1. The issue of resource utilization shows up in different forms in different types of operating systems. List what resources must be managed carefully in the following settings: (10%)
   a. Sever systems
   b. Desktops connected to servers
   c. Tablet

2. Run `ps` with `-u` option and show what is your current terminal type, the pid of `ps` command and parent pid of it. (10%)

3. Enter the following commands and report your observation. (10%)
   a. `who` and `tty`
   b. `tput clear`
   c. `id`
   d. `ps`
   e. `echo $$`

4. List five services provided by an operating system. Explain how each provides convenience to the users. Explain also in which cases it would be impossible for user-level programs to provide these services and how they are protected. (20%)

5) explain mechanisms that OS and hardware provides to ensure system resources and instructions are protected. (10%)

6) Describe how OS protects memory (10%)

7) Describe the actions a kernel takes to context switch between processes. (10%)

8) if you have to improve the context switch by reducing the overhead, what will you do (hints: software or hardware solutions) (10 %)

9) issue top command on your unix/linux (e.g. sample screen below is just an example only) and interpret what are all column across for each process (10%)

```
$ top
  16:52:32 up 10 days, 23:00, 2 users,  load avg: 0.32, 0.65, 0.73
  44 total, 1 running, 43 sleeping, 0 stopped, 0 zombie
Mem: 761M total, 328M used, 433M free, 16M buffers
Swap: 0 total, 0 used, 0 free, 21888k cached
PID USER      PR  NI  VIRT  RES  SHR S %CPU %MEM    TIME+ COMMAND
25628 root    20   0 2636 1124  94 R  1.9  0.0  0:00.30 top
31231 user    20   0  4760  208  56 S  0.1  0.1  0:33.61 wserver
3 root       20  -5  840  412  36 S  0.0  0.0  0:00.08 ksoftirqd/0
694 user      20  -5  840  412  36 S  0.0  0.0  0:00.68 ksoftirqd/0
```