1.1 Naming numerous bits

Modern computers may store large amounts of data, such as thousands, millions, billions, or even trillions of bits. Ex: A sm memory (used by apps when running) may consist of about 1 billion bits, typically written as 1 gigabit or 1 Gb. In the metric prefix "giga" means billion. Common metric prefixes are kilo (thousand), mega (million), giga (billion), and tera (trillion).

Just as humans commonly use powers of 10, computers commonly use powers of 2. A reason is because, just like neighb decimal addresses for house locations, storage devices use binary addresses for data locations. A binary address' range is such as 30 bits representing 2^{30} addresses. That number equals 1,073,741,824, which is very close to 1 billion, so for conv commonly refer to that number of bits as 1 gigabit.

But using metric prefixes for computers is not accurate. Alternative prefixes, known as **IEC prefixes**, exist like kibi (2^{10} or 10 1,048,576), gibi (2^{30} or 1,073,741,824), and tebi (2^{40} or 1,099,511,627,776). In gibi, the gi refers to the metric prefix giga, and "binary". A gibi is abbreviated Gi, as in 1 Gib for 1 Gibibit. Likewise for other IEC prefixes.

When metric prefixes are used as in 1 Gigabit, computer folks understand those prefixes are informal and actually refer to t power of 2.

Table 1.1.1: Powers of 2, and common metric and IEC prefixes used near a thousand, million, and billion. Powers of 2 to the 16 and 32 are common so are listed too.

Power of 2	Value	Metric prefix (informal)	IEC prefix
1	2		

2	4		
3	8		
4	16		
5	32		
6	64		
7	128		
8	256		
9	512		
10	1024	kilo (K): 1 kilobit or 1 Kb	kibi (Ki): 1 kibibit or 1 Kib
11	2048		
12	4096		
13	8192		
14	16384		
15	32768		
16	65536	64 Kb	64 Kib
17	131072		
18	262144		
19	524288		
20	1048576	mega (M): 1 megabit or 1 Mb	mebi (Mi): 1 mebibit or 1 Meb

21	2097152		
22	4194304		
23	8388608		
24	16777216		
25	33554432		
26	67108864		
27	134217728		
28	268435456		
29	536870912		
30	1073741824	giga (G): 1 gigabit or 1 Gb	gibi (Gi): 1 gibibit or 1 Gib
31	2147483648		
32	4294967296	4 Gb	4 GiB

Sizes often refer to bytes rather than bits, as in 128 gigabytes. The abbreviation uses a B rather b, as in 128 GB rather than

To help remember the relation of powers of two and powers of ten, one may note that 2^{10} is near a thousand, 2^{20} is near a is near a billion.

PARTICIPATION ACTIVITY	1.1.1: Metric and IEC prefixes.

Write all answers in abbreviated form. Ex: Write Kb rather than kilobit.

1) 1024 bits using the metric prefix is

informally written 1 Kb. Write 4096
informally using the metric prefix.

[ ]

Check   **Show answer**

2) 2^{30} is close to one billion. Write 2^{30} bits
   informally using a metric prefix.

[ ]

Check   **Show answer**

3) 2 to the power of 32 is a common value
   in computers. Write 2^{32} bits using an
   informal metric prefix.

[ ]

Check   **Show answer**

4) 1024 bits using the IEC prefix is written
   1 Kib. Write 4096 using the IEC prefix.

[ ]

Check   **Show answer**

5) 2^{30} is close to one billion. Write 2^{30} bits
   using the IEC prefix.

[ ]

Check   **Show answer**

6) 2 to the power of 32 is a common value in computers. Write 2^{32} bits using the IEC prefix.

[   ]

Check   **Show answer**

7) Sizes are often written using bytes rather than bits. Write 2^{16} bytes using an IEC prefix.

[   ]

Check   **Show answer**

Exploring further:

- IEC prefixes

⚠ **Provide feedback on this section**