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Science in Uncertainty

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Abstract: The very expression "certainty" is a contradiction in terms. There is rarely such thing as 100% certainty – and everything less than this is uncertain. The very core of science is the deep awareness that we have wrong ideas, we have prejudices. We have ingrained prejudices and these prejudices are organized into equations. For many people this might be a startling claim. Uncertainty does not mean we know nothing, that evidence is unquestionably fraught with misinterpretation. We can say how far we are from the end state, 'almost certain' for instance. Our facts and knowledge of the science should always be taken with a skeptical grain salt. Uncertainty in science which in effect means that nothing is real in any absolute sort of way.

Key words: Science; Uncertainty; Scientific knowledge; limitation

"Scientific knowledge is a body of statements of varying degrees of certainty -- some most unsure, some nearly sure, none absolutely certain."

- Richard Feynman

To many people, mathematics presents a significant barrier to their understanding of science. Certainly, mathematics has been the language of physics for four hundred years and more, and it is difficult to make progress in understanding the physical world without it.

If a force F acts on a particle of mass m_o at rest and produces acceleration a in it, then the force is given by:

$$F = m_o a$$

The particle remains at rest (a=0) when no external force (F=0) acts on it. Under this condition the rest mass of the particle is $m_o = F/a = 0/0$, which is meaningless. There can be no bigger limitation than this. The rest mass is always non zero. And in relativistic mechanics, we define the total energy of a particle to be equal to the sum of its rest mass energy and kinetic energy. That is,

Total energy = rest energy + kinetic energy

$$mC^2 = m_o C^2 + KE$$

So this means that the kinetic energy — the energy of motion of a particle is

Kinetic energy = total energy – rest energy

$$KE = (m - m_o)\, C^2$$

For non-relativistic case $m = m_0$. Therefore, we have $KE = (m - m_o)\, C^2 = 0$, which is not justified as the kinetic energy, KE, of a non-relativistic particle moving with a velocity $v << C$ is equal to

$$KE = \frac{1}{2} m_o v^2$$

Suppose the particle is brought to rest, then (KE = 0, v=0). Now the equation for rest mass i.e., $m_o = 2KE/v^2$ becomes: $m_o = 2KE/v^2 = 2\,(0)\,/0 = 0$, which is meaningless. There can be no bigger limitation than this. The rest mass is well defined, $m_o>0$.

In the paper which is widely known as the special theory of relativity, Albert Einstein put forth an equation of Lorentz – Fitzgerald length contraction

$$\ell_0 = \ell \,/ \sqrt{1 - v^2/C^2}$$

where ℓ is the length of the rod measured by an observer in a frame moving with velocity v, and ℓ_0 is the length of the rod in the rest frame. Suppose the observer moves with the speed of light i.e. $v= C$ then

$\ell_0 = \infty$, which is again a meaningless result. ℓ_0 is well defined and cannot be infinity.

For an object of mass m on earth, the force required to lift it is equal to the object's weight =mg. If we lift this object a height = h above the earth surface, then we do work. As a result, we have

Potential Energy PE = mgh, it will be equal to zero when h=0.

Now under the condition (h=0, PE=0) the mass of the object becomes

$m = \frac{1}{g}(PE / h) = \frac{1}{g}(0 / 0) = 0$, which is meaningless. There can be no bigger limitation than this. The mass cannot be zero.

The average kinetic energy of gas atoms is …

$$\langle KE \rangle = \frac{3}{2} k_B T$$

where k_B is known as Boltzmann's constant and is given by

$$k_B = 1.4 \times 10^{-23} \text{ J/K}$$

At Temperature T = 0,

$$\langle KE \rangle = 0$$

$$k_B = 2\langle KE \rangle / 3T = 2 (0) / 0 = 0$$

It is reiterated that under the condition (T=0, <KE> = 0), the Boltzmann's constant reduces to zero. However, T cannot be zero. T=0 violates the third law of thermodynamics.

From classical mechanics, we find out that momentum is mass multiplied by velocity, and its symbol is p:

$$p = mv$$

Special relativity has something to say about momentum. In particular, special relativity gets its $\sqrt{1 - v^2/C^2}$ factor into the momentum mix like this:

$$p = m_o v / \sqrt{1 - v^2/C^2}$$

For non-relativistic case

$$v \ll C$$

Therefore, we have

$$p = m_o v$$

Suppose the particle is brought to rest, then ($p = 0$, $v = 0$). Now the equation for rest mass i.e., $m_o = p/v$ becomes: $m_o = p/v = 0 / 0$, which is not justified. The rest mass is always non-zero.

