Question 3 (Assuming a Block size is 8 bytes.

SIZE : $4 \times 1 \times x$.

$x = \frac{4 \times 1 \times x}{4}$.

$x = x$ direct-mapping.

SIZE = (#sets) × (ASSOC) × (BLOCKSIZE).

SIZE = (#sets) × (#ways) × (#bytes/block).

SIZE = 4 × 1 × 8.

SIZE = 32

#ways

As the given example has 1 way it is direct-mapped Cache

Question-4

Assume each Block is 8 bytes.

	way 0	way 1	way 2
set 0			
set 1			
set 2			
set 3.			

SIZE = (#sets) × (ASSOC) × (BLOCKSIZE).

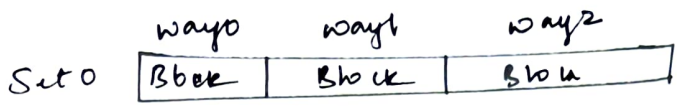
(#sets) × (#ways) × (#bytes/block)

SIZE = 4 × 3 × 8.

$12 \times 8 =$ 96 bytes.

#ways = 3

Question - 5



We know Direct - mapped & fully - associative are extremes where

Direct-mapped has a single (1) way.

& fully - associative has a single set in a cache.

Question 6 -

Number of Block offset bits

Number of index bits.

Number of tag bits.

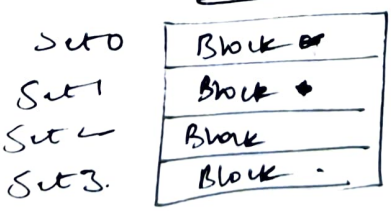
(Memory address = 32 bit = 8 bytes)

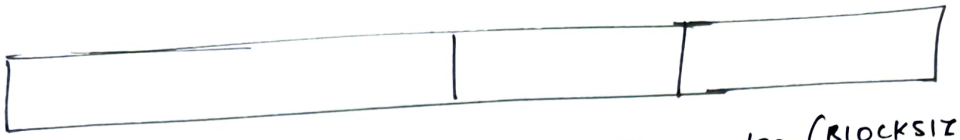
	SIZE	ASSOC	BLOCKSIZE
1.	32 B	1	8B.

SIZE = (#sets) x (ASSOC) x (BLOCKSIZE)

32 = (#sets) x 1 x 8

#Sets = 4





(#addrshifts) $-\log_2$(#Sets) $-\log_2$(BLOCKSIZE) $\log_2$(#Sets) $\log_2$(BLOCKSIZE).

Block offset bits = $\log_2$(BLOCKSIZE)

$\log_2(8) = 3$

$\log_2(2^3)$

$3\log_2 2 = \underline{3}$

index Bits = $\log_2$(#Sets)

$\log_2(2^2) = 2\log_2 2 = \underline{2}$

tg bits = (# addrs Bits) − $\log_2$(#Sets) − $\log_2$(BLOCKSIZE)

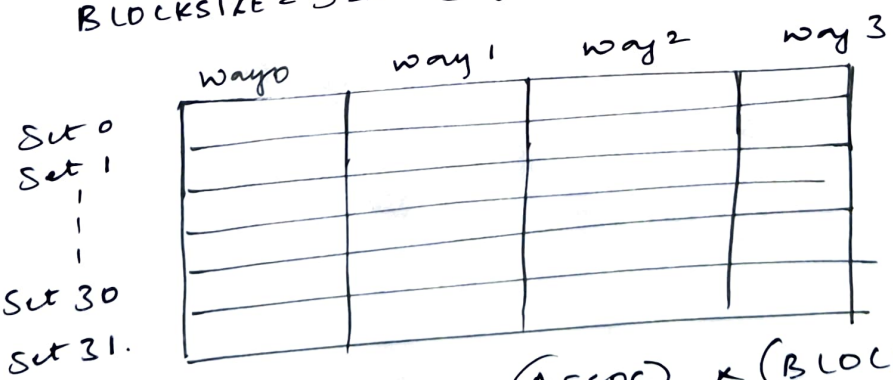
$= 32 - \log_2(2^2) - \log_2(2^3)$

$32 - 2 - 3 = \underline{32-5 = 27}$

(ii) Given SIZE = 4 KB = $4 \times 2^{10} = \underline{2^{12}\ B}$.

