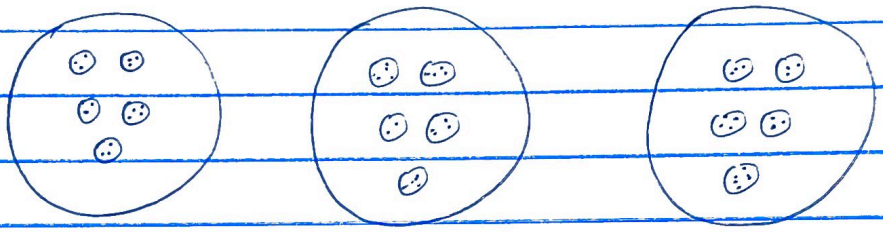
Section 3-4 Multiplication of Whole #s

Models for Whole Number Multiplication

1. Repeated Addition

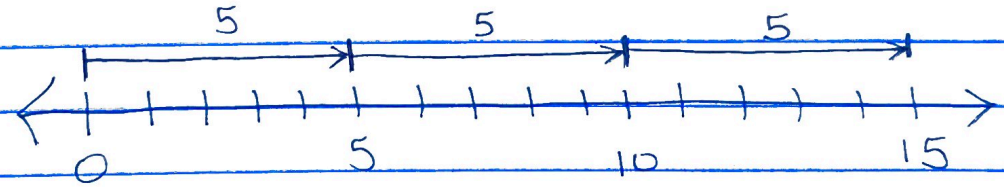
$3 \times 5 = 5 + 5 + 5 = 15$

sets:

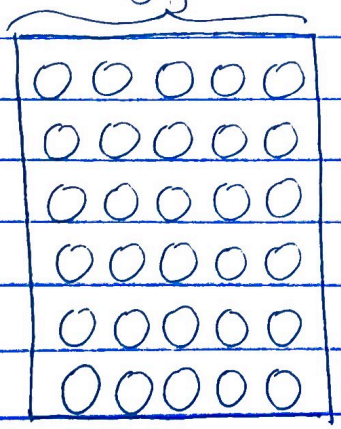


union of these sets is 15

Number Line

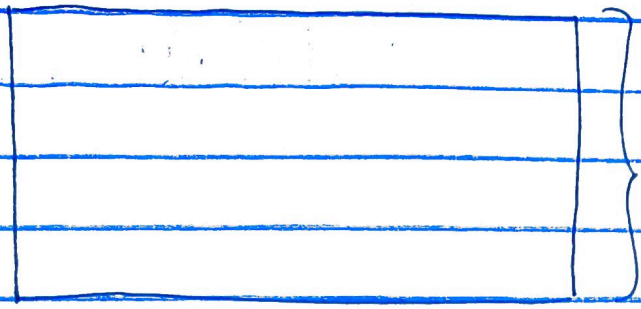


2. Rectangular Array / Area Model



How many mini muffins are in the pan?

$6 \times 5 = 30$

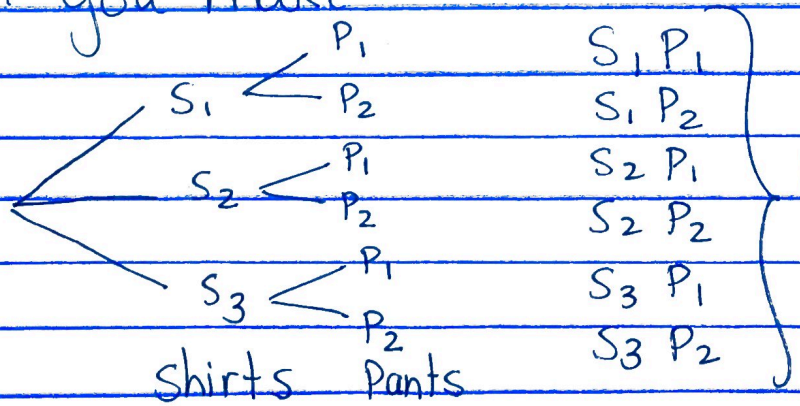


How many 1 ft by 1 ft tiles are needed to cover a floor that is 10 ft by 7 ft?

$10 \times 7 = 70$ sq. feet

3. Cartesian Product

On a trip, you pack 3 shirts and 2 pairs of pants. How many outfits can you make?



