

Exactly one of the Following Five numbers is not prime. Which is it?

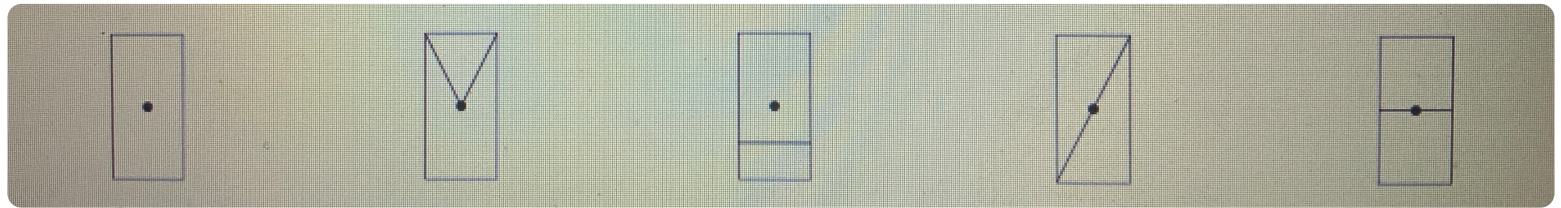
A) 101   B) 103   C) 107   D) 109   E) 111

The answer is **E** because  $1+1+1=3$ , so 111 is a multiple of 3.

What is the value of  $2020 \div 20$ ?

$$\begin{aligned}\text{We have } 2020 \div 20 &= (2020 \div 10) \div 2 \\ &= 202 \div 2 \\ &= \mathbf{101}\end{aligned}$$

Each of these Figures is based on a rectangle whose centre is shown. How many of the Figures have rotational symmetry of order 2?



Yes

No

No

Yes

Yes

So the answer is **3**

How many centimetres are there in 66.6 metres?

We have

$$\begin{aligned}1\text{m} &= 100\text{ cm} \\ \Rightarrow 66.6\text{m} &= 66.6 \times 100\text{ cm} \\ &= \mathbf{6660\text{ cm}}\end{aligned}$$

Amrita thinks of a number. She doubles it, adds 9, divides her answer by 3 and Finally subtracts 1. She obtains the same number she originally thought

of. What is it?

Let the number be  $x$ .

We have

$$x = \frac{(2x + 9)}{3} - 1$$

$$\Rightarrow x + 1 = \frac{2x + 9}{3}$$

$$\Rightarrow 3x + 3 = 2x + 9$$

$$\Rightarrow x = 6$$

What is the value of

$$\frac{6}{12} - \frac{5}{12} + \frac{4}{12} - \frac{3}{12} + \frac{2}{12} - \frac{1}{12} ?$$

The answer is

$$\frac{6-5+4-3+2-1}{12} = \frac{3}{12} = \frac{1}{4}$$

Four different positive integers have a product of 110. What is their sum?

Factorise 110 :

$$110 = 2 \times 55$$

$$= 2 \times 5 \times 11$$

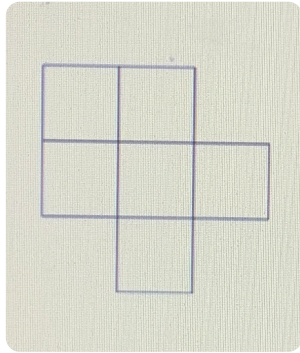
To write this as a product of four positive integers, include 1 :

