

# QUESTIONS AND ANSWERS

I list here below my main contributions to Quora, English version, since mid-May 2018. I wrote so far (21 August 2018) 30 answers.

I have edited a few answers. Others, the longest ones, I have put (or I plan to put) on separate pages in the present site.

Main contributions:

## [Will Serbs help their brothers \(Turks\) against Greece?](#)

5 August 2018

Whether Serbia will find it convenient to help Turkey against Greece for political, economic or whatever reasons is their business.

What is certain is that it is hard to see any “brotherhood” of any kind between Serbians and Turks.

1. Ethnically: Serbians are Indo-Europeans, like the Greeks, and Turks are not (they belong to the “Turkic ethnic group” of central Asian origins, possibly related to Mongolians and Tungusic).
2. Linguistically: Serbians speak a Slavic, Indo-European language, with common (albeit far) roots with Greek; Turks speak an (Ural-)Altaic language, which is totally different.
3. Serbians have been Christians since the IX century (of the Greek-Orthodox brand since the XII-XIII century), while the Turks have been Muslim (mostly Sunni) starting from the XI century.
4. Historically: Turks and Serbs were never allied in any recent war of importance, notably WWI. In WWII Serbia (then part of Yugoslavia) was invaded by the Axis troops, while Turkey managed to stay neutral, joining the Allied only at the end of the war. But if you look at List of Serbian–Ottoman conflicts - Wikipedia ([List of Serbian–Ottoman conflicts - Wikipedia](#)) (from 1352 to 1913) you may be amazed to see the list of wars and battles fought between such “ brothers.”

## What are the different types of aquatic animals?

3 August 2018

The question was asked, although apparently only very few people are interested in it. I posted my answer in scienze/scienze-generalì of this site, in English.

## Why does $\cos(\theta)=\cos(-\theta)$ ?

25 July 2018

The question is really not too difficult. Faithful to my method of looking for the most straightforward answer, I compared the series expansion for  $\cos(\theta)$  and  $\cos(-\theta)$ , which are equal since all terms contain only the even powers of  $\theta$  or  $-\theta$  respectively.

## How do I simplify the expression $(1+i)^2(1-i)^3$ ?

21 July 2018

Again, by writing it as  $[(1+i)(1-i)(1+i)(1-i)](1-i)$  the terms  $(1+i)(1-i)$  in the square brackets can be paired, and  $4(1-i)$  is the immediate result.

## What remains to be discovered in the field of mathematics?

19 July 2018

I gave the following (shocking, I hope) answer:

I reckon that to understand even the statement of all the seven Millennium Problems, the infant who is now learning to count on his fingertips must study at least fifteen to seventeen years. And here we feel a cold chill on the back if we notice that to formulate these problems a few centuries of mathematical research have been enough on the part of the finest intellects of humanity. If mathematics (even in a single branch) proceeds, if it can proceed indefinitely, as - according to certain interpretations - promise Gödel's theorems, it is immediate to assume that within the next millennium we will not only have solved the problems pompously baptized "millennium problems", but we will face other theorems far more complex, to understand the statement of which a human life will not suffice. Alas! And who will enunciate them? Evidently not human beings, but computers. And who will prove them? Like the four-color theorem (1976), they will be proven, if they

ever will be, not by human beings but by computers. And who will program such computers? There is no hope, other computers will do it. Mathematics, inevitably, will become a game reserved for computers, and we will have research centers, from which every now and then a computer will yell in its language "EUREKA !!", having demonstrated in a way for us unknowable, a theorem for us incomprehensible. Soon, that is, we will reach the boundary beyond which lies the true infinity, the infinity of the Problems Not Resolved, or rather, of the Problems Non-Enunciabile in a way that we understand. But then, on a bad day, the Sun will become a red giant and our computer will fade away, with the heart-rending feeling (but do computers have a heart? Do they have feelings?) that apart from a paltry few trillions of results already obtained, which are not even the beginning of infinity, EVERYTHING is still to be discovered.