ASSOC = 4-way-set-Associative = 4.

BLOCKSIZE = 32. (Bytes / block) ⟶ 2^5.



SIZE = (#sets) × (ASSOC) × (BLOCKSIZE)

$2^{12} =$ #sets $\times 2^2 \times 2^5$

#sets $= \frac{2^{12}}{2^7} =$ $\boxed{2^5 = 32 \text{ sets}}$

Block offset Bits = $\log_2$ (BLOCKSIZE).

$= \log_2(2^5) = 5\log_2 2$

$= 5$.

index Bits = $\log_2$ (# sets)

$= \log_2(2^5)$

$= 5\log_2 2 = 5$

tag bits = (# address Bits) − (# index Bits) − (# block offset Bits)

$= 32 - 5 - 5 = 22$

iii) SIZE = 12KB = $2 \times 3 \times 2 \times 2^{10}$

$= 3 \times 2^2 \times 2^{10}$

$= 3 \times 2^{12}$ B.

ASSOC = 3.

BLOCKSIZE = 32 B. $= 2^5$ B.

SIZE = (# sets) × (ASSOC) × (BLOCKSIZE)

3×2^{12} = (# sets) × 3 × 2^5

sets = $\frac{3 \times 2^{12}}{3 \times 2^5} = 2^7$.

sets = 32 × 4

= 128

Block offsets = $\log_2$(BLOCKSIZE)

= $\log_2(2^5)$ = **5** bits.

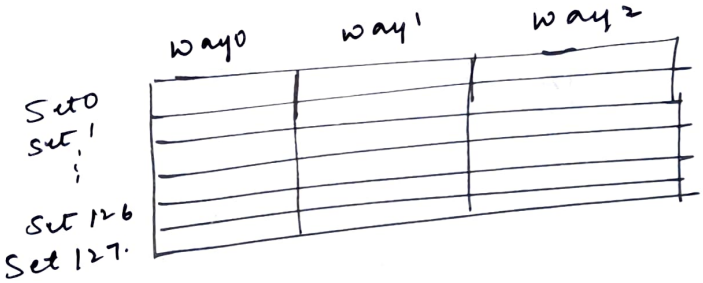
Index bits = $\log_2$(#sets)

= $\log_2(2^7)$ = **7** bits.

tag bits = # address Bits − # index Bits − # Block offset Bits.

= 32 − 5 − 7 = 32 − 12

= **20 bits**



iv → SIZE = 128 = 2^7 B.

#ASSOC = 8

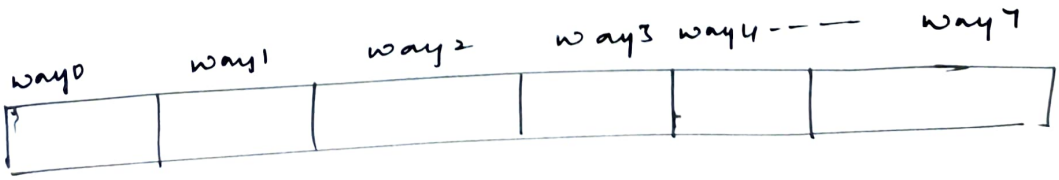
BLOCKSIZE = 16 = 2^4 B.

SIZE = (#sets) × (ASSOC) × (BLOCKSIZE)

2^7 = (#sets) × 8 × 2^4.

sets = $\frac{2^7}{2^3 \times 2^4}$ = 1.

sets = 1 (fully-Associative).



~~# index bits~~

Block offset bits = $\log_2(\text{BLOCKSIZE})$

$= \log_2(16) = \log_2(2^4)$

$= \boxed{4 \text{ bits}}$.

index bits = $\log_2(1) = 0$ bits.

Tag bits = (# address bits) − (# index bits) − (# Block offset bits)

$= 32 - 0 - 4 = \boxed{28 \text{ bits}}$