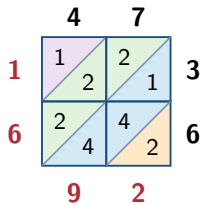


Lattice Multiplication



1. Area



Multiplying is finding the **area** of a **rectangle**.

2. Grid method

×	20	3
10	200	30
4	80	12

The **rectangle** written as a table.

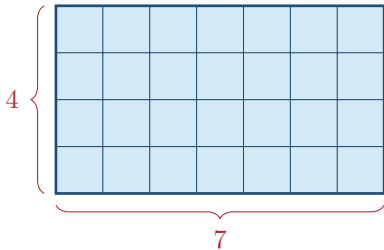
Every zero shown.

3. Lattice



The same **products**, with the **diagonals** doing the **place value**.

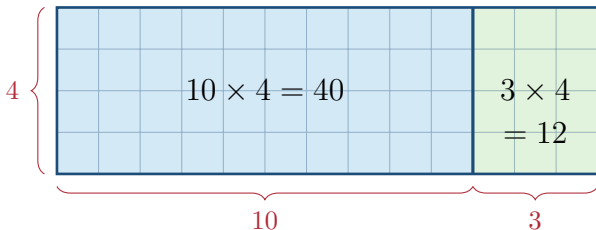
ضرب دینا رقبہ Multiplication is area



- A **rectangle** 7 wide and 4 tall.
- Count the **squares**: $7 \times 4 = 28$.

- Every **multiplication** question can be represented as a **rectangle**.

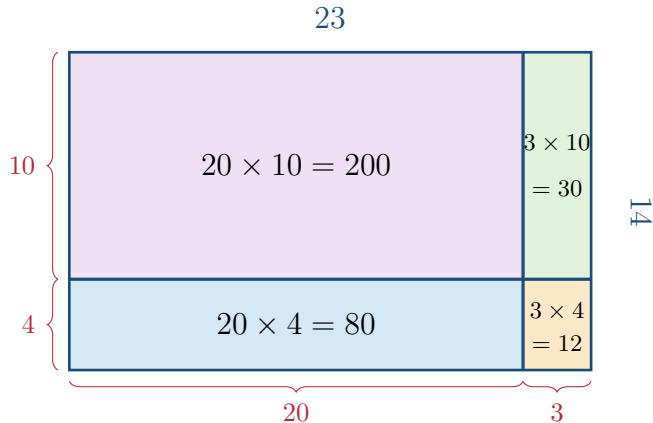
Chopping the ^{مستطيل}rectangle up



$$13 \times 4 = (10 \times 4) + (3 \times 4) = 40 + 12 = 52$$

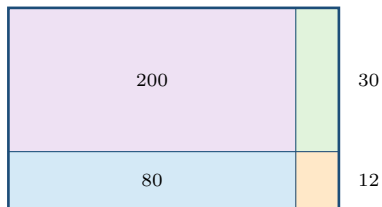
We split 13 into the parts we can actually multiply in our heads: its ^{دهائی}tens and its ^{اکائی}units.

Two ^{هیندسه}digits by two ^{هیندسه}digits: four pieces



$$23 \times 14 = 200 + 30 + 80 + 12 = 322$$

The same ^{مستطیل}rectangle, written as a ^{گرڈ}grid



×	20	3
10	200	30
4	80	12

$$200 + 30 + 80 + 12 = 322$$

- The ^{گرڈ}grid is like the picture, but not drawn to scale.

$\times$	40	7
30	1200	210
6	240	42

$$4 \times 3 = 12 \quad \text{so } 40 \times 30 = 1200$$

$$4 \times 6 = 24 \quad \text{so } 40 \times 6 = 240$$

$$7 \times 3 = 21 \quad \text{so } 7 \times 30 = 210$$

$$7 \times 6 = 42 \quad \text{so } 7 \times 6 = 42$$

$$1200 + 240 + 210 + 42 = 1692, \quad \text{so } 47 \times 36 = 1692$$

Your turn: grid method

(a) $34 \times 12 =$

(b) $26 \times 45 =$

(c) $53 \times 27 =$

(d) $18 \times 63 =$

(e) $72 \times 84 =$

(f) $95 \times 48 =$

$\times$		

Challenge. 124×36 . How many boxes does

 your **grid** need now, and why?

