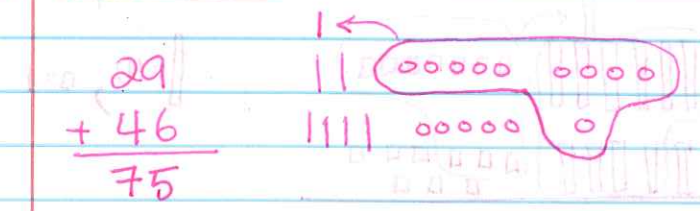
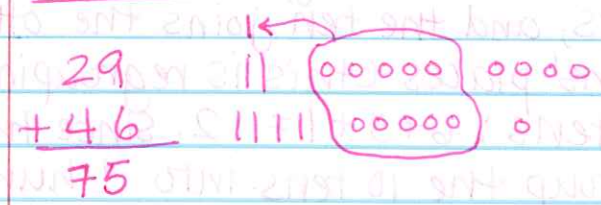
Textbook Problems from Section 3.3

① Student 1



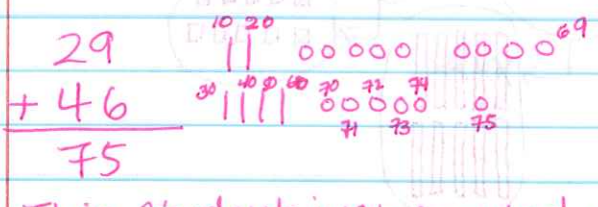
This student grouped the ones from 29 with enough ones from 46 to make a ten, which is what student 1 did in Activity 3M.

Student 2



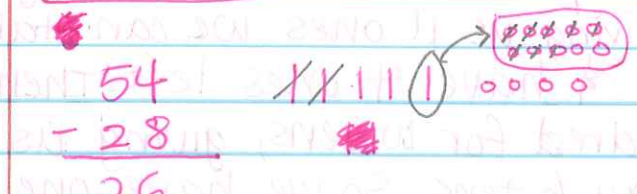
This student took 5 ones from 29 and 5 ones from 46 to make one group of ten, which is what student 2 did in Activity 3M.

Student 3



This student just counted the total number of base-ten blocks, which is what student 3 did in Activity 3M.

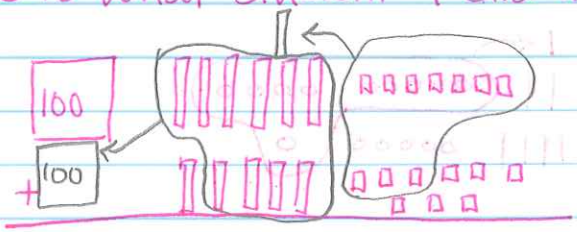
Student 4



This student lined up base-ten blocks which equal 54, then crossed out 28 of them. First, she had to take away 2 tens, then exchange one of the remaining ⇒

tens for ten ones and takes away 8 of those ones. This is what Student 4 did in Activity 3M.

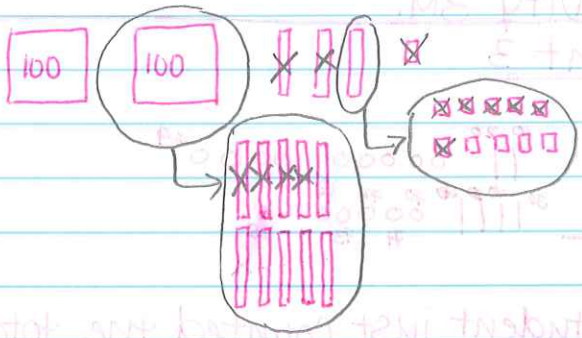
② $\begin{array}{r} {\scriptstyle 1\ 1} \\ 167 \\ +\ 59 \\ \hline 226 \end{array}$



2 hundreds, 2 tens, 6 ones

In order to add 167 + 59, first add the ones' places. Since 7+9 = 16, we regroup this to look like 1 ten and 6 ones, and the ten joins the other numbers in the tens' places (this is regrouping). Now we add the tens: 6+5+1 = 12. Since there are 12 tens, we regroup the 10 tens into 1 hundred, and move that to the hundreds place. Then we add the hundreds: 1+1 = 2. So the answer is 226.