$$110 = 1 \times 2 \times 5 \times 11$$

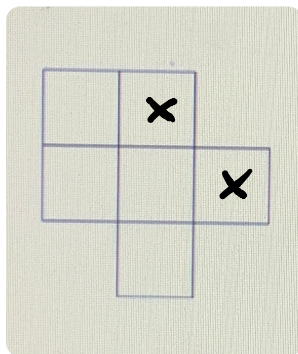
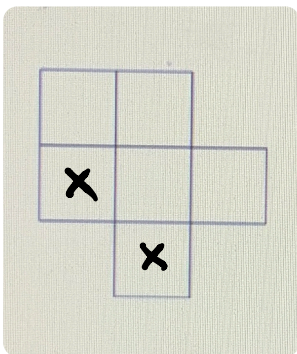
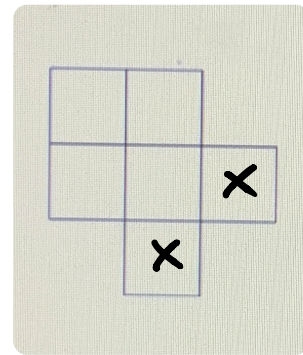
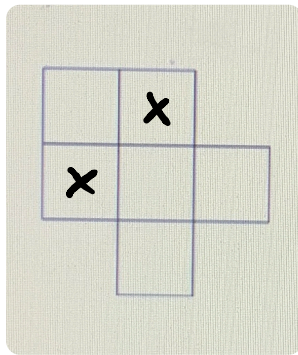
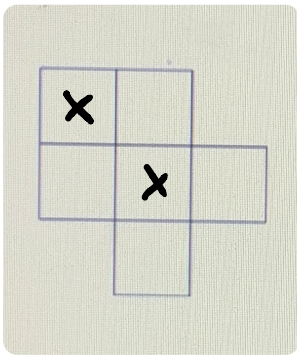


So the answer is  $1+2+5+11 = 19$

Wesley has a grid of six cells. He wants to colour two of the cells black so that the two black cells share a vertex but not a side. In how many ways can he achieve this?



List the ways:



So the answer is **5**

One half of one third of one quarter of one fifth of a number is 2. What is the number?

Let the number be  $x$ .

We have

$$\frac{1}{2} \left( \frac{1}{3} \left( \frac{1}{4} \left( \frac{1}{5} x \right) \right) \right) = 2$$

$$\Rightarrow \frac{x}{120} = 2$$

$$\Rightarrow x = 2 \times 120 = 240$$

How many of these equations have the solution  $x = 12$ ?

$$x - 2 = 10$$

$$\frac{x}{2} = 24$$

$$10 - x = 2$$

$$2x - 1 = 25$$

We have

$$x - 2 = 10 \Rightarrow x = 12$$

$$\frac{x}{2} = 24 \Rightarrow x = 48$$

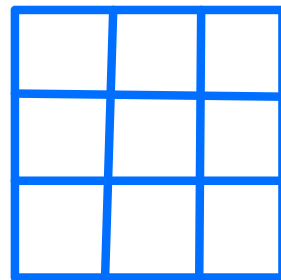
$$10 - x = 2 \Rightarrow x = 8$$

$$2x - 1 = 25 \Rightarrow x = 13$$

So the answer is 1

This  $3 \times 3$  grid shows nine  $1\text{cm} \times 1\text{cm}$  squares and uses  $24\text{cm}$  of wire. What length of wire is required for a similar  $20$  by  $20$  grid?

In the  $3 \times 3$  grid, we need enough wire to make 4 vertical lines of length 3 and 4 horizontal lines of length 3.

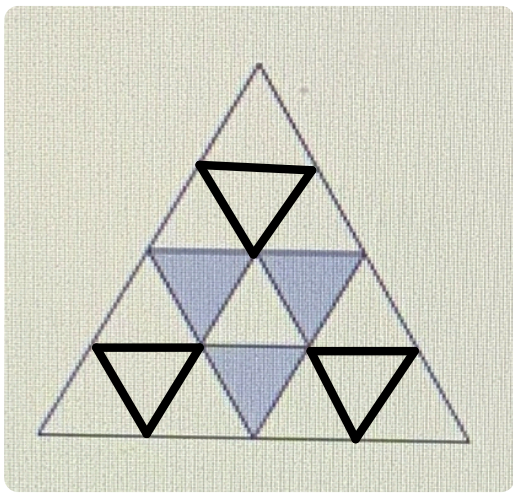
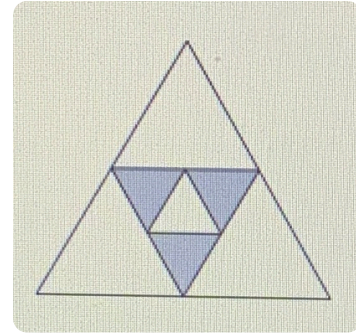


In the  $20 \times 20$  grid, we need

$$\underbrace{21 \times 20}_{\text{vertical}} + \underbrace{21 \times 20}_{\text{horizontal}} = 2 \times 21 \times 20 = 840 \text{ cm}$$

The diagram shows an equilateral triangle divided into four smaller equilateral triangles. One of these triangles has itself been divided into four smaller equilateral triangles. What fraction of the area of the large triangle has been shaded?

