Algorithms

More problems about algorithms.

Problem 1 Here is an example of a standard addition algorithm:

$$11$$
 892
 $+398$
 1290

Learning outcomes:

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- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 2 Here is an example of the column addition algorithm:

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

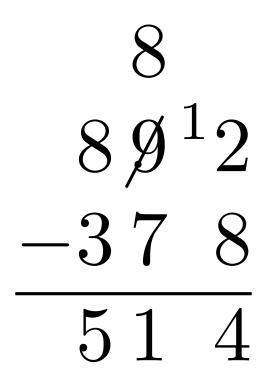
 $\begin{array}{ll} \textbf{Problem} & \textbf{3} & \textit{If you check out Problems} & \textit{and , you will learn about "partial"} \\ & \textit{algorithms}. \end{array}$

- (a) Develop a "partial" algorithm for addition, give it a name, and describe how to perform this algorithm.
- (b) Provide a relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 4 Here is an example of the banker's addition algorithm:

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 5 Here is an example of a standard subtraction algorithm:



- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 6 Here is an example of the subtraction by addition algorithm:

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 7 Here is an example of the Austrian subtraction algorithm:

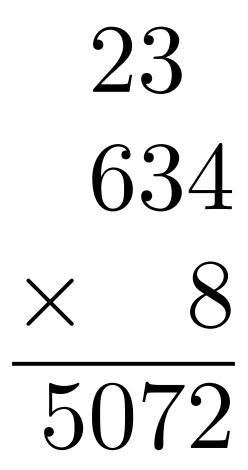
$$89^{1}2$$
 $-3^{8}78$
 $\overline{5}14$

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

 $\begin{array}{ll} \textbf{Problem} & \textbf{8} & \textit{If you check out Problems} & \textit{and , you will learn about "partial"} \\ & \textit{algorithms}. \end{array}$

- (a) Develop a "partial" algorithm for subtraction, give it a name, and describe how to perform this algorithm.
- (b) Provide a relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 9 Here is an example of a standard multiplication algorithm:



- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 10 Here is an example of the partial-products algorithm:

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 11 Here is an example of a standard division algorithm:

$$\begin{array}{r}
 97 R 1 \\
 \hline
 8) 777 \\
 \hline
 72 \\
 \hline
 57 \\
 \hline
 56 \\
 \hline
 1
 \end{array}$$

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 12 Here is an example of the partial quotients algorithm:

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 13 Here is another example of the partial-quotients division algorithm:

- (a) Describe how to perform this algorithm—be sure to explain how this is different from the scaffolding division algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 14 Here is an example of a standard multiplication algorithm:

634 $\times 216$ 3804 6340 126800136944

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here—you may

assume that you already know the algebra behind the standard multiplication algorithm.

Problem 15 Here is an example of the addition algorithm with decimals:

$$1 \\ 37.2 \\ +8.74 \\ \hline 45.94$$

- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

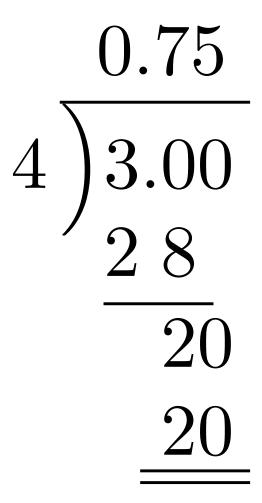
Problem 16 Here is an example of the multiplication algorithm with decimals:

$$3.40$$
 $\times .21$
 340
 6800
 7140

(a) Describe how to perform this algorithm.

- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.
- (c) Show the "behind-the-scenes" algebra that is going on here.

Problem 17 Here is an example of the division algorithm without remainder:



- (a) Describe how to perform this algorithm.
- (b) Provide an additional relevant and revealing example demonstrating that you understand the algorithm.

(c) Show the "behind-the-scenes" algebra that is going on here.

Problem 18 In the following addition problem, every digit has been replaced with a letter.

$\frac{\textit{MOON}}{+ \textit{SUN}}$

Recover the original problem and solution. Explain your reasoning. Hint: S=6 and U=5.

Problem 19 In the following addition problem, every digit has been replaced with a letter.

SEND +MORE MONEY

Recover the original problem and solution. Explain your reasoning.

Problem 20 In the following subtraction problem, every digit has been replaced with a letter.

DEFER -DU7Y N2G2

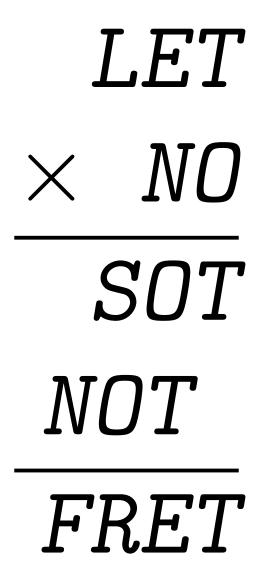
Recover the original problem and solution. Explain your reasoning.

Problem 21 In the following two subtraction problems, every digit has been replaced with a letter.

$$NINE \ -TEN \ TWO \ -NINE \ ALL$$

Using both problems simultaneously, recover the original problems and solutions. Explain your reasoning.

Problem 22 In the following multiplication problem, every digit has been replaced with a letter.



Recover the original problem and solution. Explain your reasoning.

Problem 23 The following is a long division problem where every digit except

7 was replaced by X.

$$\begin{array}{c} X7X \\ XX \\ XX \\ X77 \\ \hline X7X \\ X7X \\ \underline{X7X} \\ XX \\ \underline{XX} \end{array}$$

Recover the digits from this long division problem. Explain your reasoning.

Problem 24 The following is a long division problem where the various digits were replaced by X except for a single 8. The double bar indicates that the remainder is 0.

Recover the digits from this long division problem. Explain your reasoning.