Ninth Grade Religious Education
St. Raymond of Peñafort Catholic Church
Anthropic Conditions at time of Creation Present Today
September 17, 2023

Reference: *Credible Catholic Big Book – Volumn I, The Existence of God.* https://www.magiscenter.com/catechism-resource-book#bigbook. You can find most of this information around pages 28-30.

The Anthropic conditions relate to those conditions of the universe which must exist for human life to survive. In science, these are based on several "cosmological constants"[1] which control the laws of nature. These were put in place at the time of creation and can help us determine if a celestial body will be hospitable to life. Here are some examples:

The speed of light
(c = 300,000 kilometers/second)
The gravitational attraction constant
($G = 6.67 \times 10^{-11}$)
The strong nuclear force coupling constant
($g_s = 15$)
The weak force constant
($g_x - 1.43 \times 10^{-62}$)
The rest mass of a proton
($m_p = 1.67 \times 10^{-27}$ kilograms)
The rest mass of an electron
($m_e = 9.11 \times 10^{-31}$ kilograms)
The charge of an electron
($e = 1.6 \times 10^{-19}$ coulombs).

Here are some examples showing how fragile these constants actually are.

If the gravitational constant (G) or the weak force constant (g_w) varied by one part in 10^{50} that is (0.00 000000…(50 of these)…1) then the universe would either collapse on itself or explode.

We see is constant, G, in the equation for the gravitational force:

$F_g = G \times (Mass_1) \times (Mass_2)/d^s$ where:
d is the distance between the center of mass of each body. The gravitational force (F_g) is what keeps us planted to the ground and not floating away. It also is what provides weightlessness in space.[2]

The strong force keeps the protons and neutrons together in the nucleus of an atom. Recall the nucleus contains the protons and neutrons and the electrons spin around the nucleus. If the strong force was 2% greater, then there would be no hydrogen in the universe, thus no water and thus, no life form (all life needs water).

The weak force keeps the electron from either collapsing into the nucleus of an atom or flying away.

The charge of an electron is what creates a magnet and is the basis for the creation of electricity. This is based on Coulomb's law which is very similar to the gravitational force above. The electrical force,

$F_e = k \times e_1 \times e_2/r^2$, where

k = Coulomb's constant,
e_1, e_2 = respective charge on the particles, and
r = distance between the two charges.

[1] A cosmological constant is a number that controls the equations of physics, and the equations of physics describe the laws of nature.

[2] Here is a great 7-minute video which shows this concept clearly. https://www.youtube.com/watch?v=Af9lRX4xsr0

The speed of light is the foundation of Albert Einstein's famous equation $E = m \times c^2$. Where E is an energy term and m is mass. Since c is a constant, if E increases, then m decreases and vice versa. This fundamental law shows that mass can be converted to energy and vice versa. The ramification of this law (equations too complex for here) is that the amount of energy-mass in the universe has been constant. This means that at the Big Bang, all the mass and energy of the universe was present at that precise moment. Imagine how monumental that would have been![3]

Einstein postulated at the time that he was awarded the Nobel Prize for his theory of relativity, that there are only four forces in the universe: gravitational force, strong force, weak force, and magnetic force. All other forces are derived from these four.

Now, 100 years after Einstein postulated this, we still have not been able to find any more than these four forces.

You may have learned about some of these already in your educational experience. You will learn more if you take a basic physics class.

So, as you move through your science/mathematics academic experience, recall that when you come to a constant like the ones above which may have the name of the person who discovered it, e.g., Coulomb and Coulomb's law, remember that <u>they are merely discovering what God put in place at the time of creation.</u>

[3] The observable universe appears to have about 10^{55} kilograms of visible mater (5% of its total mass-energy). This was present when the universe was created 13.8 billion years ago and is present today.

Beyond the scope of this presentation is the fact that 25% of the universe is dark matter and 70% is even darker matter. See page 11 of source for discussion of this.