

FAIR DICE

Source: *Futility Closet*



Timothy and Urban are playing a game with two six-sided dice. The dice are unusual: Rather than bearing a number, each face is painted either red or blue.

The two take turns throwing the dice. Timothy wins if the two top faces are the same color, and Urban wins if they're different. Their chances of winning are equal.

The first die has 5 red faces and 1 blue face. What are the colours on the second die?

SALE



Source: *Thinking Mathematically by John Mason et al.*

In a sale, a dress has been reduced by 15% but is subject to tax at 20%. At the till, the cashier asks if you would like to add the tax on or take the discount of first. Which should you do?

8! MINUTES



Source: *UKMT Intermediate Maths Challenge*

How many weeks are there in $8!$ ($8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$) minutes?



ONE HUNDRED FACTORIAL

Source: *MathsJam*

How many zeros does $100!$ end with?

WHERE IS THE PARTY?

Source: *Tanya Khovanova*

One day you meet your friend Alice enjoying a nice walk with her husband Bob and their son Carl. They are happy to see you and invite you to their party:

Alice: Our party is on Sunday at 632 Elm St.

Bob: My wife likes exaggerating and multiplies every number she mentions by two.

Carl: My dad compensates for mum's exaggeration and divides every number he mentions by four.

Alice: Our son is not like us at all! He doesn't multiply or divide, but adds eight to every number he mentions.

Where is the party?



POLYA STRIKES OUT

Source: *Thinking Mathematically by John Mason et al.*

Write the numbers 1, 2, 3, ... in a row. Strike out every third number beginning with the third. Write down the cumulative sums of what remains:



1, 2, 3, 4, 5, 6, 7, ...

1, 2, ~~3~~, 4, 5, ~~6~~, 7, ...

1, 2, 4, 5, 7, ...

$1=1$; $1+2=3$; $1+2+4=7$; $1+2+4+5=12$; $1+2+4+5+7=19$; ...

1, 3, 7, 12, 19, ...

Now strike out every second number beginning with the second. Write down the cumulative sums of what remains. What is the final sequence? Why do you get this sequence?

TOY BOX

Source: *UKMT Senior Team Maths Challenge*



A child's wooden toy is made in the shape of a right cone joined to a hemisphere so that their circular faces coincide exactly. The cone and the hemisphere are of equal volume. The toy is packaged in the smallest possible closed cylindrical box.

What proportion of the capacity of the box is filled by the toy?

SQUARE DEAL

Source: *Futility Closet*



This unit square is divided into four regions by a diagonal and a line that connects a vertex to the midpoint of an opposite side. What are the areas of the four regions?

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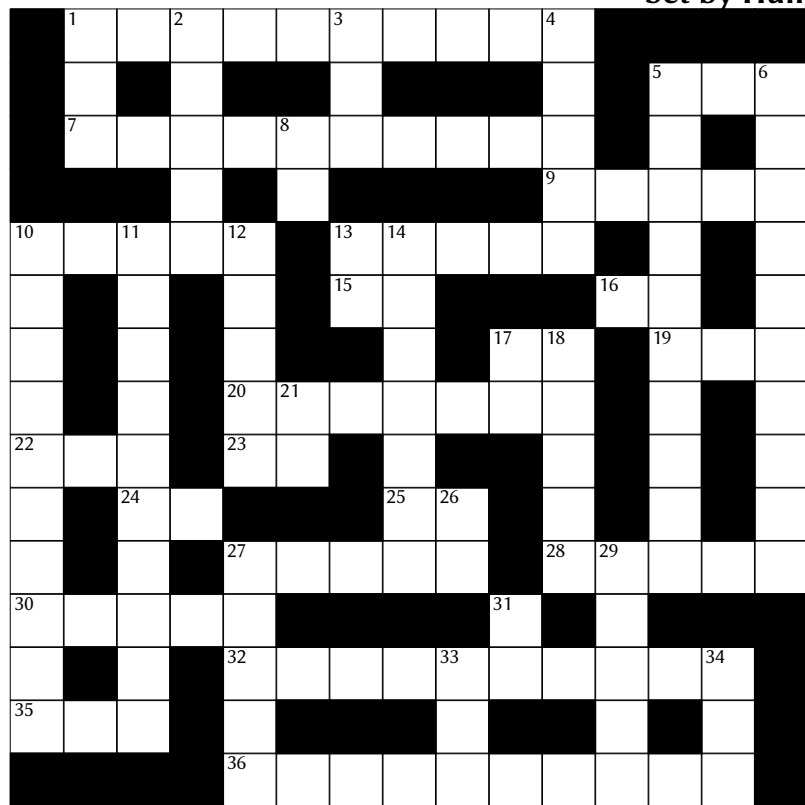
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Prize Crossnumber

