

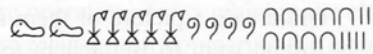
Chapter Four
 Section one

The various ways of symbolizing and working with the counting numbers are called **numeration systems**. The purpose of numeration systems is a tool of “*information transfer*”. For example, you may use *pebbles* to record the number of sheep and use *tally sticks* to record numbers when you summarize a set of survey questionnaires. The tally sticks based on *grouping* method to count the numbers. The *size of the groupings* is called **base** of the number system. The following list historical numeration systems:

- Ancient Egyptian Numeration – Simple Grouping

TABLE 1 Early Egyptian Symbols		
Number	Symbol	Description
1		Stroke
10	∩	Heel bone
100	ϩ	Scroll
1000	⊥	Lotus flower
10,000	☞	Pointing finger
100,000	𐊀	Burbot fish
1,000,000	𐊁	Astonished person

EXAMPLE 1 Write in our system the number below.



Refer to Table 1 for the values of the Egyptian symbols. Each 𐊀 represents 100,000. Therefore, two 𐊀s represent $2 \times 100,000$, or 200,000. Proceed as follows:

two	𐊀	$2 \times 100,000 = 200,000$
five	⊥	$5 \times 1000 = 5000$
four	ϩ	$4 \times 100 = 400$
nine	∩	$9 \times 10 = 90$
seven		$7 \times 1 = 7$
		205,497.

The number is 205,497.

How deep is this ship in the water?

Number	Symbol
1	I
5	V
10	X
50	L
100	C
500	D
1000	M

Roman numerals still appear today, mostly for decorative purposes: on clock faces, for chapter numbers in books, and so on. The system is essentially base ten, simple grouping, but with separate symbols for the intermediate values 5, 50, and 500, as shown above. If I is positioned left of V or X, it is subtracted rather than added. Likewise for X appearing left of L or C, and for C appearing left of D or M. Thus, for example, whereas CX denotes 110, XC denotes 90.

Greek Numerals

1	α	60	ξ
2	β	70	\omicron
3	γ	80	π
4	δ	90	φ
5	ϵ	100	ρ
6	ς	200	σ
7	ζ	300	τ
8	η	400	υ
9	θ	500	ϕ
10	ι	600	χ
20	κ	700	ψ
30	λ	800	ω
40	μ	900	λ
50	ν		

What About the Greeks?

Classical Greeks used letters of their alphabet as numerical symbols. The base of the system was the number 10, and numbers 1 through 9 were symbolized by the first nine letters of the alphabet. Rather than using repetition or multiplication, they assigned nine more letters to multiples of 10 (through 90), and more letters to multiples of 100 (through 900). This is called a ciphered system, and it sufficed for small numbers. For example, 57 would be $\nu\zeta$; 573 would be $\phi\omicron\gamma$; and 803 would be $\omega\gamma$. A small stroke was used with a units symbol for multiples of 1000 (up to 9000); thus 1000 would be ρ , α or $\prime\alpha$. Often M would indicate tens of thousands (M for myriad = 10,000) with the multiples written above M.

TABLE 2

Number	Symbol
1	一
2	二
3	三
4	四
5	五
6	六
7	七
8	八
9	九
10	十
100	百
1000	千
0	零

EXAMPLE 6 Interpret the Chinese numerals below.

(a) $\left. \begin{array}{l} \equiv \\ \text{千} \end{array} \right\} 3 \times 1000 = 3000$

$\left. \begin{array}{l} \text{一} \\ \text{百} \end{array} \right\} 1 \times 100 = 100$

$\left. \begin{array}{l} \text{六} \\ \text{十} \end{array} \right\} 6 \times 10 = 60$

$\left. \begin{array}{l} \text{四} \\ \text{十} \end{array} \right\} 4(\times 1) = \underline{4}$
Total: 3164

(c) $\left. \begin{array}{l} \text{五} \\ \text{千} \end{array} \right\} 5 \times 1000 = 5000$

$\left. \begin{array}{l} \text{零} \\ \text{十} \end{array} \right\} \begin{array}{l} 0(\times 100) = 000 \\ 0(\times 10) = 00 \end{array}$

$\left. \begin{array}{l} \text{九} \\ \text{十} \end{array} \right\} 9(\times 1) = \underline{9}$
Total: 5009

(b) $\left. \begin{array}{l} \text{七} \\ \text{百} \end{array} \right\} 7 \times 100 = 700$

$\left. \begin{array}{l} \text{零} \\ \text{十} \end{array} \right\} 0(\times 10) = 00$

$\left. \begin{array}{l} \text{三} \\ \text{十} \end{array} \right\} 3(\times 1) = \underline{3}$
Total: 703

(d) $\left. \begin{array}{l} \text{四} \\ \text{千} \end{array} \right\} 4 \times 1000 = 4000$

$\left. \begin{array}{l} \text{二} \\ \text{百} \end{array} \right\} 2 \times 100 = \underline{200}$
Total: 4200

Hindu-Arabic system:

1 2 3 4 5 6 7 8 9