Divide the whole triangle into triangles of the smallest size:



There are 16 triangles, and 3 have been shaded, so the answer is

$$\frac{3}{16}$$

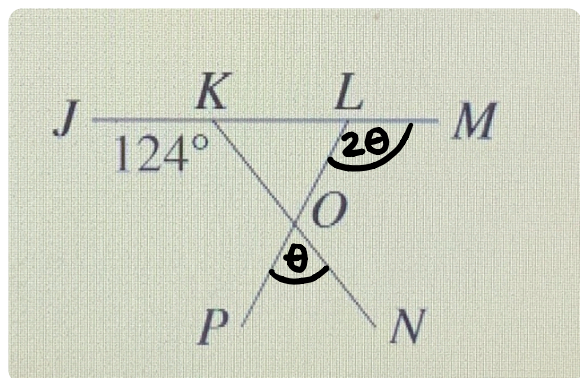
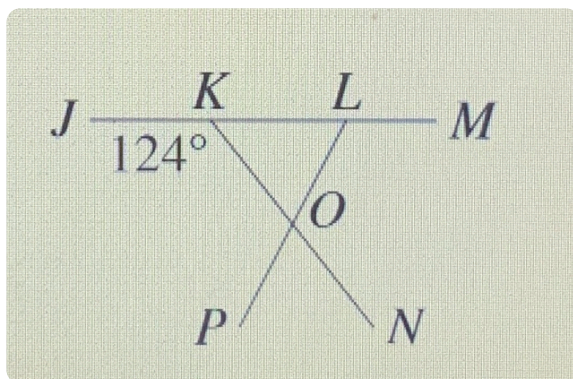
The mean of four positive integers is 5. The median of the four integers is 6. What is the mean of the largest and smallest of the integers?

Since the mean of the four numbers is 5, their sum is  $4 \times 5 = 20$ .

Since the median of the four numbers is 6, the sum of the two middle numbers is 12.

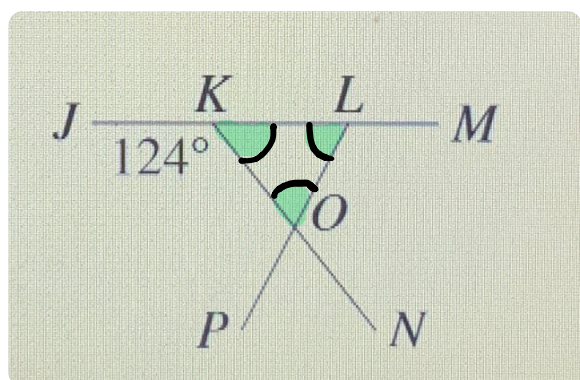
So the sum of the largest and smallest integers is  $20 - 12 = 8$ , and hence their mean is  $8 \div 2 = 4$

In the diagram, angle  $\angle OLM$  is twice as large as angle  $\angle PON$ . What is the size of angle  $\angle OLM$ ?



Let  $\angle PON := \theta$ .

Then  $\angle OLM = 2\theta$



By supplementary angles

$$\angle OLK = 180 - 2\theta$$

$$\angle OKL = 180 - 124 = 56$$

By vertically opposite angles

$$\angle KOL = \angle PON = \theta$$

So by angle sum of a triangle

$$56 + 180 - 2\theta + \theta = 180$$

$$\Rightarrow \theta = 56^\circ$$

And hence  $\angle OLM = 112^\circ$

A group of 42 children all play tennis, or Football, or both sports. The same number play tennis as play just Football. Twice as many play both tennis and Football as play just tennis. How many of the children play Football?

