1. List and define three techniques for performing I/O.

Programmed I/O: this involves the transfer of data between connected devices and the computer is controlled by the program requesting the I/O operation.

Interrupt-driven I/O: in this method, a program issues an I/O command and then continues to execute until it is interrupted by the I/O hardware to signal the end of the I/O operations.

Direct Memory Access (DMA) I/O: a specialized I/O processor takes over control of an I/O operation to move a large block of data12.

2. Calculate how much disk space (in sectors, tracks, and surfaces) will be required to store 300,000 120-byte logical records if the disk is fixed sector with 512 bytes/sector, with 96 sectors/track, 110 tracks per surface, and 8 usable surfaces. Ignore any file header record(s) and track indexes, and assume that records cannot span two sectors.

Number of logical records per sector = 512/120 = 4.3 ≈ 4.0

Required number of sectors = (300000 * 120) / (512 * 4) = 75,000 sectors

Required number of tracks = (75,000 / 96) = 781.25 ≈ 782 tracks

Required number of surfaces = (782 / 110) = 7.11 ≈ 8 surfaces

We need 75,000 sectors, 782 tracks, and 8 surfaces to store the given number of logical records.

3. Ignoring overhead for directories and file descriptors, consider a file system in which files are stored in blocks of 16K bytes. For each of the following file sizes, calculate the percentage of wasted file space due to incomplete filling of the last block: 41,600 bytes; 640,000 bytes; 4.064,000 bytes.

if files are stored in blocks of 16K bytes, then a file that is;

— 41,600 bytes will use 3 blocks (49,152 bytes) with 7,552 bytes wasted (15.4% wasted space).
— 640,000 bytes will use 40 blocks (655,360 bytes) with 15,360 bytes wasted (2.3% wasted space).
— 4,064,000 bytes will use 253 blocks (4,096,768 bytes) with 32,768 bytes wasted (0.8% wasted space).

4. What are some of the key characteristics of an embedded OS?

An embedded OS is designed to run on specific embedded devices and carry out specific tasks. Its main goal is to help the device operate seamlessly. There are a few key features that set an embedded OS apart, including low power usage, limited storage capabilities, and speedy, lightweight processing. It also needs to be able to work with a variety of input/output devices and carry out real-time operations.

5. Describe Type 1 and Type 2 virtualization and container virtualization.

When it comes to virtualization, there are a few different types to be aware of. Type 1 and Type 2 hypervisors are the two main categories. Type 1 hypervisors run directly on the physical host machine, while Type 2 hypervisors run on top of the host's operating system. The difference is that Type 1 hypervisors give virtual machines direct access to the underlying hardware, while Type 2 hypervisors do not.

Another form of virtualization is container virtualization, which is a lightweight alternative to traditional virtualization. With container virtualization, multiple applications can run on a single operating system kernel. Each container is isolated from the others and includes its own software, libraries, and configuration files. This makes them portable and consistent across different environments.