2.)
- For a 40-bit memory address
- Calculate the number of bits for the tag, index, offset fields :
- Cache of 1024K bytes, block of 64 bytes

a.) Direct mapped   b.) 4-way set assosiative   b.) Fully assosiative

- 1024K bytes (2^{10})

- in bytes = $1024 \times 1024 = 2^{10} \times 2^{10} = 2^{20}$ bytes

- Block size = 64 bytes = 2^{6} bytes.

- Total number of blocks = $\dfrac{\text{Total size}}{\text{Block size bytes}} = \dfrac{2^{20}}{2^{6}} = 2^{14}$

a.) Direct mapped ÷
- No of sets = same as blocks = 2^{14} (16384)

- Index = 14 bits (14 bits will be needed to choose each from 16384)

- offset = 6 (as block size = 2^{6} bytes so 6 bits will be needed to pick from 64)

- Tag = Total bit memory − Index − offset
  = 40 − 14 − 6 = 20

b.) 4-way set assosiative ÷ Now there is set of 4 blocks each.

- No of sets = $\dfrac{\text{Total blocks}}{4} = \dfrac{2^{14}}{2^{2}} = 2^{12}$

- Index = 12 bits (12 bits will be needed here to choose each each set where block can be)

- offset = 6 (as block size is still 2^{6} bytes)

- Tag = Total bit memory − Index − offset
  = 40 − 12 − 6 = 22

c.) Fully Assosiative Cache ÷ only 1 set full

⟹ No of set = 1

⟹ Index = as there is only 1 set so no index required = 0

⟹ offset = 6 bits (as the block size is still same 2^6)

Tag = Total bit memory - Index - offset

⟹ Tag = 40 - 0 - 6 = 34

3.) Cache of 2048K bytes, with blocks of 16 bytes

2048K bytes = 2048 × 1024 = 2097152 bytes = 2^{21} bytes.

Block size = 16 bytes = 2^4.

Total No of blocks = $\dfrac{\text{Total}}{\text{Blocksize}}$ = $\dfrac{2^{21}}{2^4}$ = 2^{17} blocks

a.) Direct-mapped ÷ no of blocks = no of sets = 2^{17} sets

- Index = 17 bits (17 bits need to pick each set)
- offset = 4 bits as block size is 2^4 so 4 bits required.

Tag = Total bit memory - Index - offset

- Tag = 40 - 17 - 4 = 19 bits

b.) ~~Fully~~ 4-way set Associative Cache ÷ Now each set has 4 blocks.

- no of blocks = $\dfrac{\text{Total Blocks}}{4}$ = $\dfrac{2^{17}}{2^2}$ = 2^{15}
- Index = 15 bits (15 bits required to pick set)
- offset = 4 bits as block size is 2^4.
- Tag = 40 - 15 - 4 = 21 bits.

C.) Fully Assosiative ⟹ only 1 Full set

⟹ No of set = 1

⟹ Index = 0 bit as there is only 1 set to choose now.

⟹ offset = 4 bits as block size is 2^4

⟹ Tag = $40 - 0 - 4 = 36$ bits.