

CS-477: Advanced Operating Systems

FULL NAME:

SCIPER:

Wait for the start of the exam before turning to the next page. This document is printed double sided, 3 pages. We have included two extra pages as extra sheets. Do not unstaple.

- This is a closed-book exam. No electronic devices are allowed.
- Place on your desk: your student ID.
- Place all other personal items below your desk or on the side.
- This exam contains two sections with a total of **2** written questions.

Do not write in the table below.

I (xx/8)	II (xx/12)	Total (xx/20)

Section I: Superpage

Question 1: *This question is worth 8 points.*

Let's say there is a file-backed superpage of size 512KB, and both the base page and the disk block size are 4KB.

A) If the application performs a stride, write at the base page level, meaning it writes to a page and then skips the next. Later when this superpage is selected as a victim, what is the write amplification of swapping this superpage to disk? (Write amplification means the ratio of the amount of data swapped to disk over the amount of data necessary to swap)

B) In the superpage paper, what is the technique to reduce such write amplification?

Section 2: TMO

Question 2: *This question is worth 12 points.*

The TMO paper discusses offloading memory to different mediums, including HDDs, NVMe SSDs, and compressed memory.

A) How does TMO ensure SSD endurance is not compromised during excessive memory offloading?

B) Why did the TMO designers still use the traditional kernel-based and page-based memory offloading approach over userspace, possibly an object-based offloading solution? What can be the tradeoffs