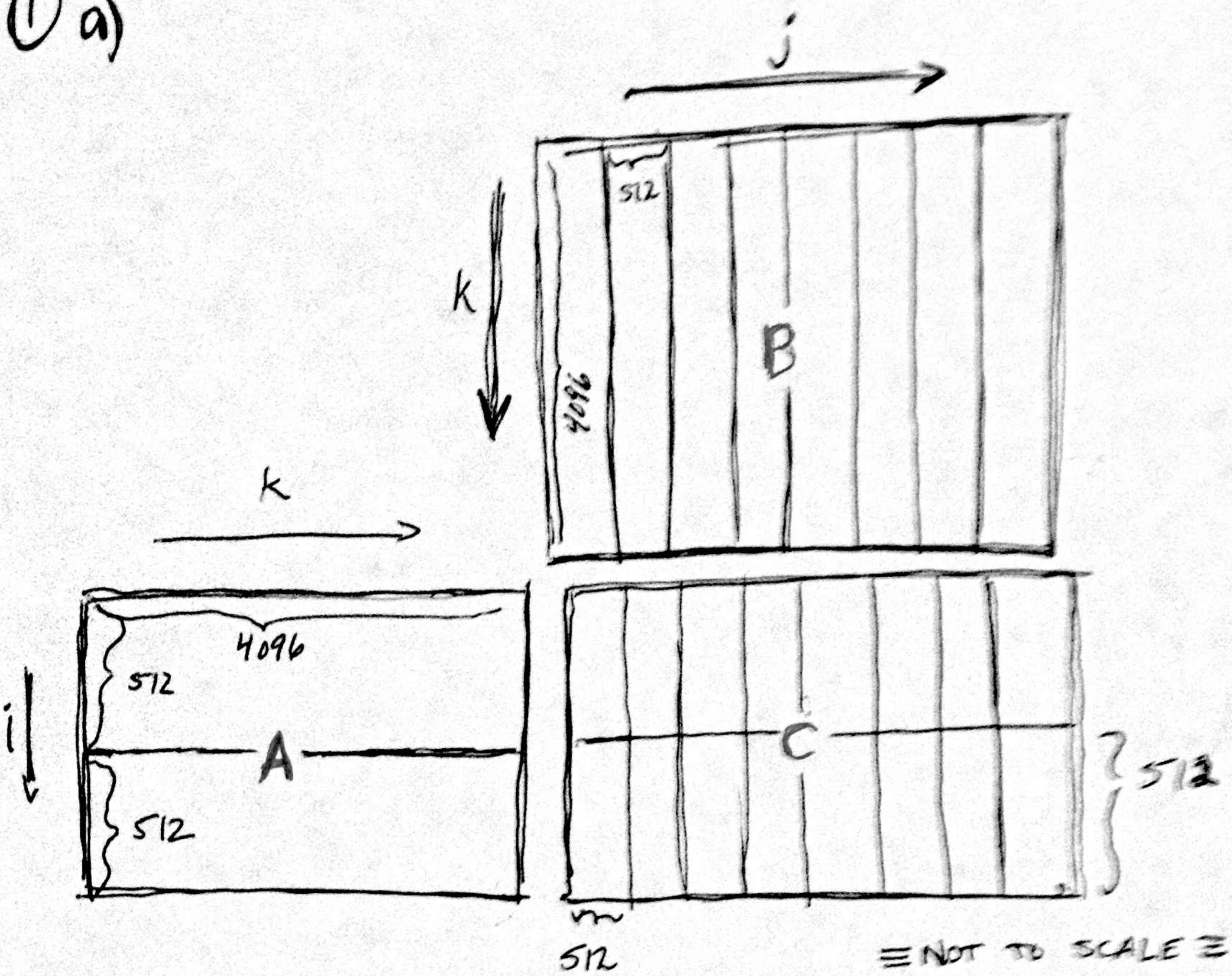
① a)



① A

k) A will miss once per every four addresses read:
$4096/8 = \boxed{1024}$

j) A is not indexed by j since all of the elements of A accessed in the k loop will fit in cache memory, the factor here is $\boxed{1}$

i) Each time we go to a new row, we see new elements of A. So each iteration will cause a miss. $\boxed{T_i = 512}$

jt) jt does not affect A's indices, but as the inner loops will access 4096 x 512 different addresses of A, the cache can not hold all of A that it must. So each iteration will cause a miss, $N_j / T_j = \boxed{4096/512 = 8}$

it) Similar to (i), this loop will cause us to switch "row blocks". Each time we reach a new block we will generate a new set of cache misses. $\boxed{N_i / T_i = 1024/512 = 2}$

