**1.4**

For (a) handheld devices, virtual memory is needed.

For (b) real-time systems, virtual memory and time-sharing are needed.

**1.17**

1. Jobs with similar needs are batched together and run through the computer as a group by an operator or automatic job sequencer. Performance is increased by attempting to keep CPU and I/O devices busy at all times through buffering, off line operation, spooling and multiprogramming. Batch the large jobs that need little interaction, it can be submitted old for exe and picked up later.
2. This kind of system is composed of many short-term trades, and the outcome of the next trade is unpredictable.
3. This system uses CPU scheduling and multiprogramming to provide economical interactive use of the system. The CPU switches rapidly from one user to another. Instead of having a job defined by spooled card images, each program reads its next control card from the terminal, and output is normally printed immediately to the screen.
4. It is often used for specific purposes. This system reads data from sensors and must respond within strict time frames to ensure correct performance.
5. It provides operating system features across a network such as a file sharing.
6. Each processor runs a copy of the same operating system. These copies communicate through the system bus.
7. This type of system involves distributed computing across several physical processors, which do not share memory or a clock. Each processor has its own local memory. They communicate through various communication channels.
8. A cluster system is formed by coupling multiple computers into a single system, distributed across the entire cluster to perform computational tasks.
9. A small computer system performs simple tasks such as calendars, email, and web browsing. Handheld systems differ from traditional desktop systems with smaller memory and display screens and slower processors.