

M110 SECTION 4.2 PLACE VALUE SYSTEMS

What do we mean by a *place value system*?

Consider the number 47. What does the 4 represent? _____

What does the 7 represent? _____

Now consider the number 74. What does the 7 represent? _____

What does the 4 represent? _____

Thus we can see that where the symbol or numeral is *placed or positioned* in the number changes the value of that symbol. It is now important that a symbol for _____ be part of any place value numeration system in order to *hold* a particular place when none of that place is required.

THE BABYLONIAN NUMERATION SYSTEM

The Babylonian number system began with tally marks just as most of the ancient math systems did. The Babylonians developed a form of writing based on cuneiform. Cuneiform means "wedge shape" in Latin. They wrote these symbols on wet clay tablets which were baked in the hot sun. Many thousands of these tablets are still around today. The Babylonians used a stylist to imprint the symbols on the clay since curved lines could not be drawn.

The Babylonians had a very advanced number system even for today's standards. It was a base 60 system (sexagesimal) rather than a base ten system (decimal). The Babylonians divided the day into twenty-four hours, each hour into sixty minutes, and each minute to sixty seconds. This form of counting has survived for four thousand years.

There were two symbols: _____ which represented one *and*
_____ which represented ten.

To write small numbers (*less than 60*), this system worked much like the Egyptian system.

For example:

25 =

42 =

◁▼▼▼ =

◁◁▼ =

To represent larger numbers, the Babylonians used *groups* of these symbols, separated by spaces, and multiplied the value of these groups by increasing power of 60.

Example < <▼ There are two groups. The right most groups represents the units or 1s (60^0) and the next group to the left represents the 60s (60^1). To calculate the value of this number:

Because the early Babylonians did not have a symbol for zero, it could be hard to tell exactly how many spaces were between groups of symbols.

Examples: Convert to a Hindu-Arabic number.

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▼ <▼ ▼▼

The Babylonians also used the symbol _____ to indicate subtraction. Thus to find the value of:

<<▼▼▼ <

Write each of the following as a Babylonian numeral.

216

1884

12,221

THE MAYAN NUMERATION SYSTEM

The Mayan Indians lived on the Yucatan Peninsula in central America from about 200 B.C. to 1540 A.D. The Mayans used a vigesimal system, which had a base 20. This system is believed to have been used because the Mayans lived in such a warm climate and there was rarely a need to wear shoes, thus 20 was the total number of visible fingers and toes making the system workable. Therefore two important markers in this system are 20, which relates to the fingers and toes, and five, which relates to the number of digits on one hand or foot.

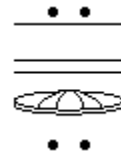
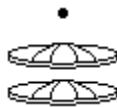
The Mayan system used a combination of three symbols.

There were two symbols: _____ which represented one
_____ which represented five *and*
_____ which represented zero.

Unlike the Babylonians, the Mayans did have a symbol for zero.

The Mayans wrote their numbers vertically as opposed to horizontally with the lowest denomination on the bottom. After 19, the Mayan used positioning of symbols to represent larger numbers. The lowest position represented the units or 1's, the next higher representing the 20's (1×20), the next position representing the 360's ($1 \times 20 \times 18$), the next representing the 7200's ($1 \times 20 \times 18 \times 20$), etc.

Examples: Convert to Hindu-Arabic



Examples: Convert to Mayan

152

175

1246

13,339

THE HINDU-ARABIC PLACE VALUE SYSTEM

The Hindu-Arabic system is a place value system based on 10 (unlike the Babylonian system which is based on 60 and the Mayan system which is based on 20). This means that the columns (like the areas in Babylonian or the levels in Mayan) are powers of 10.

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|----------|-------------------|---------------|-----------|----------|--------|---------------|
| 10^6 | 10^5 | 10^4 | 10^3 | 10^2 | 10^1 | 10^0 |
| millions | hundred thousands | ten thousands | thousands | hundreds | tens | ones or units |

WHAT IS THE BASE? _____

WHAT NUMERALS ARE USED? _____

THE MEANING OF A DIGIT

What does the digit 7 mean in the number 247,189? _____

What does the digit 2 mean in the number 247,189? _____

What does the digit 9 mean in the number 247,189? _____

WRITING A NUMBER IN EXPANDED FORM

3,592 = _____

5,208,610 = _____

$(7 \times 10^3) + (6 \times 10^2) + (0 \times 10^1) + (9 \times 10^0) =$ _____

$(3 \times 10^7) + (6 \times 10^3) + (6 \times 10^2) + (3 \times 10^0) =$ _____

MULTIPLYING USING THE GALLEY METHOD

An important belief of Hindu-Arabic is that we can do basic numerical calculation very simply using pencil and paper. One method of multiplication that preceded our current method was "The Galley Method".

Given: 45×83

| | |
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| | |
| | |

YOU TRY:

926×75

807×534