### How does one derive a quantum Hamiltonian?

A question on which I keep working.

Sooner or later you will find the answer in this site, [scienze/scienze-general](#). Possibly the most challenging answer I have tried to give thus far (5 August 2018)

**Is the United States an empire? Consider the following characteristic of all empires: an empire seeks to expand its range of power and deepen its influence over territories outside of its immediate sovereignty.**

18 July 2018

I gave the following, rather a circuitous answer, which gives a substantially different definition of what an empire is:

"History is the teacher of life", those horrible Romans, who - by the way - invented the word Empire, said.

Of course, it is difficult to say something which has not yet been noted among the many answers, be it important or unimportant, relevant or irrelevant, correct or incorrect. Nevertheless, I think I should quote a few lines of an ancient poem, which are not out of place, as a sort of a summary.

The poem was written in the fifth century CE by a good, but an obscure poet, Rutilius Namatianus, a Frenchman. He was leaving Rome to go back to his Country, and while departing, he gave his farewell for good to the Eternal City. He knew that he was living at the end of the Empire. The Visigoths had just sacked Rome for the first time in eight hundred years; besides, the myth was that Romulus got the right

to found Rome because he had seen twelve vultures, while his twin brother Remus had only seen six. There was a saying, already quoted by Cicero, that each vulture was worth one century of life for the city. And Rutilius tells us that he was writing in the year 1169 of the City. The last vulture was already folding his wings to complete his flight.

Rutilius was going to Toulouse to take care of his properties, which had already been vandalized by barbarian incursions. However, when he writes “Et liceat lacrimis addere verba” (“May I be allowed to add words to tears”), he is shedding tears not on his land alone, but also on the end of Rome, which cannot protect Gallia anymore. Yet, end of the Roman Empire or not, Rutilius thought that the concept of what an empire should be would remain. He was right. The Second Rome was Constantinople, and the Tsars claimed that Moscow was the third Rome. From Charlemagne (800 CE) to Napoleon, to Great Britain (1800) itself, everybody was inspired mainly by the same idea. Ever since, when Western Powers talk about “Empire,” they refer to the Roman Empire. In fact, at the outset of his praise, Rutilius allows us to understand that the Roman Empire was quite different from the Chinese Empire (by no means an inferior creation), which consisted mostly of the island of the civilized “black-headed people” surrounded by barbarians. Besides, the Chinese Empire did not have a Rome (or had too many, which amounts to the same). The Roman Empire, instead, consisted of a large number of very different ethnicities, *gentes*.

So, this is the quotation:-

*Fecisti patriam diversis gentibus unam,  
Profuit iniustis the dominante capi.*

“Thou hast made of alien populations one fatherland,  
Under your rule, those who had no laws found their benefit.”

*dumque offers victis proprii consortia iuris,  
Urbem fecisti quod prius orbis erat.*

“And while you offer to the vanquished to be associated in your law  
Of what was the world, you made one city.”

*....Mitigat armatas victrix clementia vires*

“Mercy in victory tempers strength in arms”

*....Hinc tibi certandi bona parcendique voluptas:  
Quos timuit superat, quos superavit amat.*

“Hence thy keen joy to strive and yet to spare  
Which wins whom it feared and loves whom it has won”

....*Quod regnas minus est quam quod regnare mereris*

“...It is a smaller thing that thou dost reign, than that thou dost deserve to.”

The poem (*De Reditu Suo*, "My return home") was written at the end of the Empire. There was no gain to be expected in writing it. If the verses were lies, why to write so many of them?

Let's instead make an exam of conscience: which one among older or modern day "empires," has earned or is sure to earn a praise such as that, which Rutilius Namatianus bestowed on Rome after 500 years of Empire, 1200 of life?

Even if the application of the idea of Empire by the Romans was far from correct (which remains to be demonstrated), I think that it is from that idea that we should start, if we want to learn anything from history.

An American friend once asked me: "Next summer I am going to Europe. Which city/cities do you advise me to visit?". I answered: "The very fact that you are asking, means that you should visit any city but Rome." Being American, he took the challenge, went to Rome first, and did not regret it.

