Subtracting Decimal Numbers – Base 10

Since we have been subtracting base 10 numbers since grade 1, the borrowing process is done automatically in our heads

An algorithm can be written to show the full process

$$
\begin{array}{r@{\hspace{2em}}r@{\hspace{2em}}r@{\hspace{2em}}r@{\hspace{1em}}l}
7 & (10)+4 & (10)+2 & & \\
\cancel{8} & \cancel{5} & \cancel{3} & (10)+4 & \text{(minuend)} \\
-\ \ 6 & 7 & 4 & 8 & \text{(subtrahend)} \\
\hline
1 & 7 & 8 & 6 & \text{(difference)}
\end{array}
$$

The borrow carries with it a weight equal to that of the base, 10

$$624.81_{10} - 2.593_{10}$$

$$705_{10} - 528_{10}$$

Subtracting Octal Numbers – Base 8

As with the base 10 system, an algorithm can be used to subtract octal numbers…just keep in mind there are only 8 possible numbers available (0,1,2,3,4,5,6,7).

$$
\begin{array}{cccl}
4 & (8)+0 & & \\
\cancel{5} & \cancel{1} & (8)+2 & \text{(minuend)} \\
-\quad 2 & 6 & 7 & \text{(subtrahend)} \\
\hline
2 & 2 & 3 & \text{(difference)}
\end{array}
$$

The borrow carries with it a weight equal to that of the base, 8

$$161_8 - 72_8 \qquad\qquad 216.34_8 - 3.75_8$$

Subtracting Hexadecimal Numbers – Base 16

As with the base 8 system, an algorithm can be used to subtract hexadecimal numbers...just keep in mind there are only 16 possible numbers available (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F).

Dec	Hex
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

$$
\begin{array}{rccl}
B\ (16)+2 & & & \\
\cancel{C} \qquad \cancel{3} & (16)+7 & & \text{(minuend)} \\
-\quad 8 \qquad 5 & E & & \text{(subtrahend)} \\
\hline
3 \qquad 13 & 9 & & \text{(difference)} = 3D9_{16}
\end{array}
$$

The borrow carries with it a weight equal to that of the base, 16

$$D\,59.43_{16} - A\,.68_{16}$$

$$F\,1\,B\,2_{16} - ABC7_{16}$$

Subtracting Binary Numbers – Base 2

As with the base 10 system, an algorithm can be used to subtract binary numbers...just keep in mind there are only 2 possible numbers available (0,1).

$$
\begin{array}{ccccc}
 & & & 0 & \\
1 & 1 & \cancel{1} & (2)+0 & \text{(minuend)} \\
- \quad 0 & 1 & 0 & 1 & \text{(subtrahend)} \\
\hline
1 & 0 & 0 & 1 & \text{(difference)}
\end{array}
$$

The borrow carries with it a weight equal to that of the base, 2

$$
\begin{array}{cccccc}
0 & & 1 & & & \\
\cancel{1} & (2)+0 & (2)+0 & 1 & 1 & \text{(minuend)} \\
- \quad 0 & 1 & 1 & 0 & 1 & \text{(subtrahend)} \\
\hline
0 & 0 & 1 & 1 & 0 & \text{(difference)}
\end{array}
$$

$$10110.10_2 - 101.01_2$$ $$110010_2 - 100111_2$$

Summary of Subtraction Algorithms – Base n

For base 8, subtract the 2 digits in each column as normal. If the minuend (top) number is smaller than the subtrahend (bottom) number, then borrow a 8 from the column to the left...then complete the subtraction...repeat until you have subtracted all the columns.

For base 16, subtract the 2 digits in each column as normal. If the minuend (top) number is smaller than the subtrahend (bottom) number, then borrow a 16 from the column to the left...then complete the subtraction...repeat until you have subtracted all the columns.

For base 2, subtract the 2 digits in each column as normal. If the minuend (top) number is smaller than the subtrahend (bottom) number, then borrow a 2 from the column to the left...then complete the subtraction...repeat until you have subtracted all the columns.

Review Questions

Review question set 6