Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	OPERATING SYSTEM
COURSE CODE	:	BIC 20803
PROGRAMME CODE	:	BIS / BIP / BIW / BIM
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 Based on **Table Q1**, a uniprocessor computer system has three processes P1, P2 and P3 each executing 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 Q1

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

(a) Draw **ALL** the 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)

Q2 Assume every process requires three seconds of service time in a system with a single processor. If new processes are arriving at the rate of 10 processes per minute, then estimate the fraction of time the CPU is busy in the system.
(3 marks)

Q3 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 Q3**.

Table Q3

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)

Q4 **Figure Q4** shows an illustration of the single-thread process and multiple-thread process. Analyze **THREE (3)** differences between processes and threads.

(6 marks)

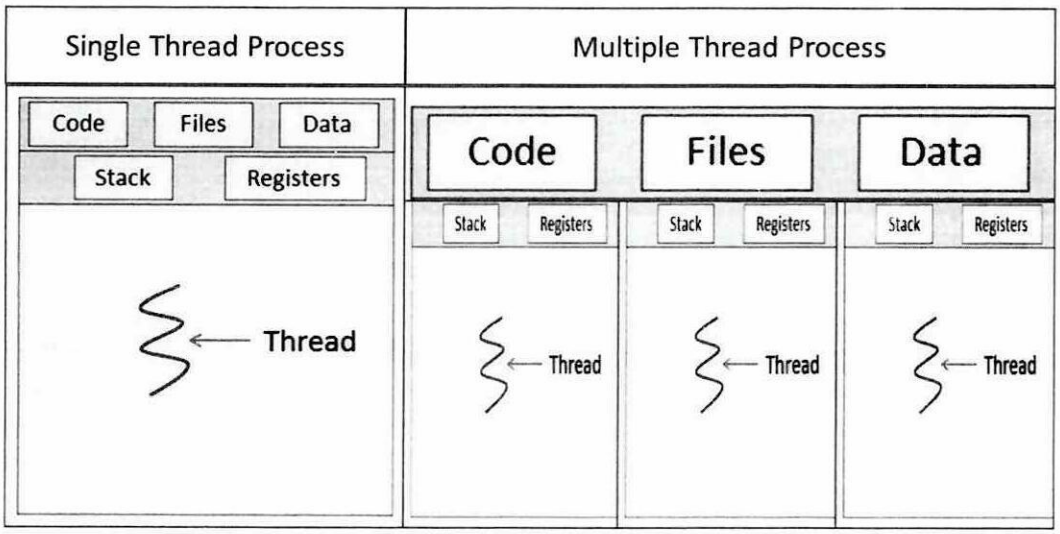

Figure Q4

Q5 Elaborate **ONE (1)** important reason why a scheduler must distinguish between an I/O-bound process and a CPU-bound process.

(3 marks)

Q6 **Figure Q6** 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 Q6

(a) Illustrate the parent and child processes after running the program.

(4 marks)

(b) How many child processes were created by the program?

(1 mark)

Q7 List **THREE (3)** examples of multiple threads happening while working on a Microsoft Word document.

(3 marks)

Q8 Consider a system with four 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 request the resources as in **Table Q8** if executed independently.

Table Q8

```
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 three processes run concurrently starting at time `t = 0`,

(a) Draw the resource allocation graph at the time:

(i) `t = 8`

(2 marks)

(ii) `t = 9`

(2 marks)

(iii) `t = 10`

(2 marks)

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

(2 marks)

Q9 (a) Based on the following scenario:

`Machine XY wants to run a process, but when it tries to access data or code that is in its address space, the data or code is not now present in the system's RAM.`

(i) Name the term of the above situation.

(1 mark)

(ii) Suggest a mechanism to handle the situation.

(4 marks)

(b) `Machine Z used a 1-KB page size and 16-bit address size.`

Calculate the page numbers and offsets for the following address references (provided as decimal numbers):

(i) `2375`

(2 marks)

(ii) `19366`

(2 marks)

(iii) `30000`

(2 marks)

(iv) `256`

(2 marks)

(v) `16385`

(2 marks)

Q10 (a) Consider a file system in which a file can be deleted and its disk space reclaimed while links to that file still exist.

(i) What problems may occur if a new file is created with the same absolute path name?

(4 marks)

(ii) Explain **TWO (2)** solutions to avoid these problems.

(4 marks)

(b) Discuss the Operating System functions in performing the following file operations:

(i) Creating a file

(2 marks)

(ii) Writing a file

(2 marks)

(iii) Deleting a file

(2 marks)

Q11 Given five memory partitions in order of `100 KB, 500 KB, 200 KB, 300 KB,` and `600 KB` and four processes in **Table Q11**.

Table Q11

Process	Size (KB)
P_1	214
P_2	420
P_3	115
P_4	430

(a) Illustrate the new memory partitions after all processes are loaded using the following algorithms:

(i) First fit

(3 marks)

(ii) Best fit

(3 marks)

(iii) Worst fit

(3 marks)

(b) Based on your answer in **Q11(a)**, discuss the most efficient algorithm for each of the following criteria:

(i) Speed

(2 marks)

(ii) Memory utilization

(2 marks)

Q12 Given the page reference sequence `1 3 5 4 2 4 3 2 1 0 5 3 5 0 4 3 5 4 3 2 1 3 4 5`

(a) Perform the access sequence with the replacement strategies as follows for the case of a cache capacity of four pages.

(i) Least Recently Used (LRU) Page Replacement Algorithm

(5 marks)

(ii) Optimal Page Replacement Algorithm

(5 marks)

(b) Calculate the hit rate and the miss rate for the LRU and Optimal scenarios.
(4 marks)

- END OF QUESTIONS –