Answer:

Your turn: grid method

(a) $34 \times 12 = 408$

(b) $26 \times 45 = 1170$

(c) $53 \times 27 = 1431$

(d) $18 \times 63 = 1134$

(e) $72 \times 84 = 6048$

(f) $95 \times 48 = 4560$

×		

Challenge. 124×36 . How many boxes does

 your **grid** need now, and why?

Answer: $3 \times 2 = 6$ boxes, one for each pair of

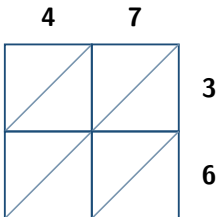
 مقامی قدر
place values; $124 \times 36 = 4464$

The problem with the grid

×	300	40	7
600	180000	24000	4200
50	15000	2000	350
8	2400	320	56

- The method is fine for bigger numbers...
- But it is a lot of writing long numbers

Building a ^{جالی}lattice: step 1, draw it



- 47×36 .
- One ^{ہندسہ}column for each **digit** of 47, written across the top.
- One ^{ہندسہ}row for each **digit** of 36, written down the right.
- Draw a ^{ترچھا خط}diagonal in every cell, running from top-right down to bottom-left.

Step 2: fill every cell with a ^{پہاڑا}times-table fact

- Multiply each of the combinations of ^{ہندسہ}digits in the relevant cell.

- ^{دہائی}Tens go in the upper-left ^{مثلاً}triangle, ^{اکائی}units in the lower-right.

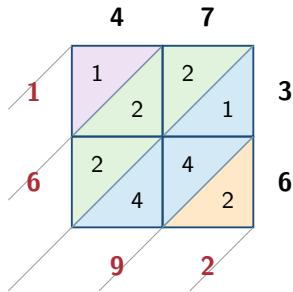
4	7	
1 2	2 1	3
2 4	4 2	6

$$4 \times 3 = 12 \rightarrow \boxed{1} / \boxed{2}$$

$$7 \times 3 = 21 \rightarrow \boxed{2} / \boxed{1}$$

Step 3: ^{جمع کرنا} add along the ^{ترچھا خط} diagonals

Start at the bottom right and work up the strips.



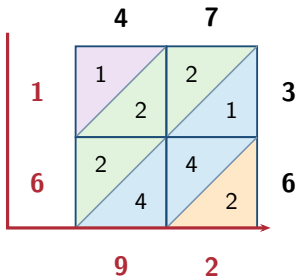
اکائی units	2	= 2
دہائی tens	4 + 4 + 1	= 9
سینکڑے hundreds	2 + 2 + 2	= 6
ہزار thousands	1	= 1

مقامی قدر

- Each shaded strip is one *place-value* column.

جالی

- Write each total just outside the *lattice*



- Read **down the left-hand side**, then **along the bottom**.

- 1, 6, 9, 2

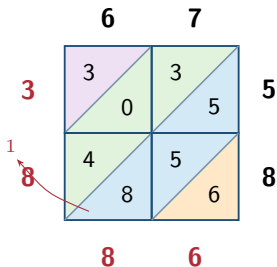
- $47 \times 36 = 1692$



Compare with the **grid** method:

$1200 + 240 + 210 + 42 = 1692$. its the same four

What if a **diagonal adds** to more than 9?



$$67 \times 58$$

اکائی

units

6

= 6

دہائی

tens

5 + 8 + 5

= 18 write 8, carry 1

سینکڑے

hundreds

4 + 3 + 0 + 1 = 8

ہزار

thousands

3

= 3

- If a strip totals 10 or more, write down the

دائی کیری مندر اکائی

Why do the **diagonals** work?

