

Which of the Following is closest to 0?

A) $6+5+4$ B) $6+5-4$ C) $6+5 \times 4$ D) $6-5 \times 4$ E) $6 \times 5 \div 4$

We have

$$6+5+4 = 15$$

$$6+5-4 = 7 \leftarrow$$

$$6+5 \times 4 = 26$$

$$6-5 \times 4 = -14$$

$$6 \times 5 \div 4 = \frac{30}{4} = \frac{15}{2} = 7.5$$

So the answer is **B**

What number is twenty-one less than sixty thousand?

We have

$$60\,000 - 21 = 59979$$

One lap of a standard running track is 400m.

How many laps does each athlete run in a 5000m race?

We have

$$\frac{5000}{400} = \frac{50}{4} = 12.5$$

In January 1859, an eight-year old boy dropped a newly hatched eel into a well in Sweden (to keep the water free of insects). The eel finally died in August 2014. How old was it when it died?

We have

$$2014 - 1859 = 155 \text{ years}$$

What is the value of $\frac{1}{25} + 0.25$?

$$\text{We have } \frac{1}{25} = \frac{4}{100} = 0.04 \quad \text{so}$$

$$\frac{1}{25} + 0.25 = 0.04 + 0.25 = 0.29$$

A school has 600 pupils. There are 30 more girls than boys. How many girls are there?

Suppose there are n girls. Then there are $n-30$ boys and

$$n + n - 30 = 600$$

$$\Rightarrow 2n = 630$$

$$\Rightarrow n = 315$$

A distance of 8 km is approximately 5 miles.

Which of the following is closest to 1.2 km?

- A) 0.75 miles B) 1 mile C) 1.2 miles D) 1.6 miles
E) 1.9 miles

$$8 \text{ km} = 5 \text{ miles}$$

$$\Rightarrow 1 \text{ km} = \frac{5}{8} \text{ miles}$$

$$\Rightarrow 1.2 \text{ km} = 1.2 \times \frac{5}{8} \text{ miles}$$

$$= \frac{12}{10} \times \frac{5}{8}$$

$$= \frac{60}{80} \text{ miles}$$

$$= \frac{3}{4} \text{ miles}$$

$$= 0.75 \text{ miles}$$

What is the value of

$$\frac{2+4+6+8+10+12+14+16+18+20}{1+2+3+4+5+6+7+8+9+10}$$

?

The given expression is equal to

$$\frac{2 \times (1 + \dots + 10)}{1 + \dots + 10} = 2$$

One of the three symbols $+$, $-$, $\times$ is inserted somewhere between the digits of 2016 to give a new number
eg $20 - 16 = 4$

How many of the following four numbers can be obtained in this way?