Total $= 2^{10} \cdot 2^{0} \cdot 2^{9} \cdot 2^{3} \cdot 2^{1} = \boxed{2^{23}}$

B

k) Each iteration will take us to a new row of B. Therefore we will miss each time. $\boxed{4096}$

j) In the previous iteration 4096 x 4 elements were brought to the cache. They all fit since 4096 x 4 = 1024 x 16 < 1024 x 512 = C. So, we will miss once per four loop iterations. $T_j / 4 = \boxed{512/4 = 2^7}$

i) By now we have brought a whole tile of B to the cache. It hasn't fit and all of the elements from iteration j = jt have been expelled. We will miss for every iteration of i.

$\boxed{T_i = 512}$

B (continued)

jt) We are now moving to a new tile. $\boxed{N_j / T_j = \frac{4096}{512} = 8}$

it) We will regenerate all of the misses for each iteration of it. There will be $N_i / T_i = 1024/512 = \boxed{2}$ such misses.

$$\text{Total} = 2^{12} \cdot 2^{7} \cdot 2^{9} \cdot 2^{3} \cdot 2^{1} = 2^{32}$$

C

k) No misses are generated by this loop. Factor of $\boxed{1}$

j) C will be accessed by column, so there will be $T_j / B =$ $\boxed{512 / 4 = 2^7}$ misses.

i) Each iteration will take us to a new row. $\boxed{T_i = 512}$ misses.

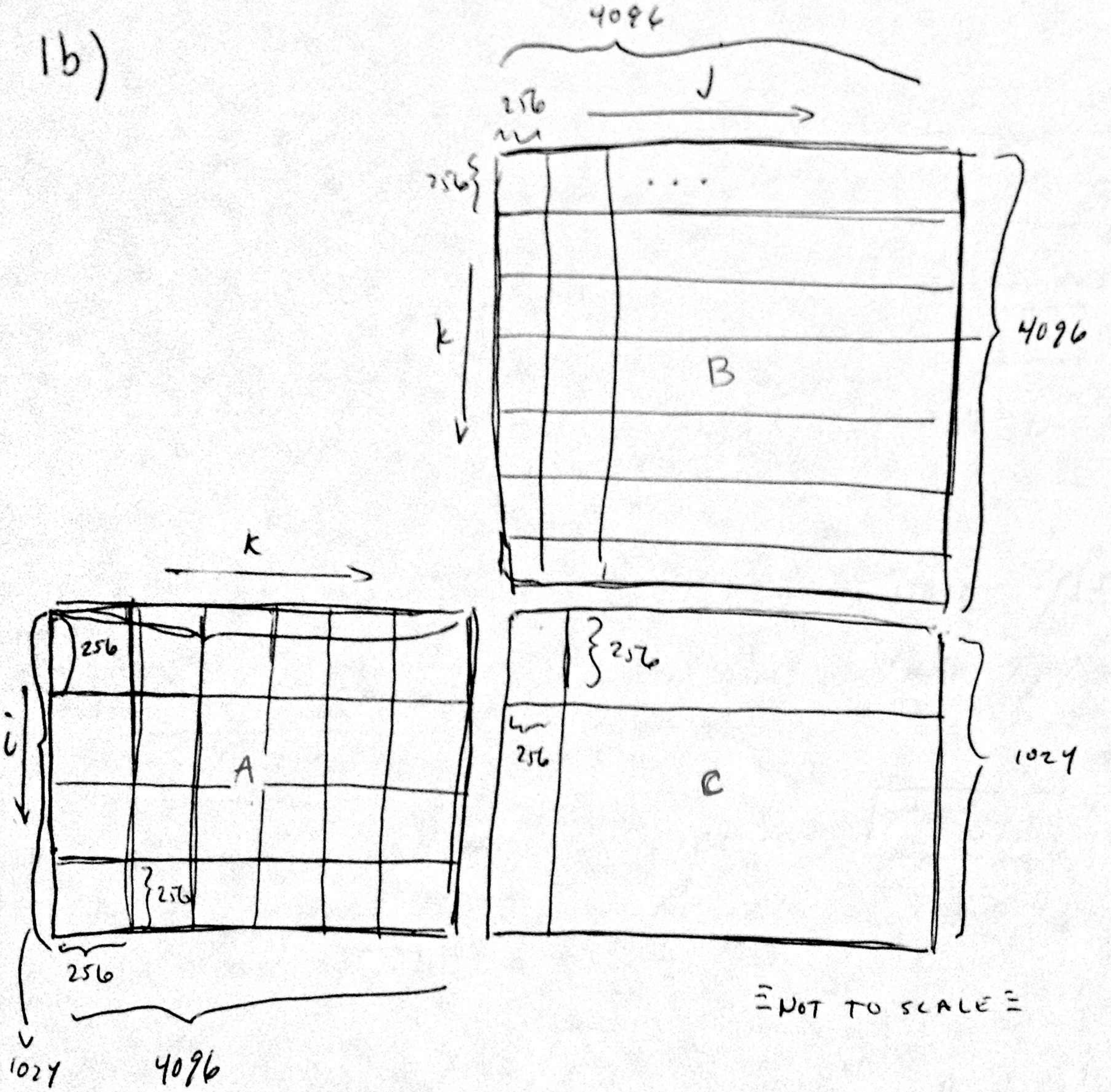
jt) We will have more misses for each new tile. $N_j / T_j = \boxed{8}$.