Let  $T$  be the number who play just tennis  
 $F$  be the number who play just football  
 $B$  be the number who play both

We have

$$T + B = F \quad (1)$$

$$B = 2T \quad (2)$$

$$T + F + B = 42 \quad (3)$$

Sub (1) into (3) :

$$(T+B) + F = 2F = 42$$

$$\Rightarrow F = 21$$

Sub (2) into (1) :

$$T + 2T = 21$$

$$\Rightarrow 3T = 21$$

$$\Rightarrow T = 7$$

and so  $B = 2 \times 7 = 14$

The number of children who play Football is

$$F + B = 21 + 14$$

$$= 35$$

You are given the sequence of digits "0625"  
and can insert a decimal point at the beginning,  
at the end or at any of the other three  
positions. Which of these numbers can you not make?

A)  $\frac{6}{25}$     B)  $\frac{5}{8}$     C)  $\frac{1}{16}$     D)  $\frac{25}{4}$     E)  $25^2$



The answer is **A** because

$$\frac{1}{25} = 0.04 \Rightarrow \frac{6}{25} = 0.24$$

Which cannot be made from the sequence provided.

The others all can:

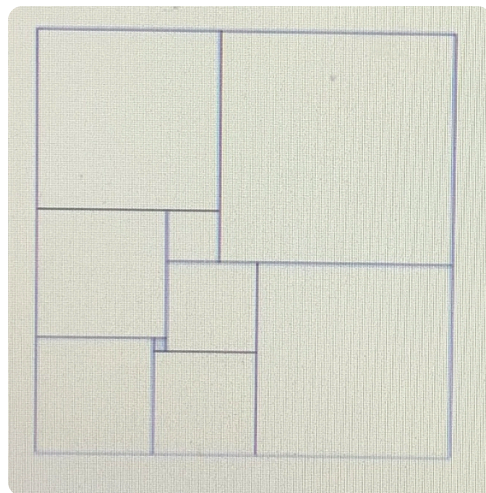
$$\frac{1}{8} = \frac{125}{1000} \Rightarrow \frac{5}{8} = \frac{625}{1000} = 0.625$$

$$\frac{1}{16} = \frac{625}{10000} = 0.0625$$

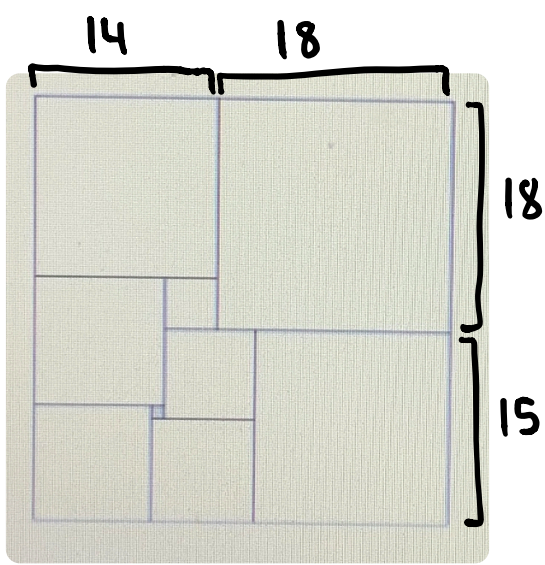
$$\frac{25}{4} = 6 \frac{1}{4} = 6.25$$

$$25^2 = 625$$

In 1925, Zbigniew Morón published a rectangle that could be dissected into nine different sized squares as shown in the diagram. The lengths of the sides of these squares are 1, 4, 7, 8, 9, 10, 14, 15 and 18. What is the area of the rectangle?







The height of the rectangle is

$$18 + 15 = 33$$

The width of the rectangle is

$$18 + 14 = 32$$

So its area is

$$32 \times 33 = 1056$$

How many 2-digit primes have both their digits non-prime?

A 2-digit prime must end in an odd number.

The only non-prime odd digits are 1 and 9.

The first digit can be chosen from 1, 4, 6, 8, 9.