36 195 207 320

We have

$$36 = 20 + 16$$

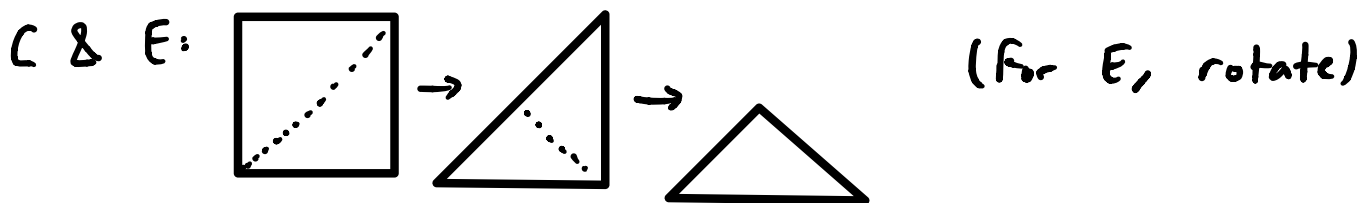
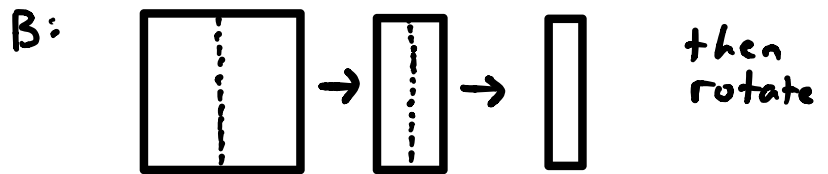
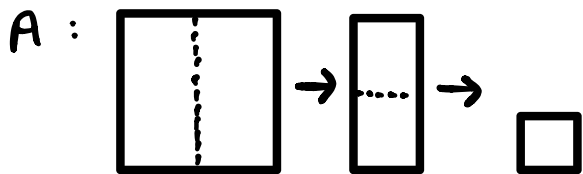
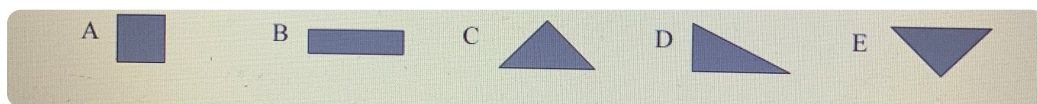
$$195 = 201 - 6$$

$$207 = 201 + 6$$

$$320 = 20 \times 16$$

So the answer is 4

A square is folded in half and then in half again.
Which of the following could not be the resulting shape?



So the answer is D

Which of the following statements is False?

- A) 12 is a multiple of 2
- B) 123 is a multiple of 3
- C) 1234 is a multiple of 4
- D) 12345 is a multiple of 5
- E) 123456 is a multiple of 6

A true since the last digit of 12 is even

B true since $1+2+3=6$ is a multiple of 3

D true since the last digit is a 5

E true since the last digit is even (hence multiple of 2) and $1+2+3+4+5+6=21$ is a multiple of 3 (hence divisible by 3)

So the answer is **C**

52560

The musical 'Rent' contains a song that starts "Five hundred and twenty Five thousand six hundred minutes".

Which of the Following is Closest to this length of time?

- A) a week
- B) a year
- C) a decade
- D) a century
- E) a millenium

$$1 \text{ hour} = 60 \text{ min}$$

$$1 \text{ day} = 24 \text{ hours}$$

$$= 1440 \text{ min}$$

$$1 \text{ week} = 7 \text{ days}$$

$$= 10080 \text{ min}$$

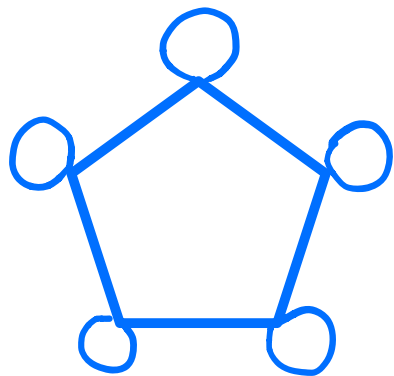
$$1 \text{ year} = 52 \text{ weeks}$$

$$= 524160 \text{ min}$$

So the answer is **B**

The diagram shows Five Circles placed at the corners

of a pentagon. The numbers 1, 2, 3, 4, 5 are placed in the circles shown, one in each, so that the numbers in adjacent circles always differ by more than 1. What is the sum of the numbers in the two circles adjacent to the circle which contains the number 5?



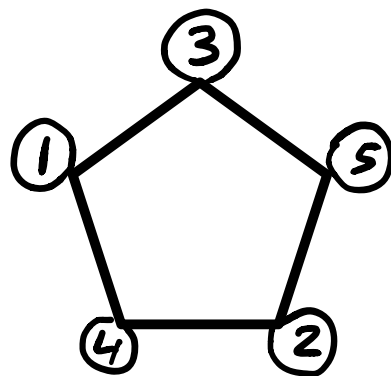
Place the 3 in some circle.