Newton's third law of motion as stated in Philosophiae Naturalis Principia Mathematica

"To every action there is always an equal and opposite reaction."

Action and reaction are not always equal and opposite. Let us consider a boy is standing in front of wooden wall, holding a rubber ball and cloth ball of same mass in the hands. Let the wall is at the distance of 5m from the boy.

Case 1:

Let the boy throws the rubber ball at the wall with some force F.

Action: Boy throws the rubber ball at the wall from distance of 5m.

Reaction: The ball strikes the wall, and comes back to the boy i.e. travelling 5m.Now action and reaction is equal and opposite.

Case 2:

Let the same boy throws the cloth ball at the wall with same force F.

Action: Boy throws the cloth ball at the wall from distance of 5m.

Reaction: The ball strikes the wall, and comes back to the boy i.e. travelling 2.5m. Now action and reaction are not equal and opposite. In this case Newton's third law of motion is completely violated.

How big of a force does electron placed in an electric field feel? Well, the electric field is E newtons per coulomb and electron have a charge of $e = -1.602 \times 10^{-19}$ coulombs, so you get the following

$$F = eE$$

That is, electron feels a force of eE Newton. Now under the condition (E = 0, F = 0) the electron charge becomes

$e = F/E = 0/0$, which is meaningless. There can be no bigger limitation than this. The electron charge cannot be zero ($e = -1.602 \times 10^{-19}$ coulombs).

The dissociation of a protein – ligand complex (PL) can be described by a simple equilibrium reaction

$$PL \rightleftharpoons P + L$$

the corresponding equilibrium relationship is defined $K [PL] = [P] [L]$ (K = dissociation constant). In this equation $[P] = [P]_T - [PL]$ and $[L] = [L]_T - [PL]$ where $[P]_T$ and $[L]_T$ are the initial total concentrations of the protein and ligand, respectively.

Case 1:

Using the equilibrium relationship

$$K [PL] = [L] [P]$$

and substituting,

$$[L]_T - [PL] \text{ for } [L]$$

$$[P]_T - [PL] \text{ for } [P]$$

Gives:

$$K [PL] = \{[L]_T - [PL]\} \{[P]_T - [PL]\}$$

$$K = [L]_T [P]_T - [PL] [L]_T - [PL] [P]_T + [PL]^2$$

Dividing throughout by [PL] gives:

$$K = \{[L]_T [P]_T / [PL]\} - [L]_T - [P]_T + [PL]$$

But

$$[P]_T = [PL] + [P]$$

And, therefore,

$$K = \{[L]_T [P]_T / [PL]\} - [L]_T - [P]$$

$$K = [L]_T (\{[P]_T / [PL]\} - 1) - [P]$$

From this it follows that

$$K + [P] = [L]_T [P] / [PL]$$

Rearranging

$$[PL] = [L]_T [P] / K + [P]$$

This defines a rectangular hyperbola with several important regional properties:

- Saturation: when $[P] >> K$, $[PL]$ asymptotically approaches $[L]_T$.
- Half-saturation: when $[P] = K$, $[PL] = [L]_T/2$ - in other word, the dissociation constant is equal to the (free) protein concentration needed to ensure that 50% of the ligand will be bounded.
- Linearity: when $[P] << K$, $[PL]$ is ~ proportional to $[P]$ with slope = $[L]_T/ K$.

Case 2:

Using the equilibrium relationship

$$K [PL] = [L] [P] \text{ and substituting,}$$

$$[P]_T - [P] \text{ for } [PL]$$

$$[L]_T - [PL] \text{ for } [L]$$

$$[P]_T - [PL] \text{ for } [P]$$

Gives:

$$K \{[P]_T - [P]\} = \{[L]_T - [PL]\} \{[P]_T - [PL]\}$$

$$K [P]_T - K [P] = [L]_T [P]_T - [PL] [L]_T - [PL] [P]_T + [PL]^2$$

Rearranging

$$K [P]_T - [L]_T [P]_T + [PL] [P]_T = - [PL] [L]_T + [PL]^2 + K [P]$$

$$[P]_T \{K - [L]_T + [PL]\} = [PL] \{- [L]_T + [PL]\} + K [P]$$

Further, if we substitute

$$[L]_T = [PL] + [L]$$

Then we get

$$[P]_T \{K - [PL] - [L] + [PL]\} = [PL] \{-[PL] - [L] + [PL]\} + K [P]$$

$$[P]_T \{K - [L]\} = - [PL] [L] + K [P]$$

Which is the same as:

