Important: This is an open book test. You can use any books, notes, or paper, but not exchange anything with other students. You are not allowed to use any electronic/communication devices, including a calculator and e-books. *Do not log into the computer during the test. Switch off your cell phones. Any device with an* ON-OFF *switch should have its switch in the* OFF *position.* Any calculations and rough work can be done on the back side of the test pages. You will lose five points for not writing your name.

1. [6 pt] During copy-on-write as a result of `fork(2)`, the kernel just assigns the parent's page frames to the child's address space. Does it allocate *any* memory exclusively to the child at all? If yes, explain what is the memory used for.

2. [6 pt] Under what circumstances does it become necessary to disable interrupts on a running process?

3. [6 pt] We know that a zombie process cannot be killed. Is it possible to somehow revive a zombie by changing its state?

4. [6 pt] Describe the difference between semaphore and condition operations – both `wait` and `signal`.

5. [6 pt] All the processes that are typically in a computer system have three phases: input, processing, and output. Yet, there are some processes that cannot take any input and do not produce any output. Can you give the generic name of those processes and give an example of two of them? How can we communicate with such processes because there is no input or output?

6. [6 pt] Describe spinlocks in Linux. Can spinlocks lead to a thundering herd?