The numbers adjacent to it must be 1 and 5 - it doesn't matter what order they're placed since the pentagon could be Flipped.

Then we have 2 and 4 remaining.

The 2 must be adjacent to the 5 and the 4 must be adjacent to the 1.

So the answer is $3 + 2 = 5$

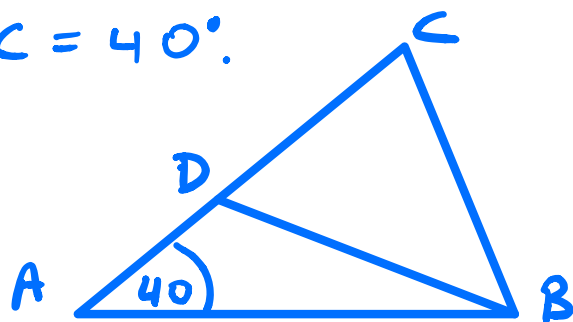


In the diagram, $AB = AC$ and D is a point on AC such that $BD = BC$. $\angle BAC = 40^\circ$.

Find $\angle ABD$.

Since $AB = AC$, we have

$$\begin{aligned}\angle ABC &= \angle ACB = \frac{180 - 40}{2} \\ &= 70^\circ\end{aligned}$$



Since $BD = BC$, we have $\angle BDC = \angle BCD = 70^\circ$

So $\angle CBD = 180 - 2 \times 70 = 40$

Hence $\angle ABD = \angle ABC - \angle CBD$

$$= 70 - 40$$

$$= 30$$

How many of these Four expressions are perfect squares?

$$1^3 + 2^3 \quad 1^3 + 2^3 + 3^3 \quad 1^3 + 2^3 + 3^3 + 4^3$$

$$1^3 + 2^3 + 3^3 + 4^3 + 5^3$$

We have

$$1^3 + 2^3 = 1 + 8 = 9 = 3^2 \quad \checkmark$$

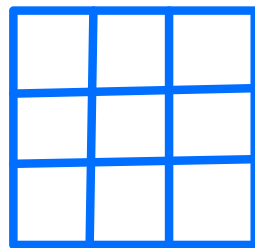
$$1^3 + 2^3 + 3^3 = 9 + 27 = 36 = 6^2 \quad \checkmark$$

$$1^3 + 2^3 + 3^3 + 4^3 = 36 + 64 = 100 = 10^2 \quad \checkmark$$

$$1^3 + 2^3 + 3^3 + 4^3 + 5^3 = 100 + 125 = 225 = 15^2 \quad \checkmark$$

So the answer is 4

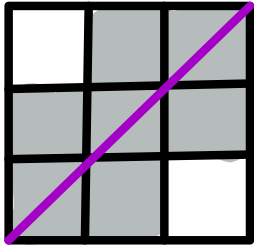
Each of the nine small squares in this grid can be coloured completely black or completely white. What is the largest number of squares that can be coloured black so that the design created has rotational symmetry of order 2 but no lines of symmetry?



Start off with all squares black and change the colour of as few as possible in order to satisfy the conditions.

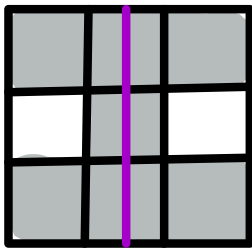
The colour of the central square has no effect on the symmetries so leave that black.

If we make one corner square white, we must do the same to the diagonally opposite corner to preserve rotational symmetry.

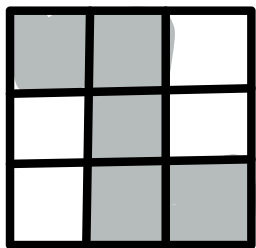


But this is insufficient as we still have an axis of symmetry.

The same situation occurs if we change an edge square:



So we must have at least four white squares. The following configuration satisfies the requirements:



Hence the answer is 5

In a group of 48 children, the ratio of boys to girls is 3:5. How many boys must join the group to make the ratio of boys to girls 5:3?