$$[P]_T \{K - [L]\} = K [P] - [PL] [L]$$

$$K - [L] = K \{[P]/ [P]_T\} - \{[PL]/ [P]_T\} [L]$$

Labeling $[P] / [P]_T$ as F_{FP} (fraction of free protein) and $[PL] / [P]_T$ as F_{BP} (fraction of bound protein) then above expression turn into

$$K - [L] = K F_{FP} - F_{BP} [L]$$

- If $F_{FP} = F_{BP}=1$, then the LHS = RHS, and the above Equation is true.
- If $F_{FP} = F_{BP} \neq 1$, then the LHS $\neq$ RHS, and the above Equation is invalid.

Let us now check the validity of the condition

$$\text{“}F_{FP} = F_{BP} = 1\text{”}.$$

As per the protein conservation law,

$$[P]_T = [PL] + [P]$$

From this it follows that

$$1 = F_{BP} + F_{FP}$$

If we assume $F_{BP} = F_{FP} = 1$, we get:

$$1 = 2$$

The condition $F_{FP} = F_{BP} = 1$ is invalid, since 1 doesn't = 2.

In fact, the only way it can happen that K – [L] = K – [L] is if both $F_{FP} = F_{BP} = 1$. Since $F_{FP} = F_{BP} \neq 1$, EquationK – [L] = K FFP – FBP [L] does not therefore hold well.

Conclusion:

- Using the equilibrium relationship K [PL] = [L] [P] and substituting, $[L]_T$ – [PL] for [L]

$[P]_T$ – [PL] for [P] and simplifying we get the right result

$$[PL] = [L] T [P] / K + [P]$$

- Using the equilibrium relationship K [PL] = [L] [P] and substituting, $[P]_T$ – [P] for [PL]

$[L]_T$ – [PL] for [L]

$[P]_T$ – [PL] for [P] and simplifying we get the wrong result

$$K - [L] = K F_{FP} - F_{BP} [L]$$

Substitution for '[PL]' along with the substitutions for '[L]' and '[P]' should be avoided in order to prevent the occurrence of wrong result. Consider an incoming photon of energy $mC^2$and momentum mC scattering from any electron of mass m_o, which is treated as being at rest. $p = m_E v$ is the momentum and $m_E C^2$ is the total energy of the electron after scattering and MC^2, MC are the energy and momentum of the scattered photon.

The conservation of energy merely equates the sum of energies before and after collision.

$$mC^2 + m_o C^2 = MC^2 + m_E C^2$$

Which is the same as:

$$(m - M) = (m_E - m_o)$$

From the conservation of momentum, the momenta of the particles should be similarly related by

$$mC = MC + m_E v$$

On rearranging:

$$(m - M) = m_E \times (v/C)$$

Since $(m - M) = (m_E - m_o)$. Therefore:

$$(m_E - m_o) = m_E \times (v/C)$$

On rearranging:

$$m_E = m_o C / \{C - v\}$$

Say for an electron moving with a velocity of $0.9C$

$$m_E = m_o C / \{C - v\} = m_o C / \{C - 0.9C\} = 10\, m_o$$

But, according to Einstein's mass velocity equation

$$m_E = m_o C / \sqrt{C^2 - v^2} = m_o C / \sqrt{C^2 - 0.81C^2} = 2.29 m_o$$

This frames the best example for uncertainty in the sense of inadequacy of our knowledge is presented. We can define the kinetic energy KE of the electron to be equal to the work done by a photon impulse J to increase velocity of the electron from zero to some value v. That is

$$KE = J \times v$$

(Assuming one- dimensional motion)

where the photon impulse J is defined as the change of momentum of the electron

i.e., $$J = \Delta p_E$$

$$KE = \Delta p_E \times v$$

The initial momentum of the electron is taken to be zero since we assume the electron is at rest, its final momentum is $m_E v$. Thus

$$KE = m_E v \times v$$

From the conservation of momentum,

$$mC = MC + m_E v$$

Or $m_E v = (mC – MC)$

On substituting above expression for $m_E v$ in the equation KE = $m_E v \times v$, we get

$$KE = (mC – MC) \times v$$

As we know that:

