

# CREATE WITH MATH

Worksheet Solutions

**Learning Outcome:**  
Apply understanding of exponents as repeated multiplication to develop and create equivalent expressions and justify the laws of multiplication and division.  
CCSS.MATH.CONTENT.8.EE.A.1

Now that you have seen how math was instrumental for XLabs to solve the Binate problem, why don't we practice some challenges on exponents and powers?

- 1 The sum of three consecutive numbers is 45. These numbers are \_\_\_\_.
- 2 Match the following to the correct operations on the exponents.

$a^m \times a^n = a^{m+n}$

$a^m + a^n = a^{m+n}$

$(a^m)^n = a^{m \cdot n}$

$-$

$\times$

$+$

- 3 A box with area  $2^6$  square units is divided into two equal parts. Write the area of each inside the box below.

Area =  $2^6$  square units



- 4 Complete the table given below. We have completed the first one for you.

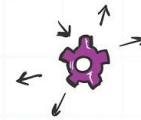
Problem	Solution	Law of Exponents
$x^3 \times x^4$	$x^7$	$a^m \times a^n = a^{m+n}$
$12^{20} \div 12^6$		
$(z^2)^5$		

- 5 Evaluate the following expressions and show the steps in the space given below. Don't forget to pay attention to the order of operations.

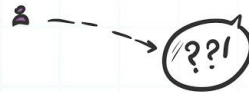
$(25 - 20) \times 5^3$	$2^2 - 2^3 \div 4$	$(14 - 7) \times (7^2)^2 \div 7$

- 6 XLabs ordered 42 research kits. These kits come in packets of 3. Which of the following equation correctly represents x, the number of packets?

☐  $x+3 = 42$     ☐  $3x = 42$     ☐  $\frac{x}{3} = 42$     ☐  $x = \frac{3}{42}$



Foundation





1 The sum of three consecutive numbers is 45. These numbers are \_\_\_\_.

Given:

Sum of 3 consecutive numbers is 45.

Solution:

Let the first number in the series of these 3 consecutive numbers be 'x'.

Since, they are consecutive numbers then other two numbers would be 'x+1' and 'x+2'.