③ $\begin{array}{r} {\scriptstyle 1\ 12\ 11} \\ 2\not{3}\not{1} \\ -\ 67 \\ \hline 164 \end{array}$



Start with a representation of 231 (I used base-ten blocks). We want to take-away 67. We need to exchange one ten for 10 ones, giving us 11 ones. We can take away 7 ones from this & have 4 ones left. Then, we exchange one hundred for 10 tens, giving us 12 tens, and we take away 6 tens. So we have one hundred and 6 tens left. We are left with a total of 164.

(6) 512 - 146

512	400
-146	-30
-4	370
-30	-4
400	366

512 - 146 = 366.

This student did the following:

512 - 146 → (500 + 10 + 2) - (100 + 40 + 6)

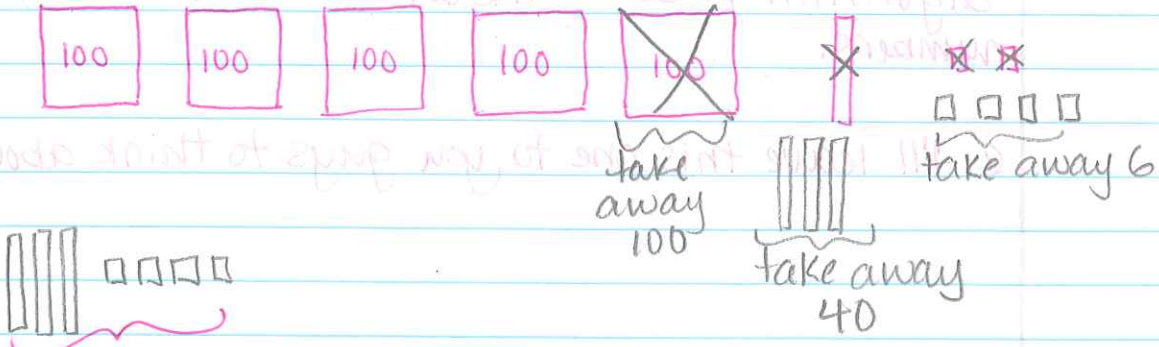
→ 2 - 6 = -4

10 - 40 = -30

500 - 100 = 400

→ 400 - 30 - 4 = 370 - 4 = 366.

She took 6 ones from 2 ones, leaving negative 4 ones, then took 4 tens from 1 ten, leaving negative 3 tens, then took one hundred from 5 hundreds to get 4 hundreds. Then she added those three results to get 366. This makes sense because when she "takes" 6 from 2, she knows that she will in the future still need to take 4 away. Same with the -30 she had after taking 40 from 10. At the end, she takes 30 and 4 away from 400.



(13) a.

$$\begin{array}{r} 5\,\overset{12}{\not 2}\,4^{14} \\ -\ \not 2\,\not 1^{10}\not 9\ 8 \\ \hline 3\ 2\ 6 \end{array} \qquad\qquad \begin{array}{r} 1\,\overset{10}{\not 0}\,\overset{10}{\not 0}\,\not 3^{13} \\ -\ 1\,1\ 10\,\not 9\ 5 \\ \hline 9\ 0\ 8 \end{array}$$

new algorithm   new algorithm

Verify with standard algorithm:

$$\begin{array}{r} {}^{4}\not 5\,\overset{11}{\not 2}\,\not 4^{14} \\ -\ 1\ 9\ 8 \\ \hline 3\ 2\ 6 \end{array} \qquad\qquad \begin{array}{r} {}^{0}\not 1\,\overset{10\,9}{\not 0}\,\overset{10\,9}{\not 0}\,\not 3^{13} \\ -\ \ \ 9\ 5 \\ \hline 9\ 0\ 8 \end{array}$$

:)

b. In the old (standard) algorithm, in order to do 524 − 198, we would have to exchange one ten in 524 for 10 ones and one hundred in 524 for 10 tens. So then we would have 4 hundreds, 11 tens and 14 ones, so we could take away 1 hundred, 9 tens and 8 ones easily. With the new algorithm, we have 5 hundreds, 12 tens and 14 ones and we want to take away 2 hundreds, 10 tens and 8 ones. Notice that

$4-1=3$ and $5-2=3$] hundreds
$11-9=2$ and $12-10=2$] tens
$14-8=6$ $14-8=6$] ones.

The differences between the numbers in each place value does not change! So this subtraction algorithm preserves the difference between the two numbers.

c. I'll leave this one to you guys to think about! :)