



VIC SKEPTICS

Logic and Maths Puzzles 84 July 2019

1. Write the next number in each of these this sequences;

- (a) 2, 6, 12, 20 ...
- (b) 1, 8, 27 ...

2. Four families met recently when one child in each family received a prize, each for a different subject (math, art, science & music).

The subjects, first names and surnames are given in the table at right.

None of the four students is less than eleven or more than 20 years old.

The four prizes were given to Rose, then the 16-year-old, then the musician, and finally the student with the surname of White.

The difference in ages between the Brown child and the scientist is more than four years.

Megan is 8 years older than the Black child.

The artist is 14 years old, 2 years older than Michael.

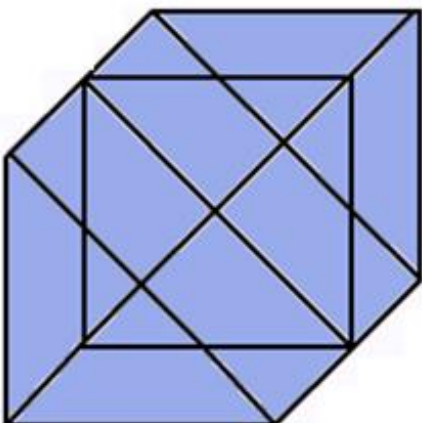
- (a) What is the full name of the Science Prize winner?
- (b) How old is George?

Hint: Work out the actual ages of the students first.

	Black	Brown	Green	White	Math	Art	Science	Music	Youngest			Oldest
George												
Michael												
Megan												
Rose												
Youngest												
Oldest												
Math												
Art												
Science												
Music												

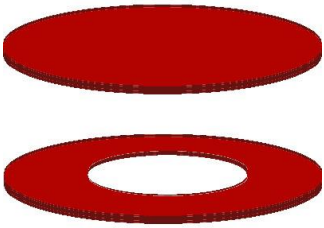
3. What is the probability of getting a total score of:

- (a) six or less from a single throw of two dice?
- (b) six or less from a single throw of three dice?



4. What is the total number of triangles in this figure?

5.



The figure at top represents a metal disc of radius 10 cm. It has a mass of 100 g.

The figure below it is the same metal disc with a 10 cm diameter hole bored through it. What is its mass?

6. In a group of 200 people, everybody has a candle.

To begin with, no candles are lit. One person has a match and lights his candle. With this candle he walks to somebody else and lights a new candle.

Then everybody with a burning candle will look for somebody without a burning candle, and if found they will light it.

This will continue until all candles are lit.

Suppose that from the moment a candle is lit it takes exactly 30 seconds to find a person with a non-burning candle and light that candle.

From the moment the first candle is lit, how long does it take before all candles are lit?

7. A 1 km long train travelling at a steady speed of 60 km/h enters a 1 km long tunnel at 9:00 am. At what time will the train completely clear the tunnel?

8. My house has a number.

IF that number is a multiple of 3, the number is from 50 to 59 inclusive.

IF the number is NOT a multiple of four, it lies in the range 60 to 69 inclusive.

IF the number is NOT a multiple of 6, it lies in the range 70 to 79 inclusive.

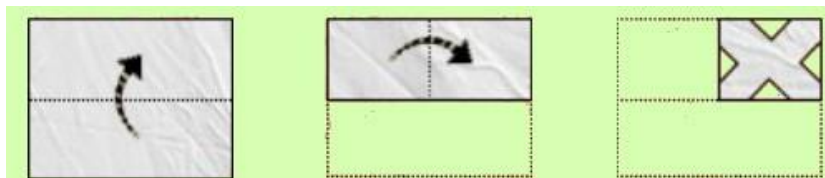
What is my house number?

9. The **%** symbol is called "per cent" and means "parts per hundred"; what is this symbol

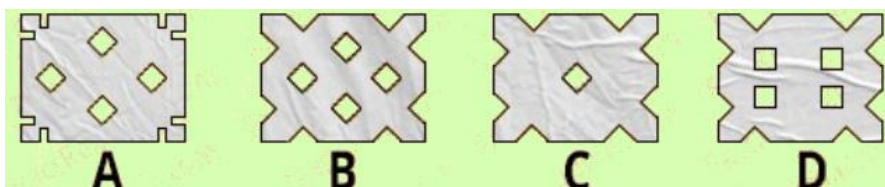
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called, and what does it mean?