According to the question

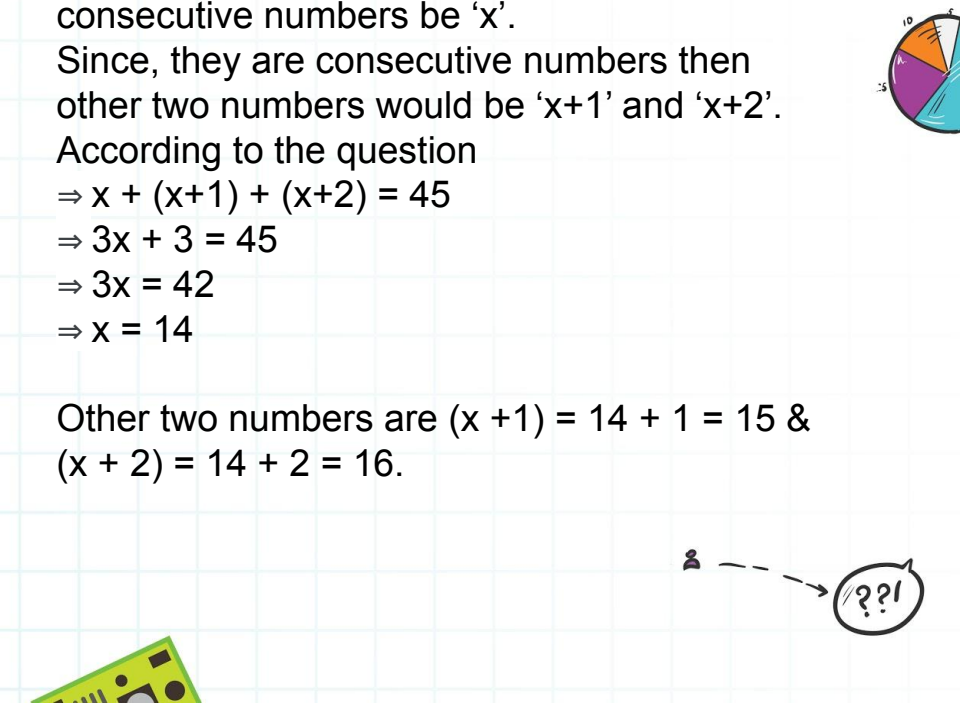
$$\Rightarrow x + (x+1) + (x+2) = 45$$

$$\Rightarrow 3x + 3 = 45$$

$$\Rightarrow 3x = 42$$

$$\Rightarrow x = 14$$

Other two numbers are  $(x + 1) = 14 + 1 = 15$  &  $(x + 2) = 14 + 2 = 16$ .



Answer: 14, 15, 16

2 Match the following to the correct operations on the exponents.

$$a^m \times a^n = a^{m \_ 2n}$$

$$a^m \div a^n = a^{m \_ 2n}$$

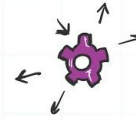
$$(a^m)^n = a^{m \_ 2n}$$

-

x

+

Solution:



(a)  $a^m \times a^n = a^{m + n}$

(b)  $a^m \div a^n = a^{m - n}$

(c)  $(a^m)^n = a^{m \times n}$

$$a^m \times a^n = a^{m \_ n}$$

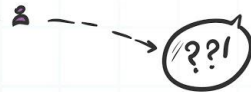
$$a^m \div a^n = a^{m \_ n}$$

$$(a^m)^n = a^{m \_ n}$$

-

x

+



3 A box with area  $2^6$  square units is divided into two equal parts.  
Write the area of each inside the box below.

Area =  $2^6$  square units



Given:

Area of bigger box is  $2^6$  square units

Solution:

The area of bigger box needs to be equally divided into two parts.

Therefore, the area to be filled in two boxes is

$$2^6 \div 2$$

$$= 64 \div 2$$

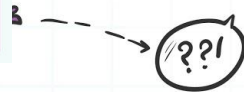
$$= 32 \text{ or } 2^5 \text{ square units.}$$

Area =  $2^6$  square units



$2^5$   
square  
units

$2^5$   
square  
units



Answer: Each box is  $2^5$   
square units or 32 square  
units

4 Complete the table given below. We have completed the first one for you.

Problem	Solution	Law of Exponents
$x^3 \times x^6$	$x^9$	$a^m \times a^n = a^{m+n}$
$12^{20} \div 12^6$		
$(z^3)^5$		

Solution:

Problem	Solution	Law of Exponents
$x^3 \times x^6$	$x^9$	$a^m \times a^n = a^{m+n}$
$12^{20} \div 12^6$	$12^{(20 - 6)} = 12^{14}$	$a^m \div a^n = a^{m - n}$
$(z^3)^5$	$z^{(3 \times 5)} = z^{15}$	$(a^m)^n = a^{m \times n}$

??!

5 Evaluate the following expressions and show the steps in the space given below.  
Don't forget to pay attention to the order of operations.

$$(25 - 20) \times 5^3$$

$$2^2 - 2^3 \div 4$$

$$(14 - 7) \times (7^2)^2 \div 7$$

Solution:

$$(25 - 20) \times 5^3$$

$$= 5 \times 5^3$$

$$= 5^1 \times 5^3$$

$$= 5^{3+1} = 5^4$$

$$= 625$$

$$2^2 - 2^3 \div 4$$

$$= 2^2 - 2^3 \div 2^2$$

$$= 4 - 8 \div 4$$

$$= 4 - 2$$

$$= 2$$

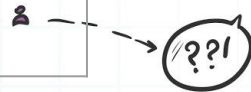
$$(14 - 7) \times (7^2)^2 \div 7$$

$$= (7) \times (7^2)^4 \div 7$$

$$= (7)^{1+4} \div 7$$

$$= 7^5 \div 7^1$$

$$= 7^4$$



6

XLabs ordered 42 research kits. These kits come in packets of 3.  
Which of the following equation correctly represents  $x$ , the number of packets?