We have $48 \div 8 = 6$ so originally there are $6 \times 3 = 18$ boys and $6 \times 5 = 30$ girls.

For a ratio of 5:3 boys to girls, we have

$$3n = 30 \Rightarrow n = 10$$

and so $5n = 10 \times 5 = 50$

Hence the number of boys who must join the group is $50 - 18 = 32$

In the addition sum shown, each letter represents a different non-zero digit. Find X.

$$\begin{array}{r} S E E \\ S E E \\ \hline A X E S \end{array} +$$

Since there is a carry into the Final column, we must have $A = 1$.

By comparing the units and tens columns, we know that there must be a carry from the units column (and therefore also a carry from the tens column).

$$\text{So } 2E = S + 10 \quad (\text{units})$$

$$\text{and } 2E + 1 = E + 10 \quad (\text{tens})$$

$$\Rightarrow E = 10 - 1 = 9$$

$$\text{Hence } S = 2E - 10 = 18 - 10 = 8$$

In the hundreds column:

$$X + 10 = 2S + 1$$

$$\Rightarrow X = 16 + 1 - 10 = 7$$

Three boxes under my stairs contain apples or pears or both. Each box contains the same number of pieces of fruit. The first box contains all twelve of the apples and one-ninth of the pears. How many pieces of fruit are there in each box?

Suppose there are n pears in the first box.

Since that is one-ninth of the total number of pears, there must be $8n$ pears in the other two boxes.

Since each box has the same number of pieces of fruit, boxes 2 and 3 must each contain $4n$ pears and

$$4n = 12 + n$$

$$\Rightarrow 3n = 12$$

$$\Rightarrow n = 4$$

So each box contains $4 \times 4 = 16$ pieces of Fruit

A cyclic quadrilateral has all Four vertices on the circumference of a circle. Brahmagupta (598 - 670 AD) gave the following Formula for the area, A , of a cyclic quadrilateral whose edges have lengths a, b, c, d :

$$A = \sqrt{(s-a)(s-b)(s-c)(s-d)}$$

where s is half of the perimeter of the quadrilateral.

What is the area of the cyclic quadrilateral with sides of length 4cm, 5cm, 7cm, 10cm?

