

3 Operating Systems (rmm1002)

(a) *Interrupts* are a mechanism to decouple CPU requests from device responses. *Traps* are a mechanism for a user-space program to invoke a kernel function.

(i) How are interrupts handled in a modern UNIX-like operating system?

(ii) Why are traps sometimes referred as *software interrupts*?

[4 marks]

(b) A system has paged memory with memory access time of 80 ns, and a page-fault service time of 8 ms assuming a free frame is available. In the course of designing the paging system, you are given a target maximum *Effective Access Time* of 100 ns.

(i) What is the maximum permitted page-fault rate for your design to meet this target?

(ii) Unfortunately, your design only manages to achieve a page-fault rate that is double the maximum permitted. Calculate the resulting effective access time.

(iii) During testing with some real workloads, it is observed that half the page-faults actually occur when there are no free frames available. Calculate the resulting effective access time.

[12 marks]

(c) An innovative engineer wishes to ensure there is always at least one free frame available when a page fault occurs. To that end they propose the following scheme: whenever a page fault occurs that would require a frame to be swapped out, instead two frames are swapped out. State and discuss two system-wide performance implications of this proposal?

[4 marks]