

# Chapter 1

## Keeping Count: Writing Whole Numbers

1. The Very Beginning
2. Ancient Egypt
3. Babylonian Numeration
4. The Mayans
5. Ancient Greece
6. Roman Empire
7. Hindu-Arabic Numerals

References

Timeline

# 1. The Very Beginning

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- Mathematical (?) artifacts from Africa 37,000 years ago
- Tally marks on “The Ishango Bone” in Zaire dated around 20,000 YA






# 2. The Egyptian Numeration System


Pre-3000 – 1000 BC

Hindu-Arabic Numeral	Egyptian Hieroglyphic	Description of Hieroglyphic
1		stroke
10	∩	heel bone
100	ϩ	scroll
1000	⊗	lotus flower
10,000	☞	pointing finger
100,000	🐟	fish
1,000,000	🧑	astonished person

The hieroglyphic system is an **additive system**.

5 = 

23 =  = 

489 = 

204,183 = 

1	
10	∩
100	⊗
1000	⌘
10,000	∩
100,000	⊗
1,000,000	⌘

# 3. The Babylonian Numeration System

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- 3000 – 200 BC
- Cuneiform on clay tablets



# 3. The Babylonian Numeration System

- 3000 – 200 BC
- Cuneiform on clay tablets






























































**Numerals:**

1 

10 

combine to  
make 1 – 59.

1		11		21		31		41		51	
2		12		22		32		42		52	
3		13		23		33		43		53	
4		14		24		34		44		54	
5		15		25		35		45		55	
6		16		26		36		46		56	
7		17		27		37		47		57	
8		18		28		38		48		58	
9		19		29		39		49		59	
10		20		30		40		50			

# 3. The Babylonian Numeration System

The Babylonian numeration system is **base 60** (sexagesimal)

**Place Values:**




























































...	$60^3$	$60^2$	$60^1$	$60^0$
	216000	3600	60	1

**Numerals:**

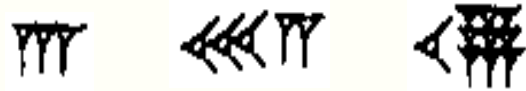
1 

10 

combine to  
make 1 – 59.

1 	11 	21 	31 	41 	51 
2 	12 	22 	32 	42 	52 
3 	13 	23 	33 	43 	53 
4 	14 	24 	34 	44 	54 
5 	15 	25 	35 	45 	55 
6 	16 	26 	36 	46 	56 
7 	17 	27 	37 	47 	57 
8 	18 	28 	38 	48 	58 
9 	19 	29 	39 	49 	59 
10 	20 	30 	40 	50 	

A Babylonian number

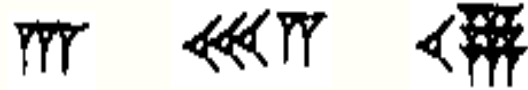


$$3 \times 60^2 \quad 32 \times 60^1 \quad 19 \times 60^0$$

$$10800 + 1920 + 19 = 12739$$

1		11		21		31		41		51	
2		12		22		32		42		52	
3		13		23		33		43		53	
4		14		24		34		44		54	
5		15		25		35		45		55	
6		16		26		36		46		56	
7		17		27		37		47		57	
8		18		28		38		48		58	
9		19		29		39		49		59	
10		20		30		40		50			

A Babylonian number



$$3 \times 60^2 \quad 32 \times 60^1 \quad 19 \times 60^0$$

$$10800 + 1920 + 19 = 12739$$

You try:



$$12 \quad 60^1 \quad 47 \quad 60^0$$

$$720 + 47 = 767$$



$$5 \quad 60^2 \quad 20 \quad 60^1 \quad 36 \quad 60^0$$

$$18000 + 1200 + 36 = 19236$$

- A problem : **no zero**

What does  $\nabla$   $\nabla$  represent?

- Vestiges of the Babylonian system today – where?
  - Time
  - Trigonometry

# 4. The Mayan Numeration System

c. 300 BC, Central America



0



1



2



3



4



5



6



7



8



9



10



11



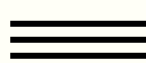
12



13



14



15



16



17



18



19

**Place Values:**

...	18	$20^3$	18	$20^2$	18	$20^1$	$20^1$	$20^0$
	144000		7200		360		20	1

“Essentially,” a **base 20** (vigesimal) system

# Mayan Numeration

Mayan numerals are written **vertically** from top to bottom.

$$\begin{array}{r} \bullet \bullet \bullet \bullet \quad 4 \quad 360 = 1440 \\ \hline \bullet \bullet \quad 12 \quad 20 = 240 \\ \bullet \bullet \bullet \quad 3 \quad 1 = + \quad 3 \\ \hline \mathbf{1683} \end{array}$$