We have

$$s = \frac{4+5+7+10}{2} = \frac{26}{2} = 13$$

and so

$$s-a = 13-4 = 9$$

$$s-b = 13-5 = 8$$

$$s-c = 13-7 = 6$$

$$s-d = 13-10 = 3$$

Hence

$$A = \sqrt{9 \times 8 \times 6 \times 3}$$

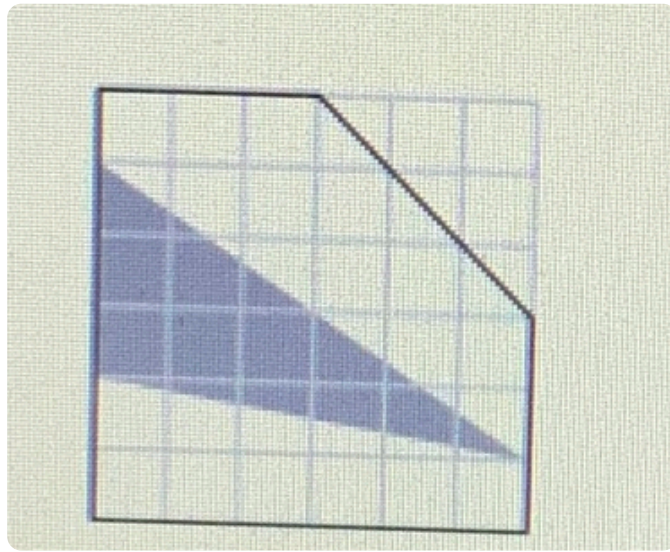
$$= \sqrt{2^4 \cdot 3^4}$$

$$= 2^2 \cdot 3^2$$

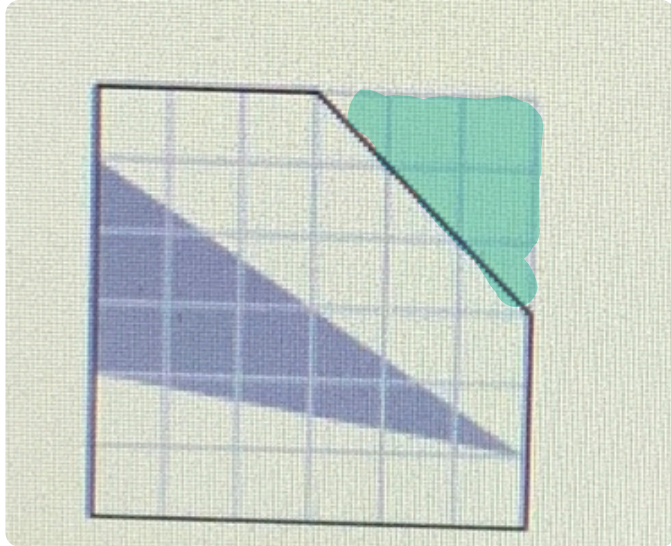
$$= 36 \text{ cm}^2$$

The diagram shows a pentagon drawn on a square

grid. All vertices of the pentagon and triangle are grid points. What Fraction of the area of the pentagon is shaded?



The area of the pentagon is the area of the square minus the area of the region highlighted in green:



$$\begin{aligned} \{ \text{Area of pentagon} \} &= 6 \times 6 - \frac{1}{2} \times 3 \times 3 \\ &= 31.5 \end{aligned}$$

The area of the shaded region is

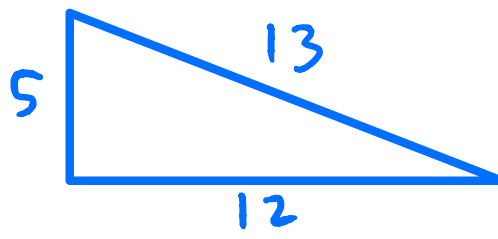
$$\frac{1}{2} \times 3 \times 3 = 4.5$$

So the Fraction of the pentagon which is shaded is

$$\frac{4.5}{31.5} = \frac{18}{126} = \frac{2}{14} = \frac{1}{7}$$

Four copies of the triangle shown are joined together without gaps or overlap to make a parallelogram. What is the largest possible perimeter

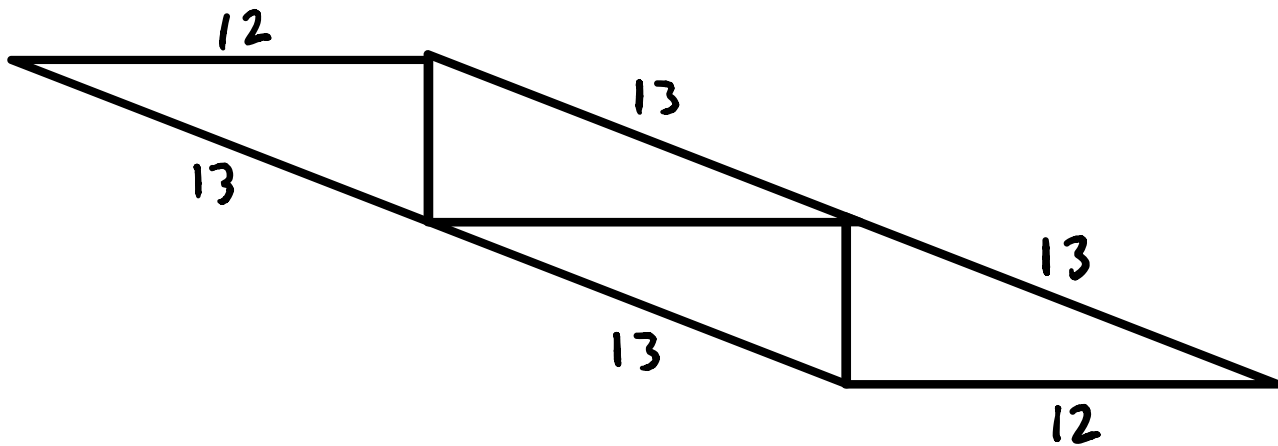
of the parallelogram?



