

What you need to know for the mathematics section of the Science Foundation Module

1 Calendars

The Muslim calendar is a lunar calendar. The year consists of 12 lunar months. The average length of a month is 29.53 days, so the year is about 354 days long. Since the solar year is about 365.25 days long, the lunar year is about 11 days too short, so the Muslim holidays will move backwards by about 11 days each year. They can occur at any time of the year.

The Chinese calendar is a lunisolar calendar. The year consists of 12 or 13 lunar months. A normal year is about 11 days too short, while a leap year is about 19 days too long. Chinese New Year will move backwards 11 (or 10 or 12) days in a normal year, and jump forward 19 (or 18 or 20) days in a leap year. Chinese New Year will always fall between January 21 and February 21.

2 Probability

In the “car and goat” game, your chances of winning jump from $1/3$ to $2/3$ if you switch.

Benford’s Law states that for numbers that occur naturally, the probability that the first digit is d is $\log_{10}(1 + 1/d)$.

In a group of 23 or more people, it is likely that two people will have the same birthday.

3 Cryptography

A public key cryptosystem is a cryptosystem where the encryption key is public, i.e., known to everybody, but someone who knows how to encipher a message cannot determine how to decipher the message without a prohibitively large computation.

The most famous public key cryptosystem is called RSA, and is based on the fact that it’s hard to factor large integers.

$a \equiv b \pmod{n}$ if $a - b$ is divisible by n . a and b are relatively prime if their greatest common divisor is 1.