	4	7	
Th	1 2	2 1	3
H	2 4	4 2	6
	T	U	

- The top-left cell really means $40 \times 30 = 1200$,

i.e. **12** *hundreds*.

- Its **2** sits on the **hundreds diagonal** and its **1** sits one **diagonal** further left — the **thousands**.

Exactly right.

- Every step you move *left* or *up* in the **lattice** multiplies by 10; both moves shift you one **diagonal** along.

A bigger جالی lattice: 327×48

	3	2	7	
1	1	0	2	4
	2	8	8	
5	2	1	5	8
	4	6	6	
	6	9	6	

اکائی

units

6

= 6

دہائی

tens

$5 + 6 + 8$

= 19 → 9, carry 1

سینکڑے

hundreds

$1 + 4 + 2 + 8 + 1$

= 16 → 6, carry 1

ہزار

thousands

$2 + 0 + 2 + 1$

= 5

دس ہزار

ten thous.

1

= 1

ہندسہ

ہندسہ

Your turn: جالی lattice

(a) $38 \times 24 =$

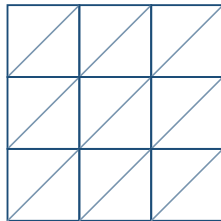
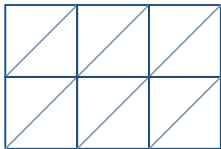
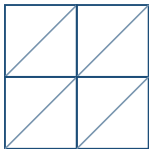
(b) $65 \times 43 =$

(c) $57 \times 89 =$

(d) $127 \times 36 =$

(e) $408 \times 57 =$

(f) $234 \times 156 =$



Your turn: جالی lattice

(a) $38 \times 24 = 912$

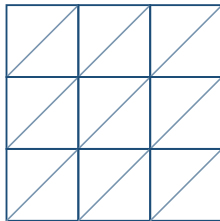
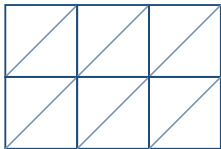
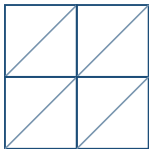
(b) $65 \times 43 = 2795$

(c) $57 \times 89 = 5073$

(d) $127 \times 36 = 4572$

(e) $408 \times 57 = 23\,256$

(f) $234 \times 156 = 36\,504$



And now the **decimal point** اعشاري نقطه

First: always ^{تخمینه} **estimate**

$$4.7 \times 3.6$$

$$4.7 \approx 5 \quad 3.6 \approx 4 \quad \Rightarrow \quad \text{the answer is about } 20$$

1.692

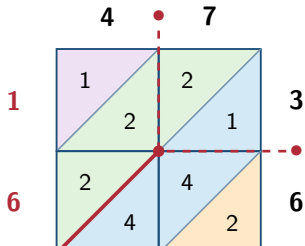
16.92

169.2

✓ the only one near 20

- The ^{جالی} **lattice** will give the ^{هندسه} **digits** 1 6 9 2 whatever the ^{اعشاریه نقطه} **decimal points** are doing.
- We just need to work out where the ^{اعشاریه نقطه} **decimal point** goes.

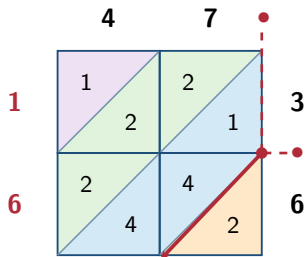
The decimal point rule



1. Ignore the ^{اعشاریہ نقطہ} decimal points and build the ^{جالی} lattice from the ^{ہندسہ} digits: 47 and 36.
2. Mark the ^{اعشاریہ نقطہ} decimal point of the top number on the **top edge**, and of the side number on the **right edge**.
3. Slide one *down* and the other *across* until they **meet**.
4. From that meeting point, **follow the**

Same ^{جالی}lattice, different ^{اعشاریہ نقطہ}decimal point

$$47 \times 3.6$$



- 47 has no ^{اعشاریہ نقطہ}decimal point written, so it sits at the **far right** of the top edge.
- 3.6 puts its point between the two rows, as before.
- They meet lower down, so the ^{ترچھا خط}diagonal ^{جالی}leaves the lattice one place further right.