Properties of Whole # Multiplication

1. Closure Property
   The product of any 2 whole #s is always a whole number.

2. Commutative Property
   ex: $6 \cdot 5 = 5 \cdot 6$

3. Associative Property
   ex: $3(2 \cdot 5) = (3 \cdot 2) \cdot 5$

4. Identity Property
   ex: $7 \cdot 1 = 1 \cdot 7 = 7$

5. Zero Multiplication Property
   ex: $6 \cdot 0 = 0 \cdot 6 = 0$

6. Distributive Property of Mult over Add/Sub
   ex: $5(3+6) = 5 \cdot 3 + 5 \cdot 6$
   ex: $4(10-2) = 4 \cdot 10 - 4 \cdot 2$

Algorithms For Whole # Multiplication

1. Standard Algorithm

$$\begin{array}{r} {\scriptstyle 2}\,36 \\ \times\ 14 \\ \hline 144 \\ +\ 360 \\ \hline 504 \end{array}$$

Why do we put a 0 here? bc we move to the ~~tens~~ place value to multiply

2. Partial Products

Vertical:

$$\begin{array}{r} 36 \\ \times\ 14 \\ \hline 24 \quad \leftarrow 6\times 4 \\ 120 \quad \leftarrow 4\times 30 \\ 60 \quad \leftarrow 6\times 10 \\ +\ 300 \quad \leftarrow 30\times 10 \\ \hline 504 \end{array}$$

Horizontal: (uses dist prop)

$$\begin{aligned} 36\times 14 &= (30+6)(10+4) \\ &= 30\times 10 + 30\times 4 + 6\times 10 + 6\times 4 \\ &= 300 + 120 + 60 + 24 \\ &= 504 \end{aligned}$$

3. Multiplication by Powers of 10

Multiplying by 10^n increases the place value by n places.

For ex: $5 \cdot 10^2 = 5 \cdot 100 = 500$

Since place values are powers of 10, multiplying by powers of 10 simply increase place value.

Pointing out that:

$5 \times 100 = 500$
$3 \times 100 = 300$
$7 \times 10 = 70$
$7 \times 1000 = 7000$
$12 \times 100 = 1200$
$23 \times 10 = 230$

$6 \times 30 = 180$

$7 \times 200 = 1400$

is helpful when starting multiplication with multidigit numbers.

36 x 14 using partial products / Area

	30	+ 6
10 + 4	30x10 = 300	6 x10 = 60
	30x4 = 120	6x4 = 24

300
120
60
+ 24
504

This is a good technique to start multiplying multidigit numbers bc it breaks the problem into manageable pieces. The kids don't have to remember order or where to put certain things.

52 x 7

	50	+ 2
7	50x7 = 350	7 x2 = 14

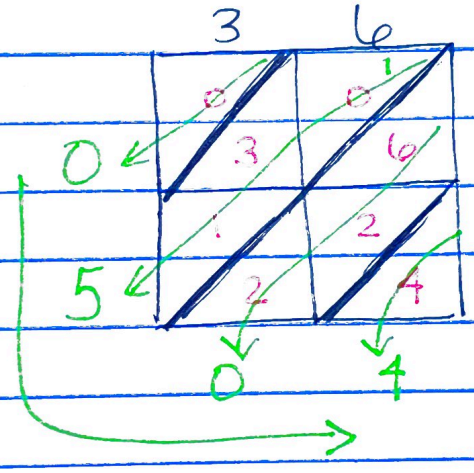
350
+ 14
364

4. Lattice Multiplication

People mistakely call this "new math" when, in fact, this technique has been around since the 10th century. It is becoming more utilized due to its structural approach to multiplication.

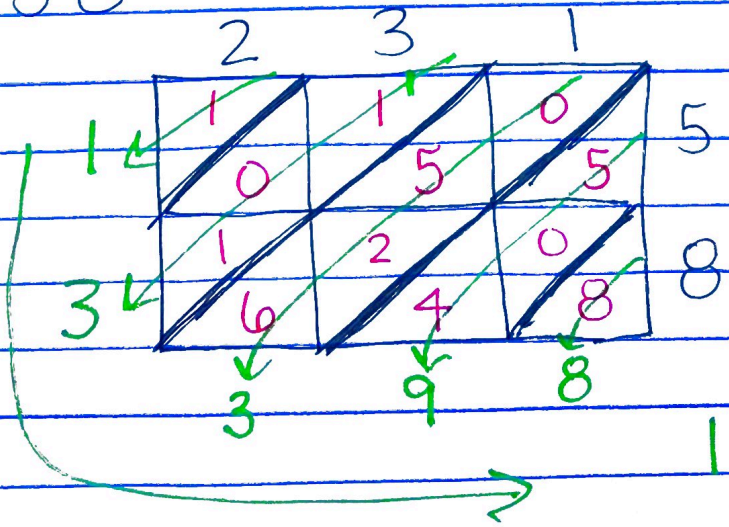
ex 1 Use lattice to multiply.

