

**Initialization (computer system starts)**

1. Initialize input queue to empty

**Upper half (application performs write)**

1. Deposit data item in queue
2. Use the CSR to request an interrupt
3. Return to application

**Lower half (interrupt occurs)**

1. If the queue is empty, stop the device from interrupting
2. If the queue is nonempty, extract an item and start output
3. Return from interrupt

**Figure 17.4** The steps that the upper and lower halves of a device driver take for an output operation when queueing is used. The upper half forces an interrupt, but does not start output on the device.