☐

$x + 3 = 42$

☐

$3x = 42$

☐

$\frac{x}{3} = 42$

☐

$x = \frac{3}{42}$

Given:



Total ordered kits = 42.

1 packet of kits consists of 3 kits.

Number of packets =  $x$

Solution:

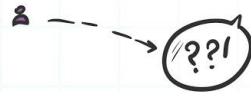
Total ordered kits = Number of packets  $\times$

Number of kits in 1 packet

$$\Rightarrow 42 = x \times 3$$

$$\Rightarrow 3x = 42$$

Answer:  $3x = 42$








## Application



 CREATE WITH  
**MATH**

Application **8**

**Learning Outcomes:**  
Apply understanding of exponents as repeated multiplication to develop and create equivalent expressions and justify the laws of multiplication and division.  
CCSS.MATH.CONTENT.8.EE.A.1

From several scientific processes to your social media followers, Math is everywhere! When it comes to XLabs' team and binates, it's all about exponents and powers. Based on that, there are a few questions for you. We are sure that you can answer them in a jiffy!

**1** On the second day, XLabs' twitter account had 16 more than twice the followers it had on the first day (let's say,  $x$ ). The expression that correctly gives this follower count is

☐  $5x - 10$ ☐  $16 + 2x$ ☐  $16x + 2$ ☐  $2x^{16}$


**2** XLabs's research team writes  $10^3$  words everyday for their paper. How many words do they write in  $10^2$  days?

☐  $10^5$ ☐  $10(6)$ ☐  $10^5$ ☐  $5^{10}$

**3** Pennies are stacked in each square of a chessboard, according to the equation below. Fill the given table, if each penny is 0.06 inches thick.

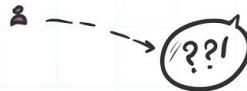
Equation =  $2 \cdot 2^y$   
 $x$  - Row number  
 $y$  - Column number

Row no.	Col no.	Penny count	Stack length
4	1		
8	8		



**4** A research team has found that the weight of an adult blue whale is 81 times that of a newborn whale calf. If the weight of an adult blue whale is 311 kilograms, then the newborn calf weighs  kilograms

**5** The hashtag #binategrowth saw  $2^4 \times 3 \times 5^3$  tweets per second. If there are  $2^8 \times 3^4 \times 5^2$  seconds in 6 days, what were the number of tweets during this period?



1 On the second day, XLabs' twitter account had 16 more than twice the followers it had on the first day (let's say,  $x$ ). The expression that correctly gives this follower count is

☐  $5x - 10$

☐  $16 + 2x$

☐  $16x + 2$

☐  $2x^{16}$

Given: Number of followers on day 1 =  $x$

Solution:

On the 2<sup>nd</sup> day, the number of followers became 16 more than two times the followers on the 1<sup>st</sup> day

No of followers on the 2nd day =  
 $16 + 2 \times \text{Number of followers on the 1st day}$

$\Rightarrow$  No of followers on the 2nd day =  $16 + 2x$

Answer:  $16 + 2x$

2 XLabs's research team writes  $10^3$  words everyday for their paper. How many words do they write in  $10^2$  days?

☐  $10^6$

☐  $10(6)$

☐  $10^5$

☐  $5^{10}$

Given:

Words written per day =  $10^3$

Solution:

We need to find out words written in  $10^2$  days

We know that words written per day are  $10^3$ .

Total number of days are  $10^2$ .

