

Student Number:

THE UNIVERSITY OF MELBOURNE

COMP30023: Computer Systems Sample Mid-semester Test

Time allowed: 30 minutes.

Authorized materials: None.

Instructions to Students:

- This paper counts for 10% of your final grade.
- There are two parts to the test:

Part A – 6×1 mark multiple choice questions.

Part B – short answer questions worth a combined total of 14 marks.

- Attempt all questions.
- The writing area below/next to each question provides an indication of the maximum length of your answer. Please write your answer to each question in the appropriate box.

Note: you do not have to “fill up the box” to be awarded full marks – clear, concise and accurate answers will be allocated full marks.

Part A: multiple choice

[6 × 1 = 6 marks]

Pick the most appropriate answer to each of the following questions. Please write your answer to each of the questions in the boxes below.

Question	1.	2.	3.	4.	5.	6.
Answer						

1. An interrupt is similar to a trap in that they both:
 - (a) indicate the completion of an I/O operation
 - (b) indicate a user space request for OS service
 - (c) block the process currently using the CPU
 - (d) cause the processor to switch to kernel (or privileged) mode and branch to a handler
2. Which of the following best describes the relationship between a *process* and a *program*?
 - (a) a process is static while a program is dynamic
 - (b) a process is a sequential program in execution
 - (c) a process is the same as a program
 - (d) there is a one-to-one mapping between a process and a program
3. For a given file, the access permissions are modified to 764 using the `chmod` command. Which of the following interpretation are valid?
 - (a) every one can read, group can execute only and the owner can read and write
 - (b) every one can read and write, but owner alone can execute
 - (c) every one can read, group including owner can write, owner alone can execute
 - (d) every one can read, write and execute the file
4. The `wait` system call on UNIX systems puts a process to sleep until:
 - (a) a semaphore wakes it up
 - (b) the specified elapsed time expires
 - (c) a child process terminates.
 - (d) the process is preempted by another process.

5. Consider a system that uses paging. Suppose an instruction in process P references virtual address V, which is located in page G, offset O. A page fault occurs if:
- (a) G is larger than the number of frames in memory
 - (b) V is an address in kernel space
 - (c) O is larger than the page size
 - (d) the page table entry PageTable[G] indicates that page G is not in memory.
6. *Thrashing* is a term to describe which of the following scenarios?
- (a) excessive paging activity causing low processor utilization
 - (b) what occurs when a disk receives many I/O requests
 - (c) what occurs when a process references nonsequential pages in its address space
 - (d) an unstable system

Part B: short answer

[14 marks]

1. Briefly describe the key differences between *kernel* mode and *user* mode. [2 marks]

2. A UNIX file system has 1-KB blocks and 4-byte disk addresses. What is the maximum file size if i-nodes contain 10 direct entries, and one single, double and triple indirect entry each. [2 marks]

3. Explain the difference between *internal fragmentation* and *external fragmentation*. [2 marks]

4. Briefly describe the advantages of a system with page-based virtual memory compared to a simply system with base-limit registers that implements swapping. [3 marks]

5. Describe the actions taken by the Unix kernel when it services the system call `open(filename)`. What data structures are involved and how are they updated? [3 marks]

6. The three columns listed below give the (i) process number, (ii) burst time – how long the process needs the CPU, and (iii) priority value – a smaller value means a higher priority, for five processes. Each of the processes arrived at time $t = 0$. You may assume that the processes arrived in the order shown for scheduling purposes.

Calculate the *average waiting time* for all processes using the following scheduling algorithms: (a) priority (non-preemptive), and (b) round robin with quantum = 3. [2 marks]

A	4	2
B	6	4
C	3	1
D	5	3
E	4	5