

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 non-USB environments, isochronous transfers have the general implication of constant-rate, error-tolerant transfers. In the USB environment, requesting an isochronous transfer type provides the requester with the following: Guaranteed access to USB bandwidth with bounded latency, Guaranteed constant data rate through the pipe as long as data is provided to the pipe, In the case of a delivery failure due to error, no retrying of the attempt to deliver the data.

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

4/4 It is used to communicate relatively large amounts of data at variable times using any available bandwidth. Requesting a pipe with a bulk transfer provides:

- Access to USB on bandwidth-available basis
- Retry of transfers, in the case of occasional delivery failure due to errors on the bus
- Guaranteed delivery of data but no guarantee of bandwidth or latency

Bulk transfers occur only on a bandwidth-available basis. For a USB with large amounts of free bandwidth, bulk transfers may happen quickly; for a USB with little bandwidth available, bulk transfers may trickle out over a relatively long period of time.

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

4/4 My understanding is that a micro frame is 125us long so that means there are 8 micro frames per millisecond. I also understand that for full speed (and for low speed?) USB has a 1ms frame rate, so that means 8 micro frames would fit in one frame.

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

4/4 When a USB device is attached to or removed from the USB, the host uses a process known as bus enumeration to identify and manage the device state changes necessary.

1. upon attachment the hub informs the host via a reply on its status, the device is powered. Seven more actions are taken to ensure the correct flow from state to state.

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

4/4 USB devices can be attached or removed at any time without crashing of the operating system. The hub that provides the attachment point is responsible for reporting changes in the state of the port. The host enables the hub port where the device is attached upon detection of attachment, this resets the device which now has these characteristics:

- Responds to the default USB address
- Is not configured
- Is not initially suspended

When a device is removed from a hub port, the hub disables the port the device was attached and notifies the host of removal.