Name: _____ USC ID: _____

## Quiz 2: Storage Systems (10 points), 10 minutes (afternoon)

Consider a hard disk with maximum seek time of 12ms, patters rotating at 7200RPM, (maximum) transmission bandwidth of 100MB/sec. Assume 4KB per block.

1. [7 points] Compute the completion time and actual bandwidth for **random** access of 100MB of data. Show your work (i.e., how you derive the answer).

   *# of blocks* $= \frac{100\ MB}{4\ KB/block} = 25{,}600$ *blocks*

   $T_{seek}$ *= Average seek time =* $\frac{1}{3}$ *x maximum seek time =* $\frac{1}{3}$ *x 12ms = 4ms*

   *Since time for a full rotation =* $\frac{60000\ ms}{7200\ rotations}$ *= 8.33 ms,*

   $T_{rotation}$ *= Average rotation latency =* $\frac{1}{2}$ *x 8.33 ms = 4.17ms*

   $T_{transfer}$ *= Transfer time per block =* $\frac{4KB}{100\ MB/sec}$ *x 1000ms = 0.04ms*

   $T$ *= # of blocks x (* $T_{seek}$ *+* $T_{rotation}$ *+* $T_{transfer}$ *) = 25,600 x ( 4ms + 4.17ms + 0.04ms )*
   *= 210,176ms = 210.176sec*

   *Actual bandwidth =* $\frac{100MB}{210.176\ sec}$ *= 0.476MB/sec = 487.2107KB/sec*

2. [3 points] Which of the time: latency or transmission time, dominates the completion time? What if the workload is changed to "**sequential** access of 100MB of data"? Explain your answer.

   *1. Latency time dominates when we access the data randomly since 8.17ms > 0.04ms for each block.*

   *2. Transmission time will dominate the completion time when it is changed to sequential access, because it doesn't need to seek and rotate for every block of data.*