

NAME: _____

DATE: _____

DSA

Alternate Base Systems for Cross-Curricular Fun & Engineering Applications

HANDOUT FOR INDIVIDUAL WORK
Level 4 – Counting, Conversion, and Addition

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We often use the Decimal system for counting. We say 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
There are other ways of counting which can be useful under different circumstances.

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Binary: The first computers only had an OFF and an ON switch. There were only two possibilities which we call Binary because the prefix "bi" means two. The Binary base only contains 1 and 10. When we count in Binary we say: 1, 10, 11, 100, 101, 110, 111, 1000...

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Octal: In the Octal system we count by eights and we say: 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16 17 20, 21, 22, 23, 24, 25, 26, 27, 30, ____, ____, ____, ____, ____, ____, ____, 40...

In each base under 10 we can use the same numbers we already use. But what happens when we have a base like the Dozenal system wherein we need to add two new numbers? In the last century everyone agreed to call the two extra dozenal letters "dec" and "el".

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How do we count in the Dozenal system? We say: 1, 2, 3, 4, 5, 6, 7, 8, 9, dec, el, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, one dozen dec, one dozen el, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, two dozen dec, two dozen el, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, _____, _____, 40...

QUESTION:

How do we add within different bases? We add in different bases the same way we add in the Decimal Base.

Examples in Decimal Base: | | | + | | | = 6 and | | | | | | | | + | | | | | = 13

Same example in Octal Base:

| | | + | | | = 6 and | | | | | | | | (10) + | | | | | (5) = 15

See above that 13 in the Decimal Base is 15 in the Octal Base!

Can you write your own examples of addition in different bases below? Please try using sticks or in your head:

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ADDITION AMONG BASES: It is fun to add and convert among the bases.

ADDITION QUESTIONS: Write examples of additions and then conversions between different bases using stick-lines to represent quantity. Use the space on this page for more additions.

Example: | | | | | | | | + | | | | | | | | | | | |

In Decimal Base = _____

In Binary Base = _____

In Octal Base = _____

In Dozenal Base = _____

YOUR ADDITION CONVERSION:

In Decimal Base = _____

In Binary Base = _____

In Octal Base = _____

In Dozenal Base = _____

YOUR ADDITION CONVERSION:

In Decimal Base = _____

In Binary Base = _____

In Octal Base = _____

In Dozenal Base = _____

Do you understand how to add in different bases? YES A LITTLE BIT NO

When you and your neighbor are both done with the work, explain alternate-bases and addition in different bases to him or her; then let your neighbor explain alternate bases and addition in different bases to you.

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Alternate Base Systems for Cross-Curricular Fun & Engineering Applications

HANDOUT FOR INDIVIDUAL WORK
Level 3 – Counting, Conversion, and Addition

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Think about the Dozenal-base system:

One, two, three, four, five, six, seven, eight, nine, dec, el, dozen.

Notice that in order to count up to 10 in dozenals, we must include two extra numbers, Dec and El. Mathematicians have agreed to call the two extra Dozenal numbers Dec and El.

Nobody has ever decided which symbols we should use for Dec and El. Maybe you can help. Below, please make up your own shapes for the two extra Dozenal numbers, Dec and El. Draw them next to their names: DEC and EL and circle your best efforts for each number.

DEC

EL