

**Daily Check:** Use the multiplication algorithm to calculate the following product by only using the counting digits 0, 1, 2

$$\begin{array}{r}
 21021 \\
 \times 11012 \\
 \hline
 21112 \\
 2210210 \\
 10000000 \\
 121021000 \\
 +210210000 \\
 \hline
 1010101022
 \end{array}$$

X	1	2
1	01	02
2	02	11

$$\begin{array}{r}
 \overset{5}{4} \overset{4}{8} 7 \\
 \times \quad 5 \overset{6}{6} \\
 \hline
 \overset{1}{2} \overset{9}{9} \overset{2}{2} \overset{2}{2} \\
 \square \square 3 5 \\
 \hline
 \square \square 2 \overset{7}{7} 2
 \end{array}$$

$$\begin{array}{r}
 \overset{74}{18} \\
 \times 50009 \\
 \hline
 162 \\
 0 \\
 00 \\
 000 \\
 0000 \\
 +9000000 \\
 \hline
 90000162 \checkmark
 \end{array}$$

$$\begin{array}{r}
 \overset{7}{50009} \\
 \times 18 \\
 \hline
 400072 \\
 +500090 \\
 \hline
 9000972 \checkmark
 \end{array}$$

$$18 \times 500,009 = (10+8) \times 500,009 = 10 \times 500,009 + 8 \times 500,009$$

Now it is single digit multiplication!

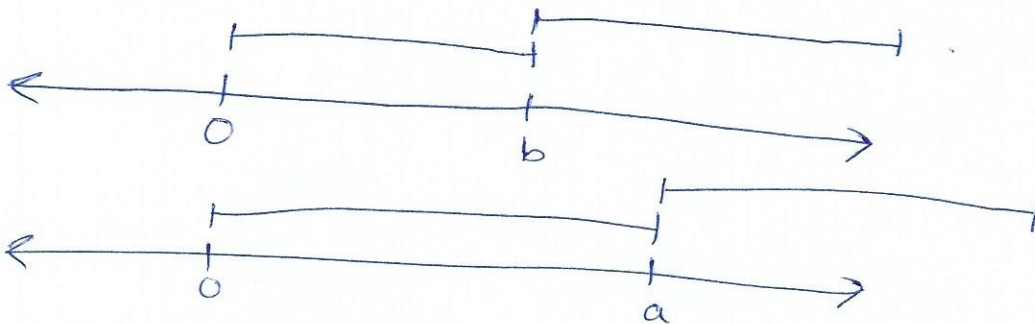
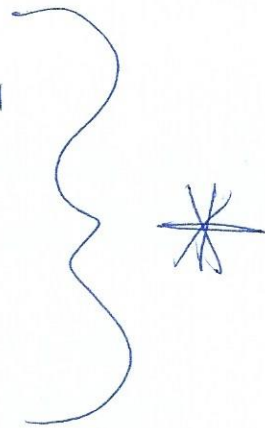
$$\begin{array}{r}
 500009 \\
 \times 1 \\
 \hline
 \end{array}
 \quad + \quad
 \begin{array}{r}
 500009 \\
 \times 8 \\
 \hline
 \end{array}$$

If  $b < n$ , then  $ab < an$ .

Why? If  $[0, b]$  is shorter than  $[0, n]$ , then  
a copies of  $[0, b]$  put end-to-end will  
be shorter than a copies of  $[0, n]$   
put end-to-end.

Hence  $[0, \overset{ab}{\cancel{ab}}]$  is to the left of  $an$ ,

so  $ab < an$ .



We are given that  $a < m$ ,  $b < n$ .

So,  $ab < an$  (by  $*$ )

but  $an < mn$  (by  $*$  again),

So,  $ab < an < mn$ .

So,  $ab < mn$

What is the quotient and the remainder if we divide 586 by 3?

★ A number is divisible by 3 if the sum of the digits are divisible by 3 ★

$$5+8+6 = 19 \div 3 \times$$



$$(100 + 90 + 5) \times 3 + 1$$

$$\begin{array}{r} 195 \\ 3 \overline{)586} \\ \underline{-3} \phantom{0} \phantom{0} \\ 28 \phantom{0} \\ \underline{-27} \phantom{0} \\ 16 \\ \underline{-15} \\ 1 \end{array}$$

~~586~~  

$$586 = 195 \times 3 + 1$$

If we knew fractions:

$$\frac{586}{3} = 195 + \frac{1}{3}$$

### Division Algorithms:

★ Steps on pg. 108 ★

★ Students must know single digit multiplication! ★

Perform single-digit division w/  
remainder on  $3 \overline{)5}$

$$5 = 1 \times 3 + 2$$

So we write

$$\begin{array}{r} 1 \\ 3 \overline{)5} \\ \underline{-3} \\ 2 \end{array}$$

Why do we bring down the 8?

If this is money \$586 & we want to give it to 3 people, then

$$586 = \underset{\substack{\downarrow \\ \text{in } 100\text{'s}}}{500} + \underset{\substack{\downarrow \\ \text{in } 10\text{'s}}}{80} + \underset{\substack{\downarrow \\ \text{in } 1\text{'s}}}{6}$$

$$586 \div 3 = (300) + (280) + 6$$

$$= (300) + (270 + 10) + 6$$

$$= (300) + (270) + 16$$

$$= (300) + (270) + (15) + 1$$

Explanation on  
back →

We have ~~5~~ 5 \$100 bills, 8 ten \$ bills + 6 \$ bills.

We want to split evenly between 3 people.

Start by giving each of the 3 people a \$100 bill

$$(300)$$

We are left with 2 \$100 bills + since we can't divide that into 3 we exchange the 2 \$100 bills for 20 \$10 bills.

$$(280) + 6$$

We can give \$90 to each person + we have 1 \$10 bill left that we need to exchange to 10 \$1 bills.

$$(270 + 10) + 6$$

So, we get 16 \$1 bills.

We can give each person 5 \$1 bills and we will have \$1 left!

★ Money analogy is good for kids; you could use actual Monopoly money + have them distribute to others + exchange for different bills.

~~195~~  
~~3 1586~~

$$3 \overline{) 5} = \boxed{1} \times 3 + 2$$

$$3 \overline{) 28} = \boxed{9} \times 3 + 1$$

$$3 \overline{) 16} = \boxed{5} \times 3 + 1$$

$$\begin{aligned} 586 &= 5 \times 100 + 8 \times 10 + 6 \\ &= (\boxed{1} \times 3 + 2) \times 100 + 8 \times 10 + 6 \\ &= (\boxed{1} \times 3) \times 100 + 2 \times 100 + 8 \times 10 + 6 \\ &= (\boxed{1} \times 3) \times 100 + 20 \times 10 + 8 \times 10 + 6 \end{aligned}$$

$$\begin{aligned} &= (\boxed{1} \times 3) \times 100 + 28 \times 10 + 6 \\ &= (\boxed{1} \times 3) \times 100 + (\boxed{9} \times 3 + 1) \times 10 + 6 \\ &= (\boxed{1} \times 3) \times 100 + (\boxed{9} \times 3) \times 10 + 1 \times 10 + 6 \\ &= (\boxed{1} \times 3) \times 100 + (\boxed{9} \times 3) \times 10 + 16 \\ &= (\boxed{1} \times 3) \times 100 + (\boxed{9} \times 3) \times 10 + (\boxed{5} \times 3 + 1) \\ &\stackrel{\text{Factor out } 3!}{=} (\boxed{1} \times 100 + \boxed{9} \times 10 + \boxed{5} \times 3) + 1 \\ &= \boxed{195 \times 3 + 1} \end{aligned}$$