Therefore total number of words in  $10^2$  days =  
 $10^3 \times 10^2 = 10^5$  words

Answer:  $10^5$  words

Given:

Pennies are stacked in each square and they are stacked according to  $2^x \times 2^y$  where  $x$  is the row number and  $y$  is the column number

1 penny = 0.06 inches thick

Solution:

Row no.	Col no.	Penny count	Stack length
4	1	$2^4 \times 2^1 = 2^5 = 32$	$32 \times 0.06 = 1.92$ inches
8	8	$2^8 \times 2^8 = 2^{16} = 65536$	$65536 \times 0.06 = 3932.16$ inches



- 4 A research team has found that the weight of an adult blue whale is 81 times that of a newborn whale calf. If the weight of an adult blue whale is 311 kilograms, then the newborn calf weighs  kilograms

Given:



Weight of adult blue whale is  $311 = 3^{11}$  kgs.  
Weight of adult blue whale = 81 times of newborn whale calf =  $3^4$  times adult blue whale's weight

Solution:

Let the weight of the newborn calf be  $x$  kilograms.

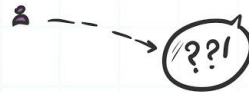
According to question

$$\Rightarrow 3^4 x = 3^{11}$$

$$\Rightarrow x = 3^{11} / 3^4$$

$$\Rightarrow x = 3^{(11 - 4)}$$

$$\Rightarrow x = 3^7$$



3<sup>7</sup> kilograms



5

The hashtag #binategrowth saw  $2^4 \times 3 \times 5^3$  tweets per second. If there are  $2^8 \times 3^4 \times 5^2$  seconds in 6 days, what were the number of tweets during this period?

Answer:  $2^{12} \times 3^5 \times 5^5$  tweets

Given:

#binategrowth tweets per second =  $2^4 \times 3 \times 5^3$

Total seconds in 6 days =  $2^8 \times 3^4 \times 5^2$  seconds

Solution:

Total number of tweets in 6 days = Number of tweets per second  $\times$  Number of seconds in 6 days

$$\Rightarrow (2^4 \times 3 \times 5^3) \times (2^8 \times 3^4 \times 5^2)$$

$$\Rightarrow (2^{4+8} \times 3^{1+4} \times 5^{3+2})$$

$$\Rightarrow 2^{12} \times 3^5 \times 5^5 \text{ tweets}$$

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Apply understanding of exponents as repeated multiplication to develop  
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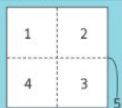
After their ground-breaking discovery, it's fun time for the team at XLabs! The lead mathematician from XLabs (disguised as an origami artist) organized a simple paper folding activity. At the end of this activity, the team discovered something that they couldn't believe! Why don't you find out what they discovered?

Take a piece of square paper (a paper from your notebook could be cut out into a square). A notebook paper is approximately 0.1 mm thick.

### Step 1

Fold the square paper into half 2 times and unfold it.

This is how the paper looks after unfolding



What is the thickness of the paper after 2 folds?

After unfolding, how many squares can you count?

### Step 2

Now, fold it into half 4 times and unfold it. Draw the pattern that you see below.

This is how the paper looks after unfolding



What is the thickness of the paper after 4 folds?

After unfolding, how many squares can you count? (It is NOT 16)

### Step 3

Now, try to fold it 8 times. Was it easy to fold? \_\_\_\_\_. If this paper was folded 8 times and then unfolded, how would the pattern look like?

This is how the paper looks after unfolding



What is the thickness of the paper after 8 folds?

After unfolding, how many squares can you count?

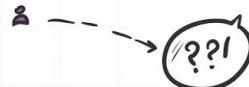
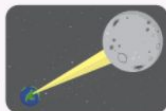
Try to see the pattern that is forming with each fold and fill the table given below:

Psst...! Try using exponent representation here

No. of folds	Thickness of the paper (in mm) after folding	No. of squares after unfolding
2		
4		
6		
8		
44		
46		

### Fun fact

The distance between Earth and the Moon is approximately  $3.8 \times 10^{11}$  mm, which is less than  $2^{45}$  mm!





**Step 1**

Fold the square paper into half 2 times and unfold it.

This is how the paper looks after unfolding

What is the thickness of the paper after 2 folds? ☐

After unfolding, how many squares can you count? ☐

**Step 2**

Now, fold it into half 4 times and unfold it. Draw the pattern that you see below.

