the nmf weekly

Ask your math friend, James

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Math and Time

G'Day!

This is your math friend James.

I like trying to answer questions people have about math, especially the "I wonder" questions people ask. Here's such a question from another James in Arizona.

"CAN YOU DO SOMETHING WITH MATH AND TIME?"

This is like the question we had last time about math and cats. It makes me think.

First of all, my brain says: there is a lot of time. Time has been happening for, well, a very long time. And time will keep on going. It always seems to go forward and never backwards. There will be tomorrow, and a next tomorrow, and a next tomorrow, but we can never go back and redo yesterday.

We measure time in all sorts of ways: in seconds, in minutes, in days, in centuries.

Oh! Here's a question:

Are you a billion seconds old?

A billion is a very big number: it's a thousand million.

How long a time period is a billion seconds? Well … There are 60 seconds in a minute and there are 60 minutes in an hour. So that makes for 60 x 60 = 3600 seconds in an hour.

There are 24 hours in a day. So that means there are 24 x 3600 = 86,400 seconds in a day.

There are 365 days in a year. Ooh! Wait! There are leap years too, usually one every four years. So, let's say there are 365-and-a-quarter days in a year.

Check on the internet:
Was the year 2000 a leap year?
Will the year 2100 be a leap year?

That makes for 365.25 x 86,400 = 31,536,000 seconds in a year. That's just over 31.5 million seconds. But we're wondering about a thousand million seconds.

Okay … The number 31.5 goes into 1000 about 31.7 times. That means you need to be about 31.7 years old to have lived for a billion seconds! Are you that old?

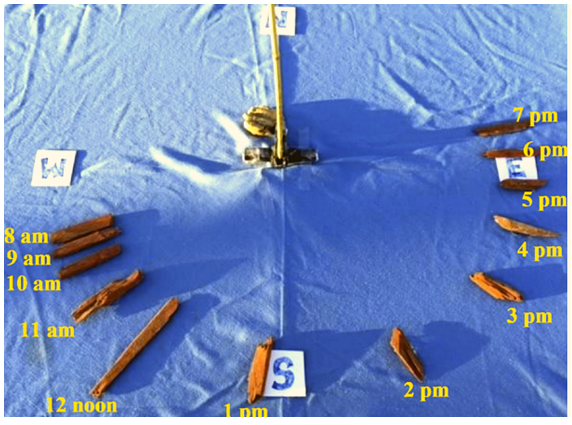
puzzle #1

How many seconds old are you? First work out how many days old you are, then how many seconds that is.

Just so you know, I am about 1.7 billion seconds old.

The earliest clock we humans invented is the sundial. One can make a very basic sundial simply by putting a stick in the ground and marking on the ground where the shadow is each hour.

Actually, I did this recently, standing a stick on a picnic table with a blue tablecloth. You can see where the shadow was just after sunrise (around 8 am) and just before sunset (around 7 pm).



Do you think there is something odd about the photo? Try sticking a stick in the ground where you live on a sunny day and observing where the shadow lies for different hours throughout the day. (For those who live in America, you'll notice something very different!)

The ancient Egyptians used sundials to measure time during the day. They divided the day into ten segments, and added two more "hours" for the twilight periods around sunrise and sunset. This is why we say there are 12 hours in a day. And it was natural to divide the night into 12 hours as well.

But here's the funny thing. The amount of sunlight during the day changes throughout the seasons—summer days are long and winter days are short—and the Egyptians divided each day into 12 equal hours no matter what. This meant that the length of the hour kept changing from day to day!

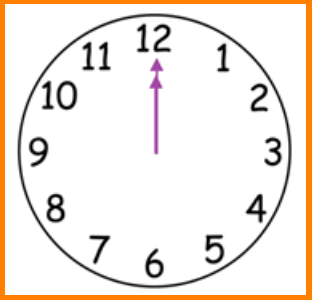
This practice went on for about 2,500 years across the globe. It wasn't until mechanical clocks were invented around the year 1300 or so and people got tired of readjusting the length of the hour that we, collectively, decided to keep the length of the hour fixed in length.

But, I digress. I am meant to be thinking about math and time. (Though the history of our human relationship with time is interesting.)

Well, there are lots of classic math puzzles about clocks and time. Here's a famous one.

puzzle #2

The two hands of clock—the minute hand and the hour hand—lie directly on top of one another right at noon.



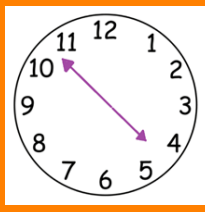
How many times over the next 12 hours will the hands again be perfectly aligned?

What times are those?

I, personally, usually don't like puzzles like these. I don't know why. I guess my first reaction to them is that they just seem hard, and a little bit annoying.

So, I usually ask myself: Is there a way to "see through" this puzzle without having to get bogged down with hard work? (In fact, mathematicians will often work very hard to avoid hard work!)

puzzle #2 BONUS



Are there times of day when the two hands—the minute hand and the hour hand—lie in opposite directions?

WRITE TO ME

Do you have a math question you'd like me to answer, or try to answer?

Have an adult help you to write to me at the website. Each week I'll pick a new student question and give my thoughts on it! Plus I'll give me solutions to the most recent puzzles.

OTHER RESOURCES

Check out MATHICAL for award-winning math books for middle-schoolers and teens, the YouTube channel NUMBERPHILE for math videos galore, and MORE MATH! for even more resources. Wowza!

This week, I have to suggest looking at the 2017 Mathical Hall of Fame book, the classic, "A Wrinkle in Time" by Madeleine L'Engle.

About the Author: Dr. James Tanton

The NMF Weekly is written by mathematician Dr. James Tanton as a resource for friends and fans of the 2021 National Math Festival. Learn more at globalmathproject.org/nmf-weekly & nationalmathfestival.org