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Faculty of Mathematics and Computer Science
Department of Computer Science

جامعة المسيلة
كلية الرياضيات و الإعلام الآلي
قسم الإعلام الآلي

$Exam : Operating Systems 1 (OS 1)$

Duration: 1h 30 - Documents: not allowed

Academic year : 2025 / 2026

Level : L2 Semester : 5

Date : 10/05/2026 (08 : 30 – 10 : 30)

First Name : ……

Last Name : ……

Group : ……

Score : … / 20

Exercise 1 : (Understanding Questions) (4.5 Points / 15 Minutes)

Q1) Would increasing the number of frames always decrease the number of page faults for a particular reference string for FIFO? Why or why not?

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Q2) The CPU scheduling can be preemptive and non-preemptive, what is the main difference between them?

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Q3) What are the two components of a virtual address used in segmented virtual memory?

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Q4) The text section of a process contains the program code; what are the other sections of the memory allocation for a process?

……

Q5) Identify the following in one phrase or sentence (do more than just expand the acronym, though).

a) PTE (Page Table Entry) : ……

……

b) Working set : ……

……

……

c) Thrashing : ……

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Exercise 2 : (Logical Addresses & Physical Addresses) (3 Points / 15 Minutes)

Q1) In paging, given the logical address **0xAFF9** (in hexadecimal) with a page size of **1024 bytes**, what is the page number and offset in decimal?

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Consider the following segment table (in hexadecimal) :

Segment #	Limit	Base
0	0x1000	0x1400
1	0x0400	0x6300
2	0x0400	0x4300
3	0x1100	0x3200
4	0x1000	0x4700

Q2) What are the physical addresses (in decimal) for the following logical addresses (segment # and offset)?

a) < 1, 1 001 >

……
……

b) < 3, 4 548 >

……
……

Q3) What are the logical addresses (segment # and offset) for the following physical addresses (in decimal)?

a) 16 374

……
……
……
……
……

b) 6 134

……
……
……
……
……

Exercise 3 : (Unix Process Creation) (2.5 Points / 10 Minutes)

Consider the following section of the code and assume that all fork system calls are successful.

```
void main() {
      int j = 2;
      pid_t pid;
      while (j >= 1) {
            pid = fork();
            j=j-1;
            if (pid > 0) {
                  printf("In parent %d. \n", j);
            }
            else {
                  printf("In child %d. \n", j);
            }
      }
}
```

Q1) What value is returned if **`fork`** system call is not successful?

……

Q2) Draw a process tree for the above program.	**Q3)** What will be printed?
……	……
……	……
……	……
……	……
……	……
……	……

