**EXPLORATION 13**

# THE RETURN OF THE VINCULUM

*The vinculum returns to save the day in problems with division!*

TOPICS COVERED: The use of vinculum in fractions. Division in algebra. Division as multiplication by fractions.

## A. GETTING STARTED

Recall from book 6 that the vinculum is the horizontal bar that was used some five hundred years ago to denote the grouping of symbols. For example, the expression:

$$\overline{a-b-\overline{c-\overline{d-\overline{e-f}}}}$$

means

$$a-\Big(b-\Big(c-\big(d-(e-f)\big)\Big)\Big)$$

and the expression

$$\overline{\overline{x-4}+\overline{y+5}-7}-\overline{x+3}$$

means

$$\Big(\big((x-4)+(y+5)\big)-7\Big)-(x+3)$$

[Check both of these!]

And also recall that multiplication comes with an invisible vinculum. For example:

$$ab-3$$

means:

$$\overline{a\times b}-3$$

and

$$\overline{\overline{w-5}\times q+2}-8\times w+4$$

has an invisible vinculum over the first multiplication sign which connects $\overline{w-5}$ and $q$, and also another vinculum over the second multiplication sign which connects $\overline{\overline{w-5}\times q+2}-8$ and $w$. Thus we could write:

$$\overline{\overline{w-5}\times q+2}-8\times w+4$$

which, in terms of parentheses, means:

$$\big((w-5)q+2\big)-8\big)w$$

**Question 1:** Are there invisible parentheses in this expression?

**Question 2:**

a) Rewrite $\overline{\overline{a+\overline{2+b}\times a-b}+7-4}$ in terms of parentheses.

b) Rewrite $\Big(3+\big(2\big(a-6\big)\big)+x\Big)\big(x-a\big)$ in terms of the vinculum.

**Comment:** Nested parentheses are often hard to read. For this reason, people often use different a variety of different brackets to make it clear which opening bracket matches with which closing one. For example, the expression in part b) might be rewritten: $\Big[3+\big\langle 2\big(a-6\big)\big\rangle+x\Big]\big(x-a\big)$.

**Question 3:** Recall from exploration 5 that "subtraction" can be interpreted as "the addition of the opposite." So, for instance:

$$2-\overline{x-3}$$

reads "2 plus the opposite of the quantity $x-3$." Since the opposite of $x-3$ is $-x+3$ we have: $2-\overline{x-3}=2-x+3=5-x$.

Evaluate and simplify each of the following:

a) $1-\overline{x-1}$

b) $\overline{5-T}+\overline{T-5}$

c) $\overline{5-T}-\overline{T-5}$

d) $\overline{5-T}-\overline{5+T}$

e) $\overline{1-\overline{1-\overline{f}}}$

The vinculum makes its appearance still today in several places in mathematics. You may have seen its use in some of locations we list here.

1. …
2. …
3. ….

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