

The Day of the Week

Charles Dodgson

Friday 27 January 1832 – Friday 14 January 1898

“So Charles, my wife was born on the 16th April 1835 and I’ve been told you can provide me with the exact day of the week on which that wonderful even occurred on, and some say you can do it in less than 20 seconds?”

“Hmm” mumbling to himself... “Well, let’s see, 18 is 4 and 35 in 12’s is 2 and the 11 over has 2 fours so 15 or 1, and April is 6 and 6 is 2, so 4, 1 and 6 and 2 is 13 or 6, so Saturday?”

“Great Scott Charles! You’re right!”

Charles Lutwidge Dodgson was an English writer and the author of the world famous children’s books *Alice’s adventures in Wonderland* and *Through the Looking-Glass*. His pen name Lewis Carroll is the name he is better known by, but Dodgson was also a gifted mathematician, a photographer and an Anglican Deacon. He matriculated at the University of Oxford and in 1885 won the Christ Church Mathematical Lectureship, which he subsequently held for over a quarter of a century.

Among the myriads of things he was known for, there was one amusing little party trick that, it is said, he used on occasion to entertain inquisitive guests with. He would astonish them by determining, in no more than 20 seconds, the day of the week for any date in the Gregorian calendar they cared to enquire about.

If you had the inside knowledge the method used is simple enough but it does require committing to memory a few numbers associated with the calendar months. Using a little license with his original terminology Charles Dodgson’s technique can be described in the following manner.

C. The Carroll century number

First of all, there are Carroll numbers for the different centuries for the years since the Gregorian calendar was adopted, and this part of the method is perhaps the simplest to learn. The 1700’s of the Gregorian calendar are given the number 4, the 1800’s are given the number 2 and the 1900’s given 0, and after that cycling 6, 4, 2, 0, 6, 4, 2, 0 etc. the current millennium has the special number 6.

Y. The Carroll year number

The Carroll number for the year is the sum of three numbers, and this can with practice be accomplished as a mental computation. The year part of any particular year is the last two digits of a four-digit year number. So for example the year 1945 has a year part of 45.

The three numbers are determined by thinking about three questions. We'll use 45 to demonstrate, but any year part will work the same. We ask ourselves, quietly...

1. How many twelves' are in 45 (The answer is 3)
2. What are the leftovers? (There are 9 left over)
3. How many fours are in the left overs (There are 2 fours in 9)

The sum of these is 14 and so 14 is the Carroll year number. Further along we will show how a number like 14 reduces to 0.

M. The Carroll month number

The Carroll month number shown in the table take some work to memorise. You might like to think about how you might remember them, but one of the authors did so in the following way (Look away if you want to learn your own)

<i>m</i>	<i>Month</i>
0	<i>January, October</i>
1	<i>May</i>
2	<i>August</i>
3	<i>February, March, November</i>
4	<i>June</i>
5	<i>September, December</i>
6	<i>April, July</i>

January is **0**, because no month comes before it

October is also 0 because it starts with an **O**

May day is May **1**

June has **4** letters

February, March and **November** remind me of the *Fe-Mi-Nine* number **3**

September and **December** *sound* similar and sound has **5** letters

August has **2** syllables

April and **July** have the letter *l* in them, and letter has **6** letters.

D. The Carroll day number

This one is not difficult at all. It's simply the number itself.

C+Y+M+D

The overall Carroll number for the date is the sum of all four Carroll numbers derived above, modulo 7. But there is a trick that Dodgson would most certainly have used to save a lot of computational strain. Any number can be reduced modulo 7 at any time through the process of obtaining Carroll number. This is the wonderful thing about adding things up in modular arithmetic when all that you are interested in is remainders. So as you progressively add the various Carroll number parts up be sure to reduce the subtotals. A subtotal of say 14 can be reduced to 0 (mod 7). To save time in the examples below we show this operation as 14(0).

After adding the Carroll numbers corresponding to the parts of the date the final Carroll number modulo 7 will be a number between 0 and 6. If the number is 0 then the day is Sunday. If it's 1, the day is Monday and if its 2, the day is Tuesday and so on up to 6 which is Saturday.