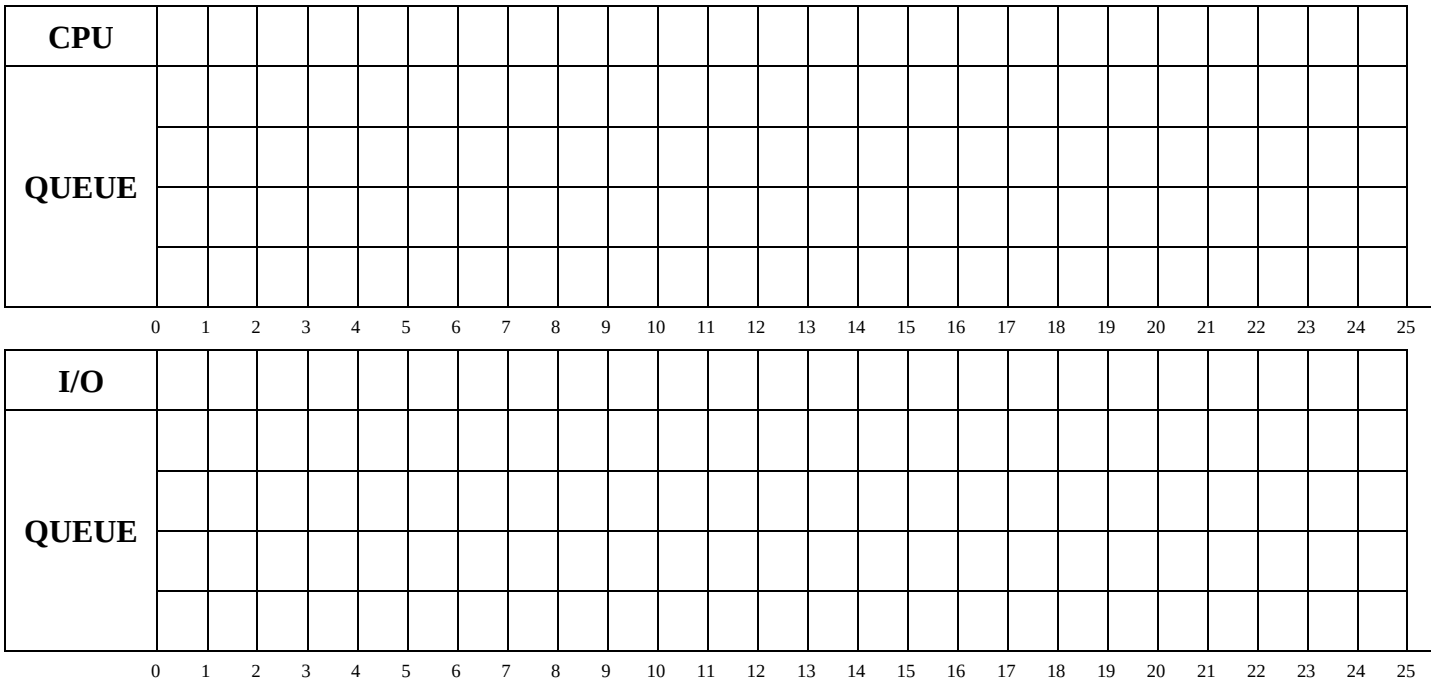
Exercise 4 : (CPU Scheduling) (4.5 Points / 20 Minutes)

Consider a single-processor system and the four processes **A**, **B**, **C** and **D**, which perform computation and I/O with a disk according to the times given below.

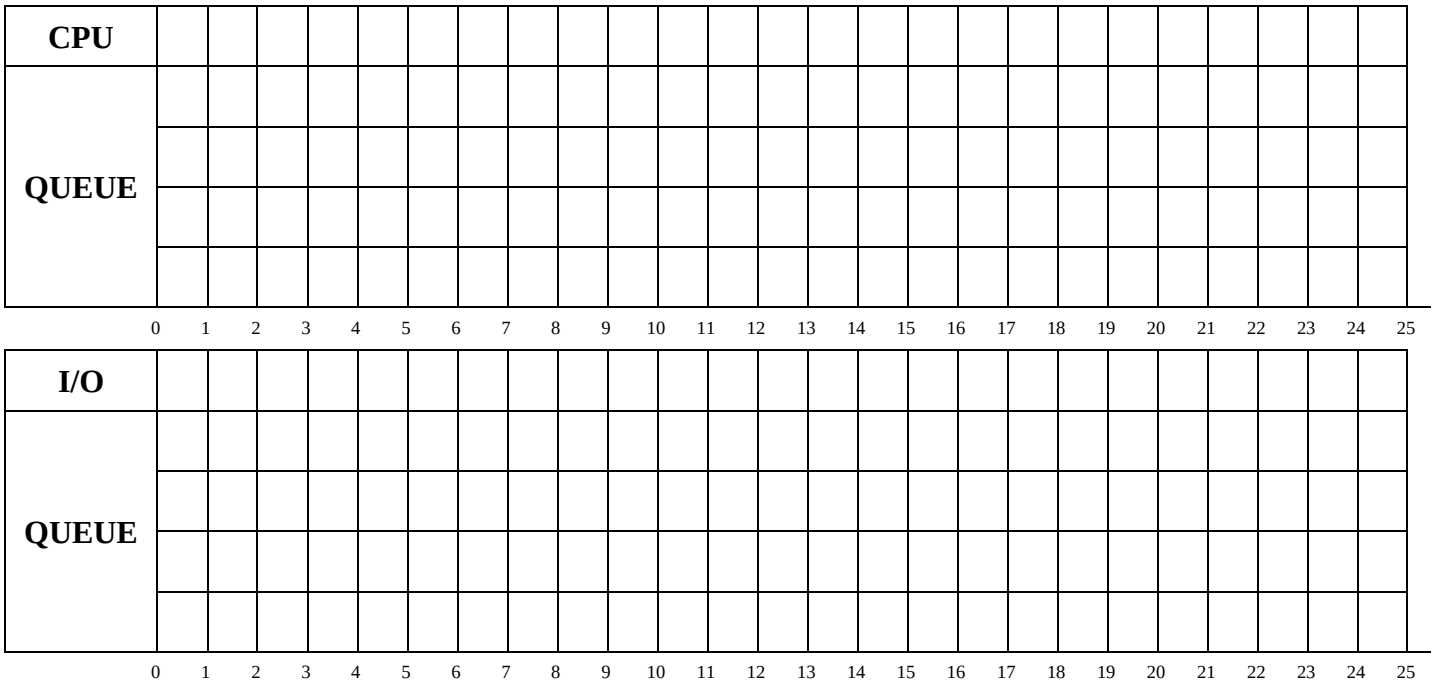
Arrival Time	Process	1st CPU	1st I/O	2nd CPU	2nd I/O	3rd CPU
2	**A**	2	3	2	3	2
4	**B**	4	1	4	-	-
5	**C**	2	1	2	-	-
8	**D**	1	1	1	1	1