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#1 **Set by Humbug**



RULES

Although many of the clues have multiple answers, there is only one solution to the completed crossnumber. As usual, no numbers begin with 0.

One randomly selected correct answer will win **£100**. Three randomly selected runners up will win a chalkdust pen. The prizes have been provided by G-Research, researchers of financial markets and investment ideas. Find out more at gresearch.com.

To enter, email crossnumber@chalkdustmagazine.com with the **sum of the across clues** by **22nd July 2015**. Only one entry per person will be accepted. Winners will be notified by email by 1st August 2015.

ACROSS

- 1 D4 multiplied by D18. (10)
- 5 A multiple of 101. (3)
- 7 The difference between 10D and 11D. (10)
- 9 A palindromic number containing at least one 0. (5)
- 10 Subtract 24A multiplied by 24A backwards from 100000. (5)
- 13 Subtract 8D from 35A then multiply by 17A. (5)
- 15 Multiply this by 13D to get a perfect number. (2)
- 16 The product of two primes. (2)
- 17 A triangular number. (2)
- 19 A factor of 6D. (3)
- 20 30A more than the largest number which cannot be written as the sum of distinct fourth powers. (7)
- 22 The sum of seven consecutive primes. (3)
- 23 When written in Roman numerals, this number is an anagram of XILXX. (2)
- 24 The largest prime factor of 733626510400. (2)
- 25 A square number. (2)
- 27 The product of all the digits of 7A. (5)
- 28 A multiple of 107. (5)
- 30 Unix time at 01:29:41 (am) on 2 January 1970. (5)
- 32 When written in a base other than 10, this number is 5331005655. (10)
- 35 The smallest number which is one more than triple its reverse. (3)
- 36 All but one of the digits of this number are the same. (10)

DOWN

- 1 700 less than 3D. (3)
- 2 The sum of this number's digits is equal to 16. (5)
- 3 A Fibonacci number. (3)
- 4 This is the same as another number in the crossnumber. (5)
- 5 A square number containing every digit from 0 to 9 exactly once. (10)
- 6 This number's first digit tells you how many 0s are in this number, the second digit how many 1s, the third digit how many 2s, and so on. (10)
- 8 The lowest prime larger than 25A. (2)
- 10 The largest prime number with 10 digits. (10)
- 11 A multiple of 396533. (10)
- 12 If you write a 1 at the end of this number then it is three times larger than if you write a 1 at the start. (5)
- 13 Multiply this by 15A to get a perfect number. (2)
- 14 The factorial of 17D divided by the factorial of 16A. (7)
- 17 The answer to the ultimate question of life, the universe and everything. (2)
- 18 A multiple of 5. (5)
- 21 The number of the D clue which has the answer 91199. (2)
- 26 The total number of vertices in all the Platonic Solids (in 3D). (2)
- 27 Two more than 29D. (5)
- 29 The first and last digits of this number are equal. (5)
- 31 A multiple of 24A. (2)
- 33 Each digit of this number is a different non-zero square number. (3)
- 34 A square number. (3)