++)
            fork();
      return 0;
}
```

Figure Q18(c)

(i) Illustrate the parent and child processes after running the program.
(5 marks)

(ii) How many child processes created by the program?
(1 mark)

Q19 **Figure Q19** shows a set of blocks of a secondary storage, each of which consists a block number. Analyze the figure and answer the following questions.

0	1	2	3	4
5	6	7	8	9
10	11	12	13	14
15	16	17	18	19
20	21	22	23	24

Figure Q19

(a) Assume that the size of each block is 512 B. How many blocks should be allocated for a file with a size of 2560 B?

(2 marks)

(b) **Figure Q19(b)** shows a directory entry for four files named JJ, KK, CJ and LT in a disk.

File	Start	Length
JJ	0	2
KK	4	4
CJ	15	1
LT	23	1

Figure Q19(b)

Based on **Figure Q19(b)**, illustrate the free space of the secondary storage using Bit Vector approach.

(6 marks)

(c) **Figure Q19(c)** shows a singly linked list data structure. Answer the following questions.

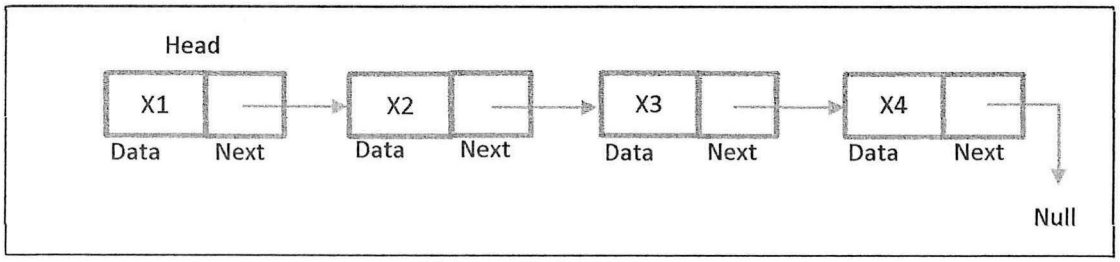

Figure Q19(c)

(i) Based on the answer in **Q19(b)**, a new file needs four blocks to be stored in the secondary storage. Assign the values of X1, X2, X3 and X4 when using Linked Allocation technique.
(6 marks)

(ii) What method can be used to access the file content of X3?
(1 mark)

- END OF QUESTIONS -