Before we show the examples, in respect of leap years a small adjustment needs to be made, and this will be discussed prior to example 6 below.

Example 1: 16 April 1835

Any 1800's year has the Century number 2
35 has 2 lots of twelve and the remainder of 11 has 2 fours in it
This means that 1835 corresponds to the Carroll number 17(3)
Add 6 for April and 16(2) for the date, the final total becomes 11(4)
Therefore the date 16 April 1835 was a Thursday.

Example 2: New years Day 1937

Any 1900's year has the Century number 0
37 has 3 lots of twelve and the remainder of 1 has 0 fours in it
This means that 1937 corresponds to the Carroll number (4)
Add 0 for January and (1) for the date, the final total becomes (5)
Therefore the date of New years Day 1937 was a Friday.

Example 1: 25 March 1956

Any 1900's year has the Century number 0
56 has 4 lots of twelve and the remainder of 8 has 2 fours in it
This means that 1956 corresponds to the Carroll number 14(0)
Add 3 for March and 25(4) for the date, the final total becomes 7(0)
Therefore the date 25 March 1956 was a Sunday.

Example 4: Using the 4 digit year number effectively

Sam goes to lots of meetings, and when dates are discussed about future events she always finds that she needs to consult her diary. To save time Sam decides to evaluate the Carroll number for the current year 2019. This involves adding together the Carroll century number **6** and the Carroll year number **2** (the sum of 1, 7 and 1, modulo 7) to get **8(1)**.

All Sam has to do now is to add 1 to the Carroll number formed by a particular date in the year. For example, if at a future meeting the date 13 December is mentioned, Sam can quickly add $13 + 5 + 1 = 19(5)$ and know it's a Friday.

Example 5: months with the same calendar

The Calendars for the months of January and October look the same. Days fall on the same month dates. In fact, apart from the total number of days, months with the same Carroll number look identical.

There are also other interesting things to discover, such as the fact that in any year the first day and the last day are always the same day of the week.

January and February of leap years

The Lewis Carroll method has an exception, as all good rules do. It's a simple fix, and it only affects the first two months of the year, January and February, and only then on Leap Years. The probability of being in such a month is scarcely more than 5% of the time, but should you find yourself in one, simply subtract 1 from the final Carroll number.

Example 6: 7 February 2020

The Century number is **6**

20 has **1** lot of twelve and the remainder of **8** has **2** fours in it

This means that 2020 corresponds to the Carroll number **17(3)**

Add **3** for February and **7(0)** for the date, the final total becomes **(6)**

But now subtract 1 from the total

Therefore the date 7 February 2020 was a Friday.

After sufficient time has been spent practicing, its not hard to imagine how Dodgson could get an answer in less than 20 seconds

Conway's Doomsday

John Conway, Professor of Mathematics at Princeton University, notes an amazing fact about the calendar.

Irrespective of the year, the:

Fourth day of the fourth month (April 4)
Sixth day of the Sixth month (June 6)
Eighth day of the eighth month (August 8)
Tenth day of the tenth month (October 10)
Twelfth day of the twelfth month (December 12)

all land on the same day. They might be all Sundays or all Tuesdays or all some other day, but they all occur on the same day. Conway dubbed it the *Doomsday*.

Not only those days, but, if you can remember that employees work 9 to 5 in every 7-11 shop then the following five days land on the same doomsday:

Ninth day of the fifth month (May 9)
Fifth day of the Ninth month (September 5)
Seventh day of the eleventh month (November 7)
Eleventh day of the seventh month (July 11)
The last day of February (February 28 or 29)

Unfortunately Conway's rule has no exceptions other than the fact that January and March are not mentioned. With a little bit of work though days for these months can be worked out once the year's doomsday is known.

The doomsday for 2020 is Saturday. It is easy to work out. Using Carroll's method, the Carroll number for 2020 is 3 and so, taking the 9th May, we add 10 to 3 to get 13(6), so that the doomsday is Saturday.