

Answers for the questions below can be found in the *Universal Serial Bus Specification* Revision 2.0 (also known as the “USB Standard”). The standard is available in hard-copy via the reserve collection at the Dordt Library. It is also available for free downloading from the Web. (A link is given on the Canvas homework page for this course.)

For each question below, provide an answer that is as complete as possible subject to the constraint that it is **less than 100 words**.

What is an **Isochronous Transfer**? (Section 5.6)

4/4 In a non-USB environment, there is the implication of constant-rate, error-tolerant transfers. In a USB environment, it allows the requester access to USB bandwidth with bounded latency, constant data rate through the pipe as long as data is being provided, and in case of a delivery failure because of error, it will not retry to send the data over and over again. It is only in one direction so there must be two pipes to send things back and forth. It can only be used by full-speed and high-speed devices. The data limit is either 1,023 or 1,024 bytes.

What is a **Bulk Transfer**? (Section 5.8)

4/4 Bulk transfer is used when there needs to be communication with large amounts of data at highly variable times using available bandwidth. You get access to the USB on bandwidth-available basis, it retries the transfer if there were delivery failure errors, and you get guaranteed delivery of data but no guarantee of bandwidth or latency. Bulk transfers can happen quickly or very slowly depending on available bandwidth. There is no data content structure. The transfer direction is either coming or going for a given pipe. You need 2 pipes for bi-directional communication flow. Only full- or high-speed can use.

How many **microframes** are there in a **frame**? (Section 8.4.3.1)

4/4 There are 8 high-speed micro-frames in 1 millisecond which is a frame. These microframes are each 125 microseconds long.

What is **Bus Enumeration**? (Section 9.1.2)

4/4 It is a process that occurs when a USB device is attached to or removed from the USB. It identifies and manage the device state changes necessary. It follows a specific set of steps. It gets a status update and allows power to stabilize. Then it sends a reset command and enables to port. A unique address is assigned to the attached device. Then a configuration value is assigned so that function can begin. Once configured, the device can be used. When the device is removed, the hub sends a notification to host to update local topological information.

What is **Dynamic Attachment and Removal**? (Section 9.2.1)

4/4 It allows for USB devices to be attached and removed at any time. The hub is responsible for reporting any changes in the status of the port. The host enables said port which resets the device. This reset device responds to default USB address, is not configured, and is not initially suspended. When the device is removed, the hub disables to port and notifies the host.