a) 36×14



504

b) 231×58



13,398

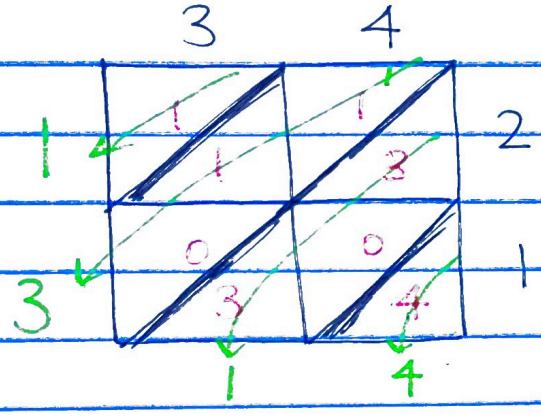
end 3-4 Part 1

Multiplication in Other Bases

Lattice multiplication is extremely useful when multiplying in other bases.

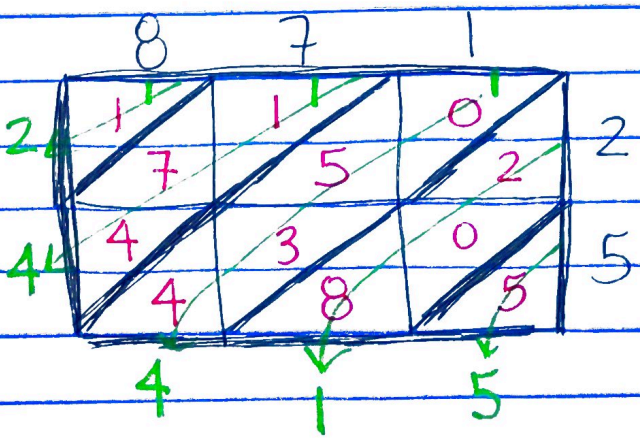
ex 2 Multiply

a) $34_{five} \times 21_{five}$



1314_{five}

b) $871_{nine} \times 25_{nine}$



24415_{nine}

$7 \times 2 = 14$
1 grp of 9 + 5 ones

$7 \times 5 = 35$
3 grps of 9 + 8 ones

$8 \times 5 = 40$
4 grps of 9 + 4 ones

Mental Multiplication Techniques

1. Front End Multiplication

ex 3 Multiply Mentally

a) $36 \times 8 \implies (30+6)\times 8 = (30\times 8)+(6\times 8)$
$= (240)+(48)$
$= 288$

b) $52 \times 3 \implies (50+2)\times 3 = 50\times 3 + 2\times 3$
$= 150 + 6$
$= 156$

2. Compensation

ex 4 Multiply

a) $12 \times 9 = 12 \times (10-1)$
$= 12\times 10 - 12\times 1$
$= 120 - 12$
$= 108$

b) $45 \times 98 = 45 \times (100-2)$
$= (45\times 100) - (45\times 2)$
$= 4500 - 90$
$= 4410$

3. Compatible Numbers

ex 5 Multiply

a) $5 \times 346 \times 2 = 346 \times 10 = 3460$

b) $25 \times 9 \times 11 \times 4 = 100 \times 99 = 9900$

c) $2 \times 9 \times 5 \times 20 \times 5 = 10 \times 100 \times 9 = 9000$

All of these mental techniques are geared toward multiplying bigger numbers.

What about mental techniques for learning basic multiplication facts?

Core

Mult by 2 ⇒ Double
Mult by 3 ⇒ Double then add 1 group
Mult by 5 ⇒ skip count by 5
Mult by 9 ⇒ finger trick or digit pattern
Mult by 10 ⇒ add a zero

Build off of core

Mult by 4 ⇒ Double 2
Mult by 6 ⇒ Double 3
Mult by 7 ⇒ 5 and 2
Mult by 8 ⇒ 5 and 3
Mult by 11 ⇒ 10 and 1
Mult by 12 ⇒ 10 and 2

$9 \times 1 = 9$
$9 \times 2 = 18$
$9 \times 3 = 27$
$9 \times 4 = 36$
$9 \times 5 = 45$
$9 \times 6 = 54$
$9 \times 7 = 63$
$9 \times 8 = 72$
$9 \times 9 = 81$

So, $9 \times 12 = 9 \times 10 + 9 \times 2$
$= 90 + 18$
$= 108$

Estimating Whole # Mult + Division

The only useful technique for estimating whole # multiplication, is rounding. and division

End 3-4