

Ponder the Portage County Skies with Paul

Sky events for June 2008

03 New Moon 2:23 p.m. & perigee
07 Mercury between Earth and Sun
09 Venus behind sun, evening object next
09 Moon passes under Saturn at sunset
10 First Quarter Moon 10:04 a.m.
16 Moon at apogee (farthest)
18 Full Moon at 12:30 p.m.
20 Summer Solstice 15 hrs. 33 min. orb visible
26 Last quarter Moon 7:10 a.m.
30 sunrise #1 (astronomical starts) 02:50 a.m.
30 sunrise #2 (nautical starts) 03:52 a.m.
30 sunrise #3 (civil starts) 04:40 a.m.
30 sunrise #4 (visible orb. starts) 05:17
30 sunset #1 (visible orb. ends) 8:46 p.m.
30 sunset #2 (civil ends) 9:23 p.m.
30 sunset #3 (nautical ends) 10:11 p.m.
30 sunset #4 (astronomical ends) 11:12 p.m.

What are these FOUR sunrises and FOUR sunsets? Civil twilight is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 6 degrees below the horizon. This is the limit at which twilight illumination is sufficient, under good weather conditions, for terrestrial objects to be clearly distinguished. Nautical twilight is defined to begin in the morning, and to end in the evening, when the center of the sun is geometrically 12 degrees below the horizon. At the beginning or end of nautical twilight, under good atmospheric conditions and in the absence of other illumination, general outlines of ground objects may be distinguishable, but detailed outdoor operations are not possible, and the horizon is indistinct. Astronomical twilight is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 18 degrees below the horizon. Before astronomical twilight in the morning and after astronomical twilight in the evening the Sun does not contribute to sky illumination.

What well known constellation rises at midnight on June 1st? The Great Square of Pegasus starts to appear with the star Scheat (the right shoulder) first, Alpheratz (the navel) edging out Markab (the saddle) by a minute and finally Algenib (the wing) rises an hour and a half latter. A neighbor, Andromeda, didn't have a head so

they annexed Alpheratz into the region of Andromeda but we still call the four stars the great square of Pegasus.

Wasn't a square responsible for the invention of a new number system? Yes, before 300 BC the Greeks thought that all numbers could be written as the ratio of two natural numbers (fractions) since between any two fractions there always exists another fraction (for instance, if you take the average of the two fractions). But Euclid proved that the length of the diagonal of a unit square (a square with a side of one unit) could not be a fraction.

How did Euclid prove the diagonal of a square was not a fractional number?

Euclid called the method for this proof "reduction ad absurdum" which we now call an indirect proof. The idea is to assume the opposite of what you are trying to prove and hopefully arriving at a contradiction, thus making what you are actually trying to prove the only outcome possible without having to prove it directly.

Euclid was aware of the Pythagorean theorem and knew that the diagonal of a square was the hypotenuse of a right triangle with legs 1 unit. So, $1^2 + 1^2 = (p/q)^2$ where you assume the length of the diagonal of the unit square is the reduced fraction (p/q) . So, $p^2/q^2 = 2$, thus $p^2 = 2q^2$. If this is the case notice p would have to be an even number. If p is an even number you can say $p=2r$, substituting you get $(2r)^2=2q^2$, thus $4r^2=2q^2$, so $q^2 = 2r^2$, therefore notice that q has to be even also. Do you see the contradiction yet? How can both p and q be even numbers if p/q is a reduced fraction. Thus the diagonal of a square must not be a fraction (a rational number), and another number system must exist (namely the irrationals).

Can you name a place in Astronomy where irrational numbers are used?

Irrational numbers come up more often than rational numbers in Astronomy as gravity causes all the conic sections (parabolic, elliptical, circular, and hyperbolic) in celestial trajectories. Einstein defined gravity as a curvature of space-time, which causes irrational numbers to exist everywhere. Also, brightness is measured in magnitudes where one magnitude differs by the fifth root of 100 (or about 2.51). GNATS