When Four triangles are joined together, 3 pairs of edges (or 6 edges in total) are used for the joining and therefore not part of the perimeter. To maximise the length of the perimeter, we want to minimise the lengths of these other edges.

Ideally, all four edges of length 5 and two edges of length 12 will be internal.

It is possible to Form a parallelogram with this configuration:

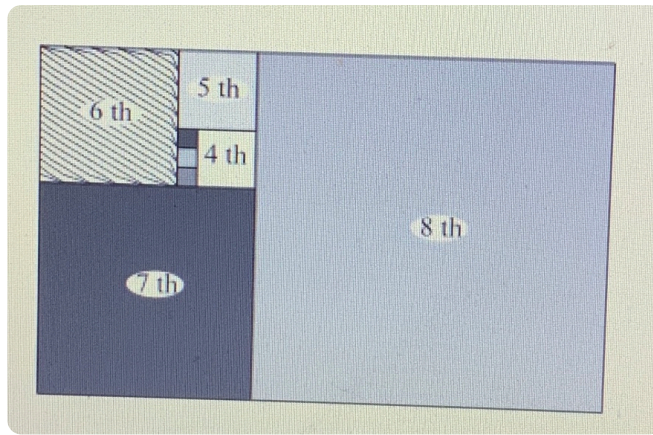


This shape has perimeter

$$4 \times 13 + 2 \times 12 = 76$$

The diagram shows the First Few squares of a spiral sequence of squares. All but the First 3 squares have been numbered. After the First 6 squares, the sequence is continued by placing the next square alongside three existing squares - the largest existing square and two others.

The three smallest squares have side length 1.
What is the side length of the 12th square?



Let a_n be the side length of the n^{th} square.

We have

$$a_1 = a_2 = a_3 = 1$$

$$a_4 = 3$$

$$a_5 = 4$$

$$a_6 = 7$$

$$a_7 = a_6 + a_5 = 11$$

$$a_8 = a_7 + a_6 = 18$$

$$a_9 = a_8 + a_7 = 29$$

$$a_{10} = a_9 + a_8 = 47$$

$$a_{11} = a_{10} + a_9 = 76$$

$$a_{12} = a_{11} + a_{10} = 123$$

where $a_n = a_{n-1} + a_{n-2}$ by looking at the side of the shape opposite where the new square is placed.

Part of a wall is to be decorated with a row of four square tiles. Three different colours of tiles

and there are at least two tiles of each colour available. Tiles of all 3 colours must be used. In how many ways can the row of four tiles be chosen?



There will be two tiles of one colour and one tile of the other two colours.

There are ${}^4C_2 = 6$ ways to choose the two tiles of the same colour, 3 ways to choose this colour, and 2 ways to choose the colours for the remaining two tiles.

So the number of possible rows is

$$6 \times 3 \times 2 = 36$$

Beatrix places dominoes on a 5×5 board, either horizontally or vertically, so that each domino covers two small squares. She stops when she cannot place another domino. When Beatrix stops, what is the largest possible number of squares that may still be uncovered from the list below?

A) 4 B) 5 C) 6 D) 7 E) 8

Each domino covers two squares, so the total number of covered squares is even and therefore the total number of uncovered squares is odd.

The diagram below demonstrates a possible placement leaving 7 squares uncovered, and as that is the highest odd number on the list,

it must be the answer.