The processes are available from the start, in this order : **A** then **B** then **C** then **D**. Give the execution charts for the following scheduling algorithms:

Q1) CPU scheduling policy is **FCFS** (First Come First Served) (Assume **FCFS for I/O**)



Q2) CPU scheduling policy is **Round Robin (RR) with Quantum=2** (Assume **FCFS for I/O**)



Q3) Calculate the **Turnaround Time (TR)** and the **Waiting Time (WT)** for each process.

	Turnaround Time (TR)				**Average**	**Waiting Time (WT)**				**Average**
Algorithm	**A**	**B**	**C**	**D**		**A**	**B**	**C**	**D**	
FCFS										
RR with Quantum=2										

Exercise 5 : (Paging) (3 Points / 15 Minutes)

Consider a system using paging technology and having the following characteristics:

- A page table with $\mathbf{2^{16}}$ $\boldsymbol{entries}$
- Each page table entry is coded on $\mathbf{16}$ $\boldsymbol{bits}$. An entry contains a frame number reference and a presence/absence bit.
- The offset is coded on $\mathbf{16}$ $\boldsymbol{bits}$
- A virtual address is indexed by $\mathbf{4}$ $\boldsymbol{Byte}$

Answer the following questions, always justifying your answer:

Q1) What is the size of a page?

……

……

Q2) How many frames does physical memory contain?

……

……

……

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……

……

Q3) What is the size of physical memory?

……

……

……

Q4) What is the size of virtual memory?

……

……

……

Q5) What is the size of the address bus in bits for this system?

……

……

……

……

Exercise 6 : (Replacement Algorithms) (4.5 Points / 15 Minutes)

Consider the following page reference string: **5, 2, 7, 3, 1, 1, 5, 7, 0, 3, 6, 2, 4, 3, 7**

Assuming demand paging with four frames, how many page faults would occur for the following replacement algorithms?

a) FIFO

FIFO														
Reference String	**5**	**2**	**7**	**3**	**1**	**1**	**5**	**7**	**0**	**3**	**6**	**2**	**4**	**3**	**7**
Frame 1															
Frame 2															
Frame 3															
Frame 4															
Page Fault															
Page Fault = ……															

b) LRU (Least Recently Used)

LRU														
Reference String	**5**	**2**	**7**	**3**	**1**	**1**	**5**	**7**	**0**	**3**	**6**	**2**	**4**	**3**	**7**
Frame 1															
Frame 2															
Frame 3															
Frame 4															
Page Fault															
Page Fault = ……															

c) Second-Chance

Second-Chance														
Reference String	**5**	**2**	**7**	**3**	**1**	**1**	**5**	**7**	**0**	**3**	**6**	**2**	**4**	**3**	**7**
Frame 1															
Frame 2															
Frame 3															
Frame 4															
Page Fault															
Page Fault = ……															

Good Luck