You try:

$$\begin{array}{r} \hline \hline \hline \quad 15 \quad 7200 = 108000 \\ \bullet \bullet \quad 2 \quad 360 = 720 \\ \text{⦶} \quad 0 \quad 20 = 0 \\ \bullet \quad 6 \quad 1 = + \quad 6 \\ \hline \mathbf{108726} \end{array}$$

[More Examples](#)

# 5. The Greek Numeration System

- circa 400 BC
- Additive system
- Letters stand for numbers

Α	Β	Γ	Δ	Ε	Ϛ	Ζ	Η	Θ
α	β	γ	δ	ε	ς	ζ	η	θ
1	2	3	4	5	6	7	8	9

Ι	Κ	Λ	Μ	Ν	Ξ	Ο	Π	Ϛ
ι	κ	λ	μ	ν	ξ	ο	π	ρ
10	20	30	40	50	60	70	80	90

Ρ	Σ	Τ	Υ	Φ	Χ	Ψ	Ω	Ϟ
ρ	σ	τ	υ	φ	χ	ψ	ω	ϟ
100	200	300	400	500	600	700	800	900

# 6. The Roman Numeration System

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- Roman Empire  
100 BC – 500 AD
- Additive system

Hindu-Arabic Numeral	Roman Numeral
1	I
5	V
10	X
50	L
100	C
500	D
1000	M

## Using Roman Numerals

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

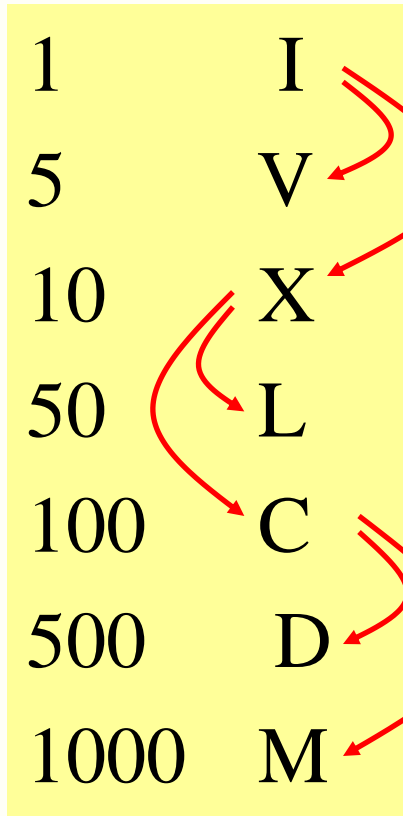
1	I
2	II
3	III
4	IV (IIII)
5	V
6	VI
7	VII
8	VIII
9	IX
10	X

You try:

23	XXIII
43	XLIII
59	LIX
429	CDXXIX
1776	M DCC LXX VI

## More Rules

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



99      90 + 9      XC IX

349      300 + 40 + 9  
          CCC XL IX

1492      1000 + 400 + 90 + 2  
          M CD XC II

## **Problems with Roman numeration**

- No Zero
- Horrible for calculation!

# 7. Hindu-Arabic Numerals

- Invented by Hindus (India) 500 AD. Zero is born!
- Adopted by Arabs, 7<sup>th</sup> – 8<sup>th</sup> c.
- Place-value system, base 10 (decimal)
- Introduced in Europe by Fibonacci, 1202 *Liber Abaci*

Brahmi	↓		—	=	≡	+	୯	୧	୨	୩	୪
Hindu	↓	୦	୧	୨	୩	୪	୫	୬	୭	୮	୯
Arabic	↓	•	١	٢	٣	٤	٥	٦	٧	٨	٩
Medieval	↓	0	I	2	3	୧	୨	6	୮	8	9
Modern		0	1	2	3	4	5	6	7	8	9

# References

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- Berlinghoff and Gouvea
- MacTutor Math History Archive
- Jamie Hubbard's Mayan Numerals web page (8/31/04) at <http://mathcentral.uregina.ca/RR/database/RR.09.00/hubbard1/MayanNumerals.html>
- Victor J. Katz, *A History of Mathematics*, Pearson/Addison Wesley, 2004
- Howard Eves, *An Introduction to the History of Mathematics*, Saunders College Publishing, 1991.
- Wikipedia entry on *Number Names* (8/31/04) at [http://en.wikipedia.org/wiki/Number\\_names](http://en.wikipedia.org/wiki/Number_names)
- <http://www.michielb.nl/maya/math.html>

# Timeline

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- 3000 BC Egyptian numerals
- 2000 BC Babylonian (Iran/Iraq)
- 400 BC Greek numerals appear
- 100 BC–500 AD Roman Empire
- 300 BC Mayan (Central America)
- 500 AD Hindu-Arabic numerals
- 800 Arabs adopt the Hindu numerals
- 500 –1100 Dark Ages in Europe
- 1202 Fibonacci publishes *Liber Abaci*