1.

$$\begin{aligned} 8M &= 2^3 * 20^{20} \\ &= 2^{23} \text{ words} \\ 64K &= 2^6 * 2^{10} \\ &= 2^{16} \text{ words} \end{aligned}$$

a)

$$\begin{aligned} \text{block size} &= 32 = 2^5 \text{ words} \\ \text{frames in cache} &= \frac{2^{16}}{2^5} \\ &= 2^{11} = 11 \text{ bits for block frame \#} \end{aligned}$$

23 bits		
TAG	BlockFrame #	Offset
7 bits	11 bits	5 bits

b)

23 bits	
TAG	Offset
$23 - m$ bits	m bits

c)

$$\begin{aligned} \text{number of BF's} &= \frac{2^{16}}{2^6} \\ &= 2^{10} \\ \text{number of sets} &= \frac{\text{number of BF's}}{\text{set size}} \\ &= \frac{2^{10}}{2^2} \\ &= 2^8 \end{aligned}$$

23 bits		
TAG	Set #	Offset
9 bits	8 bits	6 bits

2.

$$\begin{aligned} \text{BF's in cache} &= 8 \\ &= 2^3 \\ \text{BF offset} &= 16 \\ &= 2^4 \\ \text{address size} &= 2^4 * 2^6 \\ &= 2^{10} \end{aligned}$$

a)

10 bits		
TAG	BF #	Offset
$10-3-4=3$ bits	3 bits	4 bits

b)

0x37A = 1101111010 since we have tag 110 in frame 7 we know that this word will be in cache because the block 110111 is in cache.

c)

0x22C = 1000101100 since we have tag 100 in frame 2 we know that this word will be in cache because the block 100010 is in cache.

c)

0x1B9 = 0110111001 since we have tag 010 in frame 3 we know that this word will not be in cache because the block 011011 is not in cache.

3.

$$\begin{aligned} \text{number of BF's} &= 8 \\ &= 2^3 \\ \text{number of sets} &= \frac{\text{number of BF's}}{\text{set size}} \\ &= \frac{2^3}{2^1} \\ &= 2^2 \end{aligned}$$

a)

10 bits		
TAG	Set #	Offset
$10-2-4=4$ bits	2 bits	4 bits

b)

0x37A = 1101111010 since we have tag 1101 in a set 3 spot we know that this word will be in cache because the block 110111 is in cache.

c)

0x22C = 1000101100 since we have tag 1000 in a set 2 spot we know that this word will be in cache because the block 100010 is in cache.

c)

0x1B9 = 0110111001 since we have tag 0110 in a set 3 spot we know that this word will be in cache because the block 011011 is in cache.

4.

$1M = 2^{20}$words/address size$4K \quad = 2^2 * 2^{10} = 2^{12}$words/cache sizeBF's in cache $= \frac{2^{12}}{2^4} = 2^8$

a)

20 bits		
TAG	BF #	Offset
$20 - 8 - 4 = 8$ bits	8 bits	4 bits