Total energy = rest energy + kinetic energy

$$m_E C^2 = m_o C^2 + KE$$

$$KE = m_E C^2 – m_o C^2$$

On substituting above expression for KE in the equation KE = $(mC – MC) \times v$, we get

$$m_E C^2 – m_o C^2 = (mC – MC) \times v$$

From the conservation of energy,

$$mC^2 + m_o C^2 = MC^2 + m_E C^2$$

$$m_E C^2 – m_o C^2 = mC^2 – MC^2$$

On substituting above expression for $m_E C^2 – m_o C^2$ in the equation

$m_E C^2 – m_o C^2 = (mC – MC) \times v$, we get

$$mC^2 – MC^2 = (mC – MC) \times v$$

From this it follows that

$$v = C$$

As we know that:

$$m_o = m_E \sqrt{1 - v^2/C^2}$$

For $v = C$

$m_o = 0$, which means: only zero rest mass particles can travel at the speed of light in vacuum, which itself makes the central principle of Albert Einstein's special theory of relativity. If the electron with rest mass = 9.1×10^{-31} kg recoils with the velocity $v = C$, then the fundamental rules of physics would have to be rewritten.

The constant $h/m_o C$ is called the Compton wavelength of the electron that is equal to

$$\lambda_{Compton} = \Delta\lambda / (1 – \cos\theta).$$

θ is the scattering angle, m_o is the rest mass of the electron, C is the speed of light in vacuum, h is the Planck's constant and Δλ is the change in wavelength of the incident photon.

For $\theta = 0^o$,

$$\Delta\lambda = 0$$

$\lambda_{Compton} = \Delta\lambda / (1 – \cos\theta) = 0/0$, which is meaningless. The Compton wavelength of the electron cannot be zero. The value of $\lambda_{Compton}$ is 2.43×10^{-12} m.

The charge of an electron is *e* coulombs, and the potential difference between the negative and positive battery terminals is ΔV volts, so

Kinetic energy of the electron $KE = e \times \Delta V$

Now under the condition ($\Delta V = 0$, $KE = 0$) the equation for electron charge becomes:

$e = KE / \Delta V = 0/0$, which is not justified. The charge of an electron is $– 1.602 \times 10^{– 19}$ coulombs.

The three kinematic equations that describe an object's motion are:

$$d = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2ad$$

$$v = u + at$$

There are a variety of symbols used in the above equations. Each symbol has its own specific meaning. The symbol *d* stands for the displacement of the object. The symbol *t* stands for the time for which the object moved. The symbol *a* stands for the acceleration of the object. And the symbol *v* stands for the final velocity of the object, *u* stands for the initial velocity of the object. Assuming the initial velocity of the object is zero ($u = 0$):

$$d = \frac{1}{2}at^2$$

$$v^2 = 2ad$$

$$v = at$$

Since velocity *v* is equal to displacement *d* divided by time *t*:

$$a = 2d / t^2$$

$$a = d / 2t^2$$

$$a = d / t^2$$

3 different results for *a*. In truth, science can never establish "truth" or "fact" in the sense that scientific equations can be made that is formally beyond question.

The image we often see of photons as a tiny bit of light circling a black hole in well-defined circular orbit of radius $r = 3GM/C^2$ (where G = Newton's universal constant of gravitation, C = speed of light in vacuum and M = mass of the black hole) is actually quite interesting. The angular velocity of the photon orbiting the black hole is given by:

$$\omega = C/r$$

For circular motion the angular velocity is the same as the angular frequency. Thus

$$\omega = C/r = 2\pi C/\lambda$$

From this it follows that

$$\lambda = 2\pi r$$

The De Broglie wavelength λ associated with the photon of mass m orbiting the black hole is given by:

$$\lambda = h/mC. \text{ Therefore:}$$

$$r = \hbar/mC$$

where ħ is the reduced Planck constant. The photon must satisfy the condition $r = \hbar/mC$ much like an electron moving in a circular orbit. Since this condition forces the photon to orbit the hole in a circular orbit.

$$r = 3GM/C^2 = \hbar/mC \text{ or } 3GM/C^2 = \hbar/mC$$

$$\text{Or } 3mM = (\text{Planck mass})^2$$

Because of this condition the photons orbiting the small black hole carry more mass than those orbiting the big black hole. The average energy of the emitted Hawking radiation photon is given by:

$L = 2.821\, k_BT$ (where k_B = Boltzmann constant and T = black hole temperature).

$$L = 2.821\, k_BT = (\hbar C^3 / 8\pi GM)$$

On rearranging:

$$GM / C^2 = 2.821\, (\hbar C / 8\pi L)$$

Since $3GM/C^2 = \hbar/mC$. Therefore:

$$\hbar / 3mC = 2.821\, (\hbar C / 8\pi L)$$

From this it follows that

$$mC^2 = 2.968L$$

$$mC^2 > L$$

If a photon with energy mC^2 orbiting the black hole can't slip out of its influence, and so how can a Hawking radiation photon with energy $L < mC^2$ is emitted from the event horizon of the black hole? So it may be natural to question if such radiation exists in nature or to suggest that it is merely a theoretical solution to the hidden world of quantum gravity.

