

## Subtraction Error Patterns and Algorithms.

Below is the work of 6 fictional students. All of them are consistent in their work. Some of them are making consistent errors. That means, if there is the opportunity in the problem for them to make their ideosyncratic error, they will make it. Some of them have alternate algorithms that they are using (that yield the correct result in a reasonable way that is different from the standard algorithm). Try to get inside the head of each student and see if you can figure out what they are doing and why.

- Your task is to figure out what each student is doing and to do the same thing they would on the last two problems in each set.
- You then need to explain what they did in words: *what are they doing* and *why: is it an error or an alternate algorithm?* Try to use place value language to *describe why* their work is consistently in error or consistently works.

1.

$\begin{array}{r} 356 \\ -179 \\ \hline 200 \\ -23 \\ \hline 177 \end{array}$	$\begin{array}{r} 412 \\ -172 \\ \hline 300 \\ -60 \\ \hline 240 \end{array}$	$\begin{array}{r} 32 \\ -18 \\ \hline 20 \\ -6 \\ \hline 14 \end{array}$	$\begin{array}{r} 439 \\ -145 \\ \hline 304 \\ -10 \\ \hline 294 \end{array}$	$\begin{array}{r} 54 \\ -17 \\ \hline \end{array}$	$\begin{array}{r} 323 \\ -164 \\ \hline \end{array}$
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Explain the pattern, and why it works or doesn't work.

$$\begin{array}{r}
 2. \quad \overset{5}{2}\overset{1}{8} \\
 -54 \\
 \hline
 2014
 \end{array}
 \quad
 \begin{array}{r}
 \overset{6}{1}\overset{1}{3} \\
 -29 \\
 \hline
 144
 \end{array}
 \quad
 \begin{array}{r}
 \overset{5}{1}\overset{1}{9} \\
 -36 \\
 \hline
 1213
 \end{array}
 \quad
 \begin{array}{r}
 \overset{7}{3}\overset{1}{7} \\
 -54 \\
 \hline
 3213
 \end{array}
 \quad
 \begin{array}{r}
 294 \\
 -62 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 254 \\
 -39 \\
 \hline
 \end{array}$$

Explain the pattern, and why it works or doesn't work.

$$\begin{array}{r}
 3. \quad \overset{4}{5}\overset{1}{4}\overset{1}{8} \\
 -173 \\
 \hline
 375
 \end{array}
 \quad
 \begin{array}{r}
 \overset{6}{6}\overset{1}{1} \\
 -135 \\
 \hline
 536
 \end{array}
 \quad
 \begin{array}{r}
 \overset{3}{4}\overset{1}{3}\overset{1}{1} \\
 -157 \\
 \hline
 284
 \end{array}
 \quad
 \begin{array}{r}
 \overset{4}{5}\overset{1}{3}\overset{1}{6} \\
 -287 \\
 \hline
 259
 \end{array}
 \quad
 \begin{array}{r}
 416 \\
 -179 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 416 \\
 -174 \\
 \hline
 \end{array}$$

Explain the pattern, and why it works or doesn't work.

$$\begin{array}{r}
 4. \quad 70 \\
 -48 \\
 \hline
 32
 \end{array}
 \quad
 \begin{array}{r}
 300 \\
 -193 \\
 \hline
 217
 \end{array}
 \quad
 \begin{array}{r}
 60 \\
 -24 \\
 \hline
 46
 \end{array}
 \quad
 \begin{array}{r}
 100 \\
 -74 \\
 \hline
 36
 \end{array}
 \quad
 \begin{array}{r}
 80 \\
 -17 \\
 \hline
 63
 \end{array}
 \quad
 \begin{array}{r}
 500 \\
 -324 \\
 \hline
 176
 \end{array}$$

Explain the pattern, and why it works or doesn't work.

$$\begin{array}{r}
 5. \quad 743 \\
 -152 \\
 \hline
 643 \\
 593 \\
 \hline
 591
 \end{array}
 \quad
 \begin{array}{r}
 74 \\
 -18 \\
 \hline
 64 \\
 56
 \end{array}
 \quad
 \begin{array}{r}
 439 \\
 -125 \\
 \hline
 339 \\
 319 \\
 \hline
 314
 \end{array}
 \quad
 \begin{array}{r}
 231 \\
 -86 \\
 \hline
 151 \\
 145
 \end{array}
 \quad
 \begin{array}{r}
 82 \\
 -46 \\
 \hline
 36
 \end{array}
 \quad
 \begin{array}{r}
 325 \\
 -167 \\
 \hline
 158
 \end{array}$$

Explain the pattern, and why it works or doesn't work.

$$\begin{array}{r}
 6. \\
 143 \\
 - 30 \\
 \hline
 110
 \end{array}
 \quad
 \begin{array}{r}
 647 \\
 -143 \\
 \hline
 504
 \end{array}
 \quad
 \begin{array}{r}
 372 \\
 -130 \\
 \hline
 240
 \end{array}
 \quad
 \begin{array}{r}
 306 \\
 -102 \\
 \hline
 204
 \end{array}
 \quad
 \begin{array}{r}
 454 \\
 -134 \\
 \hline
 \phantom{000}
 \end{array}$$

$$\begin{array}{r}
 326 \\
 -204 \\
 \hline
 \phantom{000}
 \end{array}$$

Explain the pattern, and why it works or doesn't work.

7. Do each of these problems using A. the negative numbers algorithm and B. the “exchange first” variation on the standard algorithm.

i.  $623 - 497$

ii.  $503 - 248$

8. Mental math subtraction: Do each of these in your head, using something other than the standard algorithm, and explain how you did it:

a.  $87 - 29$

b.  $70 - 23$

c.  $502 - 206$

d.  $502 - 199$