Check all the options:

|    |   |    |   |
|----|---|----|---|
| 11 | ✓ | 19 | ✓ |
| 41 | ✓ | 49 | × |
| 61 | ✓ | 69 | × |
| 81 | × | 89 | ✓ |
| 91 | × | 99 | × |

So the answer is 5

In the table shown, the sum of each row is shown to the right of the row and the sum of each column is shown below the column. What is L?

|    |   |    |    |
|----|---|----|----|
| J  | K | J  | 5  |
| K  | K | L  | 13 |
| L  | J | L  | 15 |
| 11 | 7 | 15 |    |

We have

$$J + K + L = 11$$

$$J + L + L = 15$$

Subtract:  $L - K = 15 - 11 = 4 \Rightarrow L = K + 4$

Now

$$K + K + L = 13$$

$$\Rightarrow 2K + (K + 4) = 13$$

$$\Rightarrow 3K = 9$$

$$\Rightarrow K = 3 \Rightarrow L = K + 4 = 7$$

Edmund makes a cube using eight small cubes.

Samuel uses cubes of the same size as the small cubes to make a cuboid twice as long, three times as wide and Four times as high as Edmund's cube.

How many more cubes does Samuel use than Edmund?

Edmund's cube has sides of length 2.

Samuel's cuboid has sides of length

$$2 \times 2 = 4$$

$$3 \times 2 = 6$$

$$4 \times 2 = 8$$

So its volume is  $4 \times 6 \times 8 = 192$

So Samuel uses  $192 - 8 = 184$  more cubes than Edmund

The digits of both the 2-digit numbers in the First calculation below have been reversed to give the 2-digit numbers in the second calculation. The answers to the two calculations are the same:

$$62 \times 13 = 806$$

$$26 \times 31 = 806$$

For which one of the calculations below is the same thing true?

A)  $25 \times 36$     B)  $34 \times 42$     C)  $54 \times 56$

D)  $42 \times 48$     E)  $32 \times 43$

Examine the Final digits of the answers:

For A:  $25 \times 36$  ends in 0  
 $52 \times 63$  ends in 6

For B:  $34 \times 42$  ends in 8  
 $43 \times 24$  ends in 2

For C:  $54 \times 56$  ends in 4  
 $45 \times 65$  ends in 5

For D:  $42 \times 48$  ends in 6  
 $24 \times 84$  ends in 6

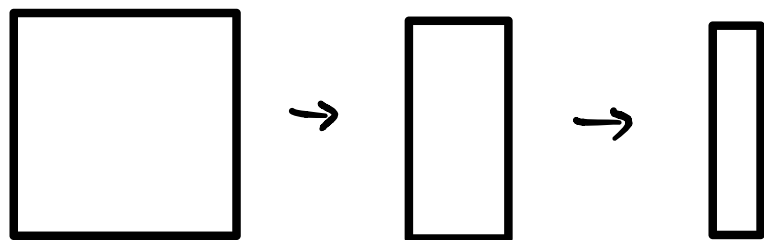
For E:  $32 \times 43$  ends in 6  
 $23 \times 34$  ends in 2

So the answer must be **D**

Harriet has a square piece of paper. She Folds it in half to Form a rectangle and then in half again to Form a second rectangle (which is not a square).

The perimeter of the second rectangle is 30 cm.  
What is the area of the original square?

Since she doesn't obtain a square after the second fold, both folds must have been in the same direction.



Suppose the original square has side length  $x$ .  
Then the second rectangle has height  $x$  and width  $x/4$ .

So its perimeter is

$$\begin{aligned} 2x + 2\left(\frac{x}{4}\right) &= 30 \\ \Rightarrow x + \frac{x}{4} &= 15 \\ \Rightarrow \frac{5x}{4} &= 15 \\ \Rightarrow x &= 4 \times \frac{15}{5} = 12 \end{aligned}$$

and therefore the area of the square is  $x^2 = 144 \text{ cm}^2$

There is more than one integer greater than 1 which leaves a remainder of 1 when divided by each of the four smallest primes. What is the difference between the two smallest such integers?

The four smallest primes are 2, 3, 5, 7.

The smallest integer satisfying the conditions is

$$2 \times 3 \times 5 \times 7 + 1 = 211$$

The next smallest is

$$(2 \times 3 \times 5 \times 7) \times 2 + 1 = 421$$

So the answer is  $421 - 211 = 210$

Susan is attending a talk at her son's school.