The quick check: count the ^{اعشاریہ مقام}decimal places

$$4.7 \times 3.6 \quad 1 + 1 = 2 \text{ places} \Rightarrow 16.92$$

$$47 \times 3.6 \quad 0 + 1 = 1 \text{ place} \Rightarrow 169.2$$

$$0.47 \times 3.6 \quad 2 + 1 = 3 \text{ places} \Rightarrow 1.692$$

$$0.47 \times 0.36 \quad 2 + 2 = 4 \text{ places} \Rightarrow 0.1692$$

- The ^{ہندسہ}digits 1692 come from the same ^{جالی}lattice every single time.
- Total ^{اعشاریہ مقام}decimal places in the question = ^{اعشاریہ مقام}decimal places in the answer.
- The ^{ترچھا خط}diagonal rule and the counting rule always agree — use whichever you prefer, and

	1	2	•	5	
0	0	0	1	3	
	3	6	5		
4	0	0	2	4	
	4	8	0		

اکائی

units

0

= 0

دہائی

tens

2 + 8 + 5

= 15 → 5, carry 1

سینکڑے

hundreds

0 + 4 + 1 + 6 + 1

= 12 → 2, carry 1

ہزار

thousands

0 + 0 + 3 + 1

= 4

دس ہزار

ten thous.

0

= 0

ہندسہ

- Digits: $125 \times 34 = 4250$.

Your turn: ^{اعشاریہ}decimals

(a) $2.4 \times 3.7 =$

(b) $6.3 \times 0.8 =$

(c) $5.2 \times 4.6 =$

(d) $0.46 \times 2.3 =$

(e) $13.4 \times 2.5 =$

(f) $0.85 \times 0.64 =$

^{تخمینہ}
For each one, write your **estimate** before you start.

Challenge 1. 1.25×0.48 . Why does the answer need fewer ^{ہندسہ}digits than you expect?

Challenge 2. A ^{جالی}lattice for $\square.\square \times 4.5$ gives the ^{ہندسہ}digits 2790 and the answer 27.90. What

Your turn: ^{اعشاریہ}decimals

(a) $2.4 \times 3.7 = 8.88$

(b) $6.3 \times 0.8 = 5.04$

(c) $5.2 \times 4.6 = 23.92$

(d) $0.46 \times 2.3 = 1.058$

(e) $13.4 \times 2.5 = 33.5$

(f) $0.85 \times 0.64 = 0.544$

^{تخمینہ}
For each one, write your **estimate** before you start.

Challenge 1. 1.25×0.48 . Why does the answer need fewer ^{ہندسہ}digits than you expect?

^{جالی}
 $= 0.6$; the **lattice** gives 6000 and the **trailing zeros** disappear. ^{آخری صفر}

^{جالی}
Challenge 2. A **lattice** for $\square.\square \times 4.5$ gives the ^{ہندسہ}digits 2790 and the answer 27.90. What

رقبہ Area



مقامی قدر

Split each number into **place values**; the

رقبہ

حاصل ضرب

four **areas** are the four **products**.

گرڈ Grid

×	40	7
30	1200	210
6	240	42

Every zero written out. Reliable, but a

long addition at the end.

جالی Lattice

1	2	2	1
2	4	4	2

ہندسہ

ترچھا خط

Digits only. The **diagonals** carry the

مقامی قدر

place value. Read down, then across.

- اکائی مثلث دہائی
Tens in the upper-left **triangle**, **units** in the lower-right.

- جمع کرنا ترچھا خط کیری
Add down the **diagonals** from the bottom right, **carrying** up-left.