This is how the paper looks after unfolding

What is the thickness of the paper after 4 folds? ☐

After unfolding, how many squares can you count? (It is NOT 16) ☐

**Step 3**

Now, try to fold it 8 times. Was it easy to fold? \_\_\_\_\_. If this paper was folded 8 times and then unfolded, how would the pattern look like?

This is how the paper looks after unfolding

What is the thickness of the paper after 8 folds? ☐

After unfolding, how many squares can you count? ☐

Given:



Thickness of the paper = 0.1 mm

Solution: Step 1

Thickness = thickness of the paper times the number of smallest squares.

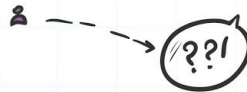
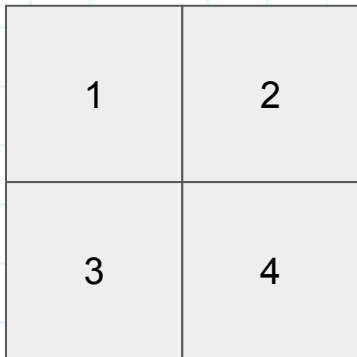
$$\text{Thickness} = 2^2 \times 0.1 \text{ mm} = 0.04 \text{ mm}$$

Number of squares formed =  
4 (small) + 1 (original square) = 5 squares

**2<sup>2</sup>**

The number of folds

Each fold gives us 2 times the number of shapes there were before





**Step 1**

Fold the square paper into half 2 times and unfold it.

This is how the paper looks after unfolding

What is the thickness of the paper after 2 folds? ☐

After unfolding, how many squares can you count? ☐

**Step 2**

Now, fold it into half 4 times and unfold it. Draw the pattern that you see below.

This is how the paper looks after unfolding

What is the thickness of the paper after 4 folds? ☐

After unfolding, how many squares can you count? (It is NOT 16) ☐

**Step 3**

Now, try to fold it 8 times. Was it easy to fold? \_\_\_\_\_. If this paper was folded 8 times and then unfolded, how would the pattern look like?

This is how the paper looks after unfolding

What is the thickness of the paper after 8 folds? ☐

After unfolding, how many squares can you count? ☐

Step 2 :

No of folds = 4



Number of squares = sum of

Squares of side 1 unit: 16 (orange border)

Squares of side 2 units: 9 (blue border)

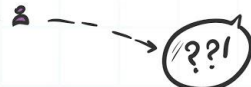
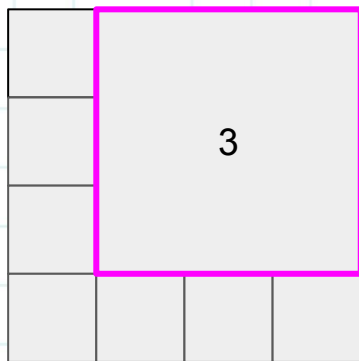
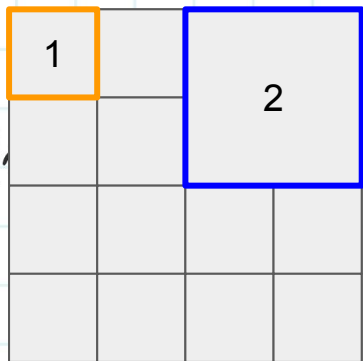
Squares of side 3 units: 4 (pink border)

Squares of side 4 units: 1 (original square)

= 30 squares

Thickness = thickness of the paper times the number of smallest squares.