There are 8 rows of 10 chairs where 54 parents are sitting. Susan notices that every parent is either sitting on their own or next to just one other person. What is the largest possible number of adjacent empty chairs in a single row at that talk?

The row with the maximum number of adjacent empty chairs must have the smallest number of parents sitting in it.

So every other row must have as many parents as possible :

~~⊗~~ ~~⊗~~ ○ ~~⊗~~ ~~⊗~~ ○ ~~⊗~~ ~~⊗~~ ○ ~~⊗~~

The maximum number of parents in a single row is 7.

So we have 7 rows of 7 parents each, leaving  $54 - 49 = 5$  parents in the last row.

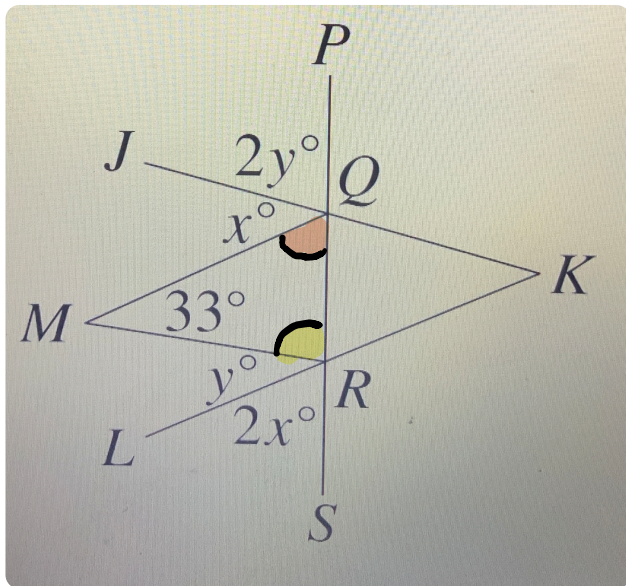
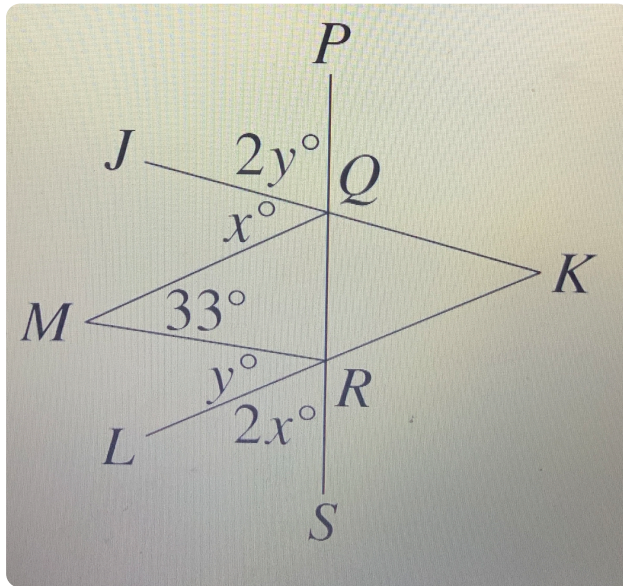
The following configuration maximises the number of adjacent empty chairs :

~~⊗~~ ~~⊗~~ ○ ○ ○ ○ ~~⊗~~ ○ ~~⊗~~ ~~⊗~~

So the answer is 4



In the diagram, PQRS, JQK and LRK are straight lines. What is the size of  $\angle JKL$ ?



By supplementary angles

$$\angle MQR = 180 - x - 2y$$

$$\angle MRQ = 180 - 2x - y$$

By angle sum of a triangle

$$180 = 33 + 180 - x - 2y + 180 - 2x - y$$

$$\Rightarrow 3(x+y) = 213$$

$$\Rightarrow x+y = 71$$

By vertically opposite angles

$$\angle RQK = 2y$$

$$\angle QRK = 2x$$

By angle sum of a triangle

$$\angle JKL = 180 - 2x - 2y$$

$$= 180 - 2(x+y)$$

$$= 180 - 2 \times 71$$

$$= 38^\circ$$