How can you determine the actual force, in newtons, on a charged electron moving at right angles to the magnetic field? That force is proportional to both the magnitude of the charge e and the magnitude of the magnetic field B. It's also proportional to the charge's velocity v. Putting all this together gives you the equation for the magnitude of the force on a moving electron:

$$F = Bev$$

Now under the condition ($B = 0$, $v = 0$, $F = 0$) the equation for the magnitude of the charge becomes:

$e = F/Bv = 0/0$, which is meaningless. There can be no bigger limitation than this. The value of e is -1.602×10^{-19} coulombs.

$$1/0 = \infty$$

On rearranging:

$$0 \times \infty = 1$$

Zero multiplied by anything is zero.

$0 \times \infty$ cannot be 1.

Power equals force times velocity:

$$\text{Power} = \text{force} \times \text{velocity}$$

$$P = F \times v$$

Assuming that the force F acts on a mass m at rest and produces acceleration a in it:

$$P = m \times a \times v$$

If $v = 0$, then

a which is $v / t = 0$

P which is $F \times v$ is 0

Now under the condition ($v = 0$) the equation for mass becomes:

$m = P/av = 0/0$, which is meaningless. Mass is always non zero.

The quantity of electric charge flowing through the filament of an incandescent bulb is given by:

$$Q = \text{current} \times \text{time}$$

$$Q = I \times t$$

If n is the number of electrons passing through the filament in the same time then

$$Q = ne$$

$$ne = I \times t$$

where e is the electron charge = -1.602×10^{-19}coulombs.

Since n / t = rate of flow of electrons (R). Therefore:

$$e = I / R$$

Now under the condition (R= 0, I = 0) the equation for electron charge becomes:

$e = I / R = 0/0$, which is not justified. The value of e is -1.602×10^{-19}coulombs.

Considering a reversible reaction such as:

$$A+B \rightleftharpoons C+D$$

The change in free energy is given by the equation

$$\Delta G = \Delta G^o + RT \ln Q$$

where R is the gas constant (8.314 J $K^{-1}mol^{-1}$), T is the temperature in Kelvin scale, ln represents a logarithm to the base e, ΔG^o is the Gibbs free energy change when all the reactants and products are in their standard state and Q is the reaction quotient or reaction function at any given time (Q = [C] [D] / [A] [B]).

We may resort to thermodynamics and write for ΔG^o:

$\Delta G^o = - RT \ln K_{eq}$ where K_{eq} is the equilibrium constant for the reaction. If K_{eq} is greater than 1, ln K_{eq} is positive, ΔG^o is negative; so the forward reaction is favored. If K_{eq} is less than 1, ln K_{eq} is negative, ΔG^o is positive; so the backward reaction is favored. It can be shown that

$$\Delta G = - RT \ln K_{eq} + RT \ln Q$$

The dependence of the reaction rate on the concentrations of reacting substances is given by the Law of Mass Action. This law states that the rate of a chemical reaction is directly proportional to the product of the molar concentrations of the reactants at any constant temperature at any given time.

Applying the law of mass action to the forward reaction:

$\nu_1 = k_1$ [A] [B] where k_1 is the rate constant of the forward reaction.

Applying the law of mass action to the backward reaction:

$\nu_2 = k_2$ [C] [D] where k_2 is the rate constant of the backward reaction.

Further, the ratio of ν_1 / ν_2yields:

$$\nu_1 / \nu_2 = (k_1/ k_2)\, Q$$

But equilibrium constant is the ratio of the rate constant of the forward reaction to the rate constant of the backward reaction. And consequently:

$$\nu_1 / \nu_2 = K_{eq} / Q$$

On taking natural logarithms of above equation we get:

$$\ln (\nu_1 / \nu_2) = \ln K_{eq} - \ln Q$$

On multiplying by –RT on both sides, we obtain:

$$-RT \ln (\nu_1 / \nu_2) = - RT \ln K_{eq} + RT \ln Q$$

Comparing Equations

$$\Delta G = - RT \ln K_{eq} + RT \ln Q$$

and $-RT \ln (\nu 1 / \nu 2) = - RT \ln Keq + RT \ln Q$, the Gibbs free energy change is seen to be

$$\Delta G = -RT \ln(\nu_1 / \nu_2)$$

Or $$\Delta G = RT \ln (\nu_2 / \nu_1)$$

At equilibrium

$$\nu_1 = \nu_2$$

$$\Delta G = 0$$

Now under the condition ($\nu_1 = \nu_2$, $\Delta G = 0$) the equation for RT becomes:

$$RT = \Delta G / \ln(\nu_2 / \nu_1) = 0 / 0$$

R= 0 or T = 0, which is meaningless. R and T cannot be zero. The value of R is 8.314 J $K^{-1}mol^{-1}$. T = 0 violates the third law of thermodynamics.