The thickness of the folded paper =  $2^4 \times 0.01 \text{ mm}$   
 $= 16 \times 0.01 \text{ mm} = 0.16 \text{ mm}$



Step 3 :

No of folds = 8

The thickness of the folded paper, when folded this way =  $2^8 \times 0.01 \text{ mm}$   
= 2.56 mm

Number of squares = sum of

Squares of side 1 unit: 64 (orange border)

Squares of side 2 units: 49 (blue border)

Squares of side 3 units: 36 (pink border)

Squares of side 4 units: 25 (purple square)

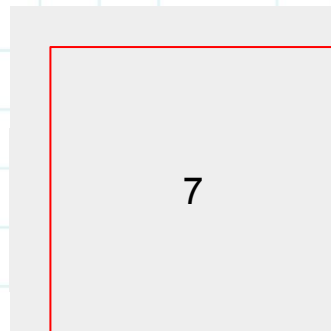
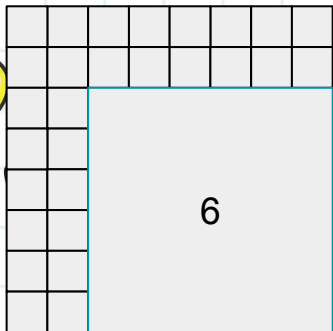
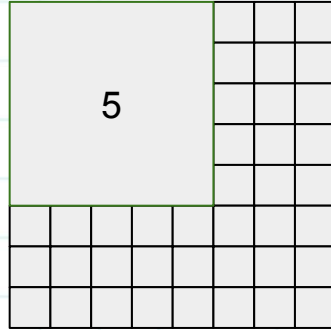
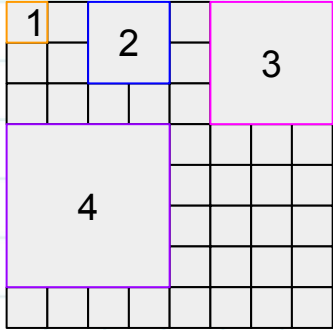
Squares of side 5 units: 16 (green square)

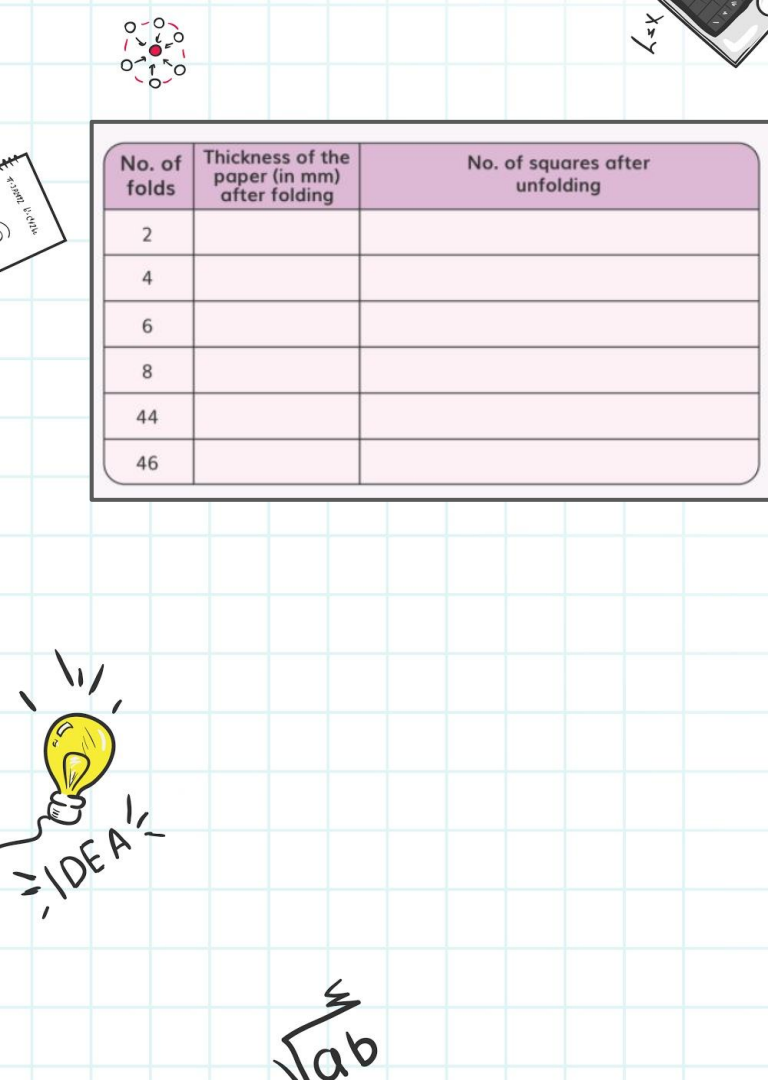
Squares of side 6 units: 9 (teal square)

