

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)

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Isochronous transfer is a constant-rate, error-tolerant transfer method. It is always a one direction transfer. An endpoint description identifies whether a given isochronous pipe’s communication flow is into or out of the host. If a device requires multiple direction flow, then two isochronous pipes must be used. An endpoint in a given configuration specifies the maximum size data payload that it can transmit or receive. The maximum payload size is 1023 for USB, and that requires that max bandwidth of 1023000 bytes/second. A high speed, high bandwidth endpoint specifies whether it requires two or three transactions per micro frame.

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

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Bulk transfer is one directional. If a device requires multiple direction flow, then two bulk pipes must be used. An endpoint for bulk transfers specifies the maximum data payload size that the endpoint can accept from or transmit to the bus. The allowable payload sizes are 8, 16, 32, and 64 bytes for full-speed endpoints and 512 for high-speed endpoints. It does not have to be padded to meet the maximum size payload. It can transmit a payload smaller than the max. It uses data toggle bits that are toggled only upon successful transaction completion to preserve synchronization between transmitter and receiver.

Bulk transfers use error detection and retries if there are errors. If a

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

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1 frame is seen as 1 ms for full-speed. High speed micro-frames occur every 125 micro seconds inside that 1 ms frame. 1 ms divided by 125 micro-seconds will yield 8 micro-frames every frame. From Figure 8-14, it can also be seen how there are 8 micro-frame ticks in every 1 ms full-speed frame.

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

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A device is attached to the USB, the host identifies and manages the device state changes necessary. When an item is attached, the hub informs the host of the device and it is powered. The host allows time for stabilization, and sends a reset command. When the reset signal is released, the USB device is now the default and is allowed to work. A unique address is given. The host reads the device to determine the maximum allowable payload. The host then assigns a configuration value to the device and it is configured and can work properly.

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

The port which the device is plugged into reports any change in the state of the port. Whenever a device is attached, the host enables the hub port which also resets the device. Whenever a device is reset, the device responds to the default USB address. It is not configured and not initially suspended. When the device is removed, the hub disables the port where the device was attached and notifies the host of the removal.

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