If an energy ΔE is added to a system, then the added energy ΔE produces a ΔM change in mass of the system. The added energy is calculated from $\Delta E = \Delta M C^2$. Suppose no energy is added to the system, then the change in mass of the system is 0.Now under the condition (ΔE = 0, ΔM = 0) the equation for C reduces to indeterminate form i.e. $C = \sqrt{\frac{\Delta E}{\Delta M}} = \sqrt{\frac{0}{0}}$, which is unphysical result. The value of C is 3×10^8 m/s.

For the reversible electrode reaction:

Cu^{2+} (aq) + $2e^- \rightleftharpoons Cu$ (s), where$Cu^{2+}$is the oxidized state and Cu is the reduced state. The change in Gibbs free energy (ΔG) is given by:

ΔG = − nFE, where n is the number of moles of electrons involved in the reaction, F is the Faraday constant (96,500 C/mol) and E is the electrode potential. The number of moles of electrons involved in the reaction is 2, therefore n=2.

$$\Delta G = -2FE$$

At equilibrium

$$\Delta G = 0$$

$$E = 0$$

Now under the condition (ΔG = 0, E = 0) the equation for F becomes:

$F = -1 \times (\Delta G / 2E) = -1 \times (0/0) = 0$, which is not justified. F cannot be zero. The value of F is 96,500 C/mol.

We're all familiar with the Doppler Effect, right? Waves of any sort -- sound waves, light waves, water waves -- emitted at some frequency by a moving object are perceived at a different frequency by a stationary observer. When source and observer are stationary, observer sees waves of frequency *f*. But if the source moves towards the observer, then the perceived frequency is higher than the emitted frequency. If we accept the postulates of Albert Einstein's Theory of Special Relativity, we can derive an equation for Doppler Effect for light for any velocity whatever as

$f_{observed} = f_{source}\frac{\sqrt{1-v^2/C^2}}{1-v/C}$where v is the relative velocity of source and observer.

If $v = C$, then

$$f_{observed} = f_{source}\frac{\sqrt{1-v^2/C^2}}{1-v/C} = 0/0$$

Again we got indeterminate form. If $v = C$, then $f_{observed} \rightarrow 0/0$.

If a quantity of heat q is added to a system of mass M, then the added heat will go to raise the temperature of the system by ΔT = q/mc where c is a constant called the specific heat capacity.

$$\Delta T = q/Mc$$

On rearranging:

$$M = \frac{1}{c}(q/\Delta T)$$

Suppose no heat is added to the system, then

$$q = 0, \Delta T = 0$$

Now under the condition (q = 0, ΔT = 0) the equation for M becomes:

$M = \frac{1}{c}(q/\Delta T) = \frac{1}{c}(0/0) = 0$, which is meaningless. Mass is non-zero.

According to Faraday's law, the amount of a substance deposited on an electrode in an electrolytic cell is directly proportional to the quantity of electricity that passes through the cell. Faraday's law can be summarized by:

$$n = Q / zF$$

where n is the number of moles of the substance deposited on an electrode in an electrolytic cell, Q is the quantity of electricity that passes through the cell, F = 96485 C mol^{-1} is the Faraday constant and z is the valency number of ions of the substance (electrons transferred per ion).Suppose no electricity passes through the cell, the number of moles of the substance deposited on an electrode in an electrolytic cell is 0.Now under the condition (Q = 0, n = 0) the equation for F becomes:

$F = \frac{1}{z}(Q / n) = \frac{1}{z}(0 / 0) = 0$, which is unjustified as all electrochemical data will change drastically. F cannot be zero. The value of F is 96,500 C/mol.

