The memory access time is 1 nanosecond for a read operation with a hit in cache, 5 nanoseconds for a read operation with a miss in cache, 2 nanoseconds for a write operation with a hit in cache and 10 nanoseconds for a write operation with a miss in cache. Execution of a sequence of instructions involves 100 instruction fetch operations, 60 memory operand read operations and 40 memory operand write operations. The cache hit-ratio is 0.9. The average memory access time (in nanoseconds) in executing the sequence of instructions is \_\_\_\_\_\_\_\_\_\_.  
**(A)** 1.26**(B)** 1.68  
**(C)** 2.46  
**(D)** 4.52



**Answer:** **(B)**  
  
**Explanation:**

The question is to find the time taken for,

"100 fetch operation and 60 operand red operations and 40 memory

operand write operations"/"total number of instructions".

Total number of instructions= 100+60+40 =200

Time taken for 100 fetch operations(fetch =read)

= 100\*((0.9\*1)+(0.1\*5)) // 1 corresponds to time taken for read

// when there is cache hit

= 140 ns //0.9 is cache hit rate

Time taken for 60 read operations = 60\*((0.9\*1)+(0.1\*5))

= 84ns

Time taken for 40 write operations = 40\*((0.9\*2)+(0.1\*10))

= 112 ns

// Here 2 and 10 the time taken for write when there is cache

// hit and no cahce hit respectively

So,the total time taken for 200 operations is = 140+84+112

= 336ns

Average time taken = time taken per operation = 336/200

= 1.68 ns