it) Same as for jt. $\boxed{2}$

$$\text{Total} = 2^{0} \cdot 2^{7} \cdot 2^{9} \cdot 2^{3} \cdot 2^{1} = \boxed{2^{20}}$$

So the total misses is $\boxed{2^{23} + 2^{32} + 2^{20}}$

1b)


4096
j
256
256
k
B
4096
k
256
i
A
256
256
1024
4096
256
256
C
1024
= NOT TO SCALE =

A

k) A will miss the cache $T_k / B = 256/4 = 2^8/2^2 = \boxed{2^6 \text{ times}} = \boxed{64}$

j) A will only miss once. All of the k elements are in the cache after the first iteration. $\boxed{1}$

i) A will miss once for each new row accessed. $T_i = \boxed{256}$

kt) A will miss each time we move to a new tile.
$N_k/T_k = \boxed{4096/256 = 16}$

jt) The cache isn't large enough to hold all of the memory addresses accessed by the inner loops. We will have accessed $N_k \cdot T_i = 4096 \cdot 256 = 2C$ addresses. $N_j/T_j = 4096/256 = \boxed{16}$

it) ~~Same reason as jt~~ We are accessing new rows of A with each iteration. $N_i/T_i = 1024/256 = \boxed{4}$

Total: $2^6 \cdot 2^0 \cdot 2^8 \cdot 2^4 \cdot 2^4 \cdot 2^2 = \boxed{2^{24}}$

B

K) Each iteration will go to a new row. $T_k = \boxed{256}$ misses.

j) We will miss every fourth iteration, as the block size $B = 4$.
$T_j / B = 256/4 = \boxed{2^6} = \boxed{64}$

i) B is not indexed by i. Furthermore, a whole tile of B will fit in the cache. $\boxed{1}$

B (Continued)

kt) We will see a new part of B. N_k / T_k = $\boxed{4096/256 = 16}$

jt) The same thing happens. We are seeing a new part of B. $\boxed{4096/256 = 16}$

it) All of B does not fit in the cache. $\boxed{1024/256 = 4}$

$$\text{Total} = 2^8 \cdot 2^6 \cdot 2^0 \cdot 2^4 \cdot 2^4 \cdot 2^2 = \boxed{2^{24}}$$

C

k) C is not indexed by k. $\boxed{1}$

j) We will go through the columns of C. T_j / B = $256/4 = \boxed{64}$

i) We will see a new row of C each iteration. So, there is a factor of $\boxed{T_i = 256}$ misses

kt) C is not indexed by k. Also, a whole tile of C fits in the cache. Therefore, miss factor of $\boxed{1}$

jt) We will go to a new part of C. $4096/256 = \boxed{16}$

it) Same as (jt). We are seeing new parts of C. $1024/256 = \boxed{4}$

$$\text{Total} = 2^0 \cdot 2^6 \cdot 2^8 \cdot 2^0 \cdot 2^4 \cdot 2^2 = \boxed{2^{20}}$$

The total misses for loop a is $2^{23} + 2^{32} + 2^{20} = 2^{20}(2^3 + 2^{12} + 1)$

$$= 2^{20}(8 + 4096 + 1)$$

$$= 2^{20}(4105)$$

The total misses for loop b is:

$$2^{24} + 2^{24} + 2^{20} = 2^{20}(16 + 16 + 1)$$

So loop b is preferable.