Squares of side 7 units: 4 (red square)

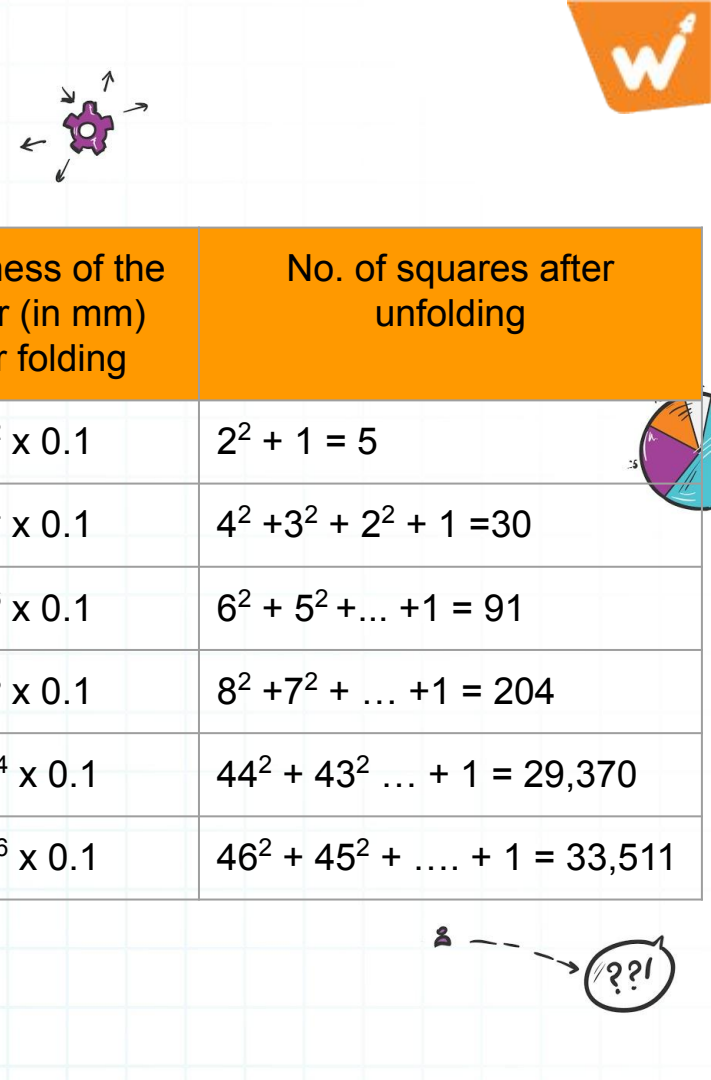
Squares of side 8 units: 1 (original square)

= 204 squares





No. of folds	Thickness of the paper (in mm) after folding	No. of squares after unfolding
2		
4		
6		
8		
44		
46		



No. of folds	Thickness of the paper (in mm) after folding	No. of squares after unfolding
2	$2^2 \times 0.1$	$2^2 + 1 = 5$
4	$2^4 \times 0.1$	$4^2 + 3^2 + 2^2 + 1 = 30$
6	$2^6 \times 0.1$	$6^2 + 5^2 + \dots + 1 = 91$
8	$2^8 \times 0.1$	$8^2 + 7^2 + \dots + 1 = 204$
44	$2^{44} \times 0.1$	$44^2 + 43^2 \dots + 1 = 29,370$
46	$2^{46} \times 0.1$	$46^2 + 45^2 + \dots + 1 = 33,511$