A free neutron of energy E = m_oC^2 has a life time of Δt_o seconds when measured at rest. If it moves with velocity v, then its life time is given by

$\Delta t = \Delta t_o / \sqrt{1 - v^2/C^2}$ and its energy by E = mC^2.

$$\Delta t = \Delta t_o / \sqrt{1 - v^2/C^2}$$

On rearranging:

$$\sqrt{1 - v^2/C^2} = \Delta t_o / \Delta t$$

Since

$$\Delta t_o \propto 1 / m_oC^2$$

$$\Delta t \propto 1 / mC^2$$

Therefore:

$$\sqrt{1 - v^2/C^2} = m / m_o$$

On rearranging:

$$m_o = m / \sqrt{1 - v^2/C^2}$$

If $v = C$, then

$m_o = m / 0 = \infty$, which is meaningless as the rest mass of the free neutron is 1.675×10^{-27} kg.

An electron of mass 'm' moving with velocity 'v' is associated with a group of waves whose wavelength 'λ' is

$$\lambda = h/mv$$

The formula of the relativistic mass

$$m = m_o / \sqrt{1 - v^2/C^2}$$

Substituting $m = m_o / \sqrt{1 - v^2/C^2}$ in $\lambda = h/mv$ we get:

$$\lambda = (h / m_oC) \times \frac{\sqrt{v^2 - C^2}}{v}$$

Since $(h / m_oC) = \lambda_{\text{Compton}} = 2.43 \times 10^{-12}$ m. Therefore:

$$\lambda = \lambda_{\text{Compton}} \times \frac{\sqrt{v^2 - C^2}}{v}$$

If $v = C$, then

$$\lambda = \lambda_{\text{Compton}} \times \frac{\sqrt{0}}{C} = 0$$

The product between the particle velocity (v) and the phase velocity (v_P) equals the square of the square of the speed of light in vacuum (C^2):

$$v \times v_P = C^2$$

The formula of the phase velocity

$v_P = \upsilon \times \lambda$ where υ is the frequency of the wave associated with the electron.
Substituting $v_P = \upsilon \times \lambda$ in $v \times v_P = C^2$ we get:

$$v \times (\upsilon \times \lambda) = C^2$$

If $v = C$, then

$$\lambda = C / \upsilon$$

2 different results for λ when v = C.

- $\lambda = \lambda_{\text{Compton}} \times \frac{\sqrt{0}}{C} = 0$
- $\lambda = C / \upsilon$

When a charged proton accelerates, it radiates away energy in the form of electromagnetic waves. For velocities that are small relative to the speed of light, the total power radiated is given by the Larmor formula:

$P = (e^2 / 6\pi\varepsilon_o C^3)\, a^2$ where e is the charge and a is the acceleration of the proton, ε_o is the absolute permittivity of free space, C is the speed of light in vacuum. If $a = 0$, then P = 0. Under this condition the charge of the proton turns out to be

$e = (6\pi\varepsilon_o C^3)^{1/2} \sqrt{\frac{P}{a}} = (6\pi\varepsilon_o C^3)^{1/2} \sqrt{\frac{0}{0}} = 0$, which is meaningless. Proton charge cannot be zero. The value of e is $+ 1.602 \times 10^{-19}$ coulombs. As we know that: The dissociation constant for the reaction

$$PL \rightleftharpoons P + L$$

can be written as:

$$K = \frac{[P]\,[L]}{[PL]}$$

(K = dissociation constant). In this equation $[P] = [P]_T - [PL]$ and $[L] = [L]_T - [PL]$ where $[P]_T$ and $[L]_T$ are the initial total concentrations of the protein and ligand, respectively. At very high ligand concentrations all the protein will be in the form of PL such that

$$[P] = 0$$

If [P] = 0, then

$$K = \frac{[P]\,[L]}{[PL]} = \frac{0 \times [L]}{[PL]} = 0$$

Since the binding constant K_B = 1/ K. Therefore:

$$K_B = \frac{1}{0} = \infty$$

$0 \times \infty = 1$, which is meaningless. Zero multiplied by anything is zero. $0 \times \infty$ cannot be 1.

The Unruh temperature, derived by William Unruh in 1976, is the effective temperature experienced by a uniformly accelerating observer in a vacuum field. It is given by $T_u = \frac{\hbar a}{2\pi C k_B}$, where a is the acceleration of the observer, k_B is the Boltzmann constant, ħ is the reduced Planck constant, and C is the speed of light. Suppose the acceleration of the observer is zero (a = 0), then

$$T_u = 0$$

Now under the condition ($a = 0$, $T_u = 0$):

$(\hbar/2\pi C k_B) = T_u / a = 0/0$, which is not justified as all physical interpretations becomes meaningless.