10. If a piece of paper is folded and cut as shown:



How will it appear when opened?



Answers:

1. (a) 30.

As the numbers ascend, the difference between each number and its consecutive number increases by 2. That's probably easy enough to follow without a formal rule.

Mathematically expressed, the value of the n th term in the sequence, X_n is given by

$$\begin{aligned}x_n &= n(n-1) + 2n \\ &= n^2 - n + 2n \\ &= n^2 + n\end{aligned}$$

Checking:

For the first term, $n = 1$, $X = 2$

$$\begin{aligned}x_n &= n^2 + n \\ 2 &= 1 + 1\end{aligned}$$

For the second term,

$$\begin{aligned}x_n &= n^2 + n \\ 6 &= 4 + 2\end{aligned}$$

For the third term,

$$\begin{aligned}x_n &= n^2 + n \\ 12 &= 9 + 3\end{aligned}$$

And so on

(b) 64

For n terms, the value $x_n = n^3$

2. (a) Megan White (b) 16

3. (a) 5/12 (b) 5/54

If we roll two dice, the following 36 equally likely outcomes may occur, using a pair of digits in brackets to represent "dice A" and "dice B" respectively:

(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (3,1), (3,2), (3,3), (3,4), (3,5), (3,6), (4,1), (4,2), (4,3), (4,4), (4,5), (5,6), (5,1), (5,2), (5,3), (5,4), (5,5), (5,6), (6,1), (6,2), (6,3), (6,4), (6,5), (6,6)

Only (1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), and (5,1) provide a combined score of six or less. That's 15 of the possible 36 equally likely outcomes

So the probability of throwing six or less with two dice is $15/36$ or $5/12$

If we roll three dice it follows that there are $6 \times 6 \times 6 = 216$ equally likely outcomes.

Only 20 of these events will result in a total score of six or less:

i.e. (1, 1, 1), (1, 1, 2), (1, 2, 1), (2, 1, 1), (1, 1, 3), (1, 3, 1), (3, 1, 1), (2, 2, 1), (1, 2, 2), (1, 1, 4), (1, 4, 1), (4, 1, 1), (1, 2, 3), (1, 3, 2), (2, 1, 3), (2, 3, 1), (3, 1, 2), (3, 2, 1) and (2, 2, 2).

So the probability of throwing six or less with three dice is $20/216$ or $5/54$

4. 24

5. 75 grams

The mass of the disc is directly related to its volume.

It's a cylinder.

Its volume will be given by $\pi r^2 h = \pi \times 10 \times 10 \times h = 100 \pi h$

π is a constant and h is unknown

But boring out the disc removes a smaller cylinder whose volume is $\pi \times 5 \times 5 \times h = 25\pi h$

If the original cylinder weighed 100 grams, then drilling the hole will effectively remove a smaller cylinder weighing 25 grams.

The bored-out cylinder will weigh 75 grams

6. 4 minutes

Start: 1 candle lit

After 30 s: 2 candles lit

After 1 min: 4 candles lit

After 1 min 30s: 8 candles lit

After 2 min: 16 candles lit

After 2 min 30s: 32 candles lit

After 3 min: 64 candles lit

After 3 min 30s: 128 candles lit

After 4 min: all 200 candles are lit

7. 9:02 am

If the train is travelling at a speed of 60 km / h, that is equivalent to 1 km / min. It therefore takes 1 minute for the train to completely fill the tunnel, and a further minute for it to completely clear the tunnel.

8. 76

IF my house number was a multiple of 3, it would have to be 51, 54 or 57.

51, 54, and 57 are NOT multiples of 4.

But if my house number is NOT a multiple of 4, the answer has to lie between 60 and 69.

So my house number is NOT a multiple of 3.

My house number can't be a multiple of 6 either, because any multiple of 6 is also a multiple of 3.

So, because my house number is NOT a multiple of 6, it must lie between 70 and 79.

If my house number is NOT a multiple of 4, it lies in the range 60 to 69.

The only possibility is that my house number IS a multiple of 4, lies in the range 70 to 79, but is NOT also a multiple of 3 (or 6).

The only candidate is 76.

9. "per mille", parts per thousand

10. B