HW 6 Solutions

Question 1

1.1

Answers can vary. Here are some items to consider:

- A high-performance computer used for large number crunching tasks: throughput (in order to get maximum performance), turnaround time (in order to ensure tasks are completed at a useful time)
- A multimedia computer (video games, movies...): response time (to ensure smooth playback)
- A smartphone: fairness/priority (UI tasks should respond quickly), low scheduling overhead (to conserve battery)
- A general-purpose computer on the CIMS network: fairness (each machine has many users)

1.2

Answers can vary. Here are some items to consider:

- A high-performance computer used for large number crunching tasks: Priority (allow important jobs to run), FIFO (lowest overhead, if the machine is only being used by one job at a time)
- A multimedia computer (video games, movies...): Priority (give multimedia programs higher priority)
- A smartphone: Priority (UI tasks should respond quickly)
- A general-purpose computer on the CIMS network: RR (allow all users to fairly use the machine), Stride/Lottery (ticket count can be controlled per-user)

1.3

Answers can vary. Here are some items to consider:

- A high-performance computer used for large number crunching tasks: RR with a small quantum (wasteful), STCF (starvation for large jobs)
- A multimedia computer (video games, movies...): MLFQ (wasted computation), STCF (penalizes long-running multimedia programs)
- A smartphone: FIFO (does not pair well with UI tasks)
- A general-purpose computer on the CIMS network: FIFO (one user submits a large job, the entire network is unusable for everyone else)

Question 2

```
    8     2^8           256 - 1 = 255
    16   2^16 = 64K     64K - 1
    32   2^32 = 4G      4G - 1
    48   2^48 = 256T    256T - 1
    64   2^64 = 16E     16E - 1  (E: Exabyte)
```

Question 3

```
  16   4K   16
  16   8K   8
  32   4K   2^20=1M
  32   8K   2^19=512K
  48   4K   2^36=64G
```

Question 4

```
  1KB   22    14    10
  2KB   21    13    11
  4KB   20    12    12
  8KB   19    11    13
```

Question 5

- The kernel's code and data has physical address range `0x40000--0x58000`
- The physical address of the kernel's stack is `0x7f000`.
- The virtual addresses are the same as the physical addresses, because for this range of the virtual address space, the kernel's page table uses the identity mapping.
- PAGENUMBER(MEMSIZE_PHYSICAL)

Question 6

6a. 7 pages, computed as 3 data pages plus 4 pages of metadata. **6b.** 2^9 + 6 (=518): computed as 5 pages of metadata (one L1 page table, one L2page table, one L3 page table, one L4 page table with 2^9 entries full, and one more L4 page table) + 2^9 + 1 data pages. **6c.** 2^18 + 2^9 + 6: Each L3 page table points indirectly to 2^18 last-level page entries (each L3 page table has 2^9 entries, each of which points to an L4 page table with 2^9 entries). Thus, the question requires two L3 page tables. The first L3 page table points to 2^9 L4 page tables; the second points to one L4 page table, for a total of 2^9 + 1 L4 page tables. Thus, the total is: 1+1+2+2^9+1 for the page structures (aka metadata) plus 2^18 + 1 for the pages themselves.