As we know that:

For a relativistic particle,

$$v \times v_P = C^2$$

where v is the particle velocity, v_P is the phase velocity and C is the speed of light in vacuum.

$$mv \times v_P = mC^2$$

where m is the relativistic mass of the particle.

The momentum of the particle is mv = p

Substituting mv = p in $mv \times v_P = mC^2$ we get:

$$mC^2 = p \times v_P$$

But, according to law of variation of mass with velocity

$$m = m_o / \sqrt{1 - v^2/C^2}$$

$$m_oC^2 / \sqrt{1 - v^2/C^2} = p \times v_P$$

If v = 0, then p = 0. Now under the condition

$$(v = 0,\ p = 0):$$

$$m_oC^2 / \sqrt{1 - 0^2/C^2} = 0 \times v_P$$

From this it follows that

$m_oC^2 = 0$, which is meaningless. There can be no bigger limitation than this. The rest energy of the particle cannot be zero.

The conductance c is related to the resistance R by:

$$c = \frac{1}{R}$$

If R = 0, then

$$c = \frac{1}{R} = \frac{1}{0} = \infty$$

It is reiterated that under the condition (R = 0) conductance becomes UNDEFINED.

If N number of photons of entropy $3.6Nk_B$ is added to a black hole of mass M, then the added photons increases the entropy of the black hole by an amount of

$$\Delta S = 3.6Nk_B$$

Suppose no photons is added to the black hole, then

$$N = 0,\ \Delta S = 0$$

Now under the condition (N = 0, ΔS = 0) the equation for k_B becomes:

$k_B = \Delta S / 3.6N \rightarrow 0/0$, which is not justified as the value of k_B is 1.4×10^{-23} J/K.

Suppose that the two masses are M and m, and they are separated by a distance r. The power given off by this system in the in the form of emitted gravitational waves is:

$$P = -\frac{dE}{dt} = 32\, G^4 (M \times m)^2 (M + m) / 5\, C^5 r^5$$

where dE is the smallest change in the energy of the system with respect to dt.

Gravitational waves rob the energy of the system. As the energy of the system reduces, the distance between the masses decreases, and they rotate more rapidly. The rate of decrease of distance r between the masses versus time is given by:

$$-\frac{dr}{dt} = 64G^3 (M \times m)(M + m) / 5C^5 r^3$$

Dividing $-\frac{dE}{dt}$ by $-\frac{dr}{dt}$, we get:

$$2 \times \frac{dE}{dr} = GMm / r^2$$

where dr is the smallest change in distance between the orbiting masses with respect to dt.

Since

$GMm / r^2 = F_G$ (the force of gravitation between the orbiting masses). Therefore:

$$F_G = 2 \times \frac{dE}{dr}$$

Suppose no gravitational waves is emitted by the system, then

$$dE = 0, dr = 0$$

$$F_G = 2 \times \frac{dE}{dr} = 2 \times \frac{0}{0} = 0/0$$

i.e., the force of gravitation between the orbiting masses becomes UNDEFINED.

The discovery of the expansion of the universe completely changed the discussion about its origin. If you take the present motion of the matter, and run it back in time, it seems that they should all have been on top of each other, at some moment, between ten and twenty thousand million years ago. The density would have been = mass / 0 = ∞ (indeterminate). It would have been what mathematicians call a singularity

Whose Energy E was = $E_B + MC^2$

where:

E_B = negative gravitational binding energy.

MC^2 = total positive energy of the matter.

If we assume that

$$E_B \text{ was } = MC^2 \text{ then}$$

$$E \text{ was } = 0$$

i.e., the total energy of the singularity was zero. So, in some sense, singularity was the free lunch. It took no net matter and energy to create a singularity.

Since

internal pressure was >>> gravitational binding pressure

the singularity was highly unstable and its life time

$$\Delta t \text{ was } = h / 4\pi E$$

Substituting E = 0 we get:

$$\Delta t = \infty$$

If E = 0, then Δt → undefined. So it may be natural to question whether the singularity came out of nothing or it took net matter and energy to create a point what physicists call a singularity.

The number of moles of reactant molecules can be obtained when the number of molecules N is divided by Avogadro number L:

$$n = N / L$$

Now under the condition (N = 0, n = 0) the equation for L becomes:

$$L = (N / n) = (0/0)$$

But $L \rightarrow 6.022 \times 10^{23}$

Conclusion:

The above arguments confirm the Richard Feynman's statement:

"Scientific knowledge is a body of statements of varying degrees of certainty -- some most unsure, some nearly sure, none absolutely certain."

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