(For further comment, I invite you to read my short tale: A Noble Friendship )

[What is the ultimate fate of universe, maybe a trillion years later or so?](#)

18 July 2018

In my answer, I do not think I can give ONE more accredited theory about the "LAST DESTINY" of the universe. I can provide an anthology of the theories that are most supported in the Astrophysics community. Wikipedia and the like are the primary sources of this anthology, which however is not mandatory to read.

THE PLEASURES OF THINKING OF ETERNITY

I am convinced that if an inquiry were made by asking the lucky participants when the world is over, most of them would say that the world will never end. In fact, that the Universe began about 14 billion years ago is commonly accepted, while a real official

statement about the duration of the universe is unknown to me, but it is now almost sure that (on the basis of physics) the Universe is eternal.

This absence of the end of the world, of our world, is therefore contrary to the concept that has been inculcated on a religious basis. The end of the world is in fact predicted by almost all religions, including Buddhism, which always seems on a different track and its absence seems to take away a great weight from the conscience of many: no end, no universal judgment with all that follows. Actually, Hinduism has a cyclical vision, and therefore is articulated in days of Brahma (*kalpa*). At the end of a *kalpa* probably the accounts are closed and the universal *karma* is set equal to zero. Or not.

Nonetheless, according to a more or less popular variant, the life of Brahma, the *maha-kalpa*, 100 years of Brahma, lasts about three hundred thousand billion ( $3 \cdot 10^{14}$ ) years. According to Hinduism (or at least some of his sects), we are more or less halfway of a *maha-kalpa* (the anthropocentric hypothesis is timeless, we do not know when it was born, and it is hard to die). One day in Brahma is 4.32 billion years. But the days are interspersed with nights in which there are partial destructions of the world (or the Universe?). And then, what happens when Brahma dies? Perhaps one or more others will be born. Man prefers eternity, but he is afraid of it and breaks it into cycles.

Of course, even if the Universe were eternal, the same could not be said of the Earth. Every trace of life could disappear within a few billion years, long before the Sun becomes a red giant, which is what will happen in perhaps seven and a half billion years. The red giant will probably swallow the Earth. Several astrophysicists speculate that at that point a belt will remain around the Sun in which life will be possible, only that it will be moved to about 50 astronomical units from the Sun (the Earth is by definition at 1 Astronomical Unit), to make room for the magnified Sun. We will, therefore, have to move, if we are still there. But maybe it will not be worth it, because in about eight billion years the Sun should become a white dwarf (perhaps gradually and perhaps not, in which case it will mean trouble), a star that could have a luminosity between one hundredth and one hundred-thousandth of the solar luminosity, and even in the most favorable case it could not heat a planet at a distance of 50 AU.

Twenty-two billion years from now, the universe could evolve through the inverse of the big bang ("big crunch") and collapse in one point. Then it could start over. But we know very little about this and very few scientists I know would bet on it.

On the other hand, if the anti-big-bang or big-crunch will not take place, and there are no other theories to allow us to close the shop, we must conclude that the universe is eternal. But between 100-120 trillion years, about  $10^{14}$  years, all stars should be turned off, having run out of fuel, all the fusion reactors that animate the universe will be turned off, and the universe will be dead, even if it will continue to exist and expand with the cheerful existence of a cemetery, increasingly rarefied: the early tombs symbolically will be white dwarfs, brown dwarfs, neutron stars and black holes.

According to Wikipedia, in  $10^{30}$  years in the Universe, there will be only those objects that are dead and isolated and more and more distant from each another in an increasingly darker expanding universe. Others give us less time: the "star" era of the Universe, which began after 150 million years at the initial instant, should end within 100 billion years ( $10^{14}$  years). What is eternal, then, is not really the universe, but its cemetery, where presumably the corpses of the various civilizations, who have been struggling and scrambling and are looking at the myriad of habitable worlds that they are discovering, will have already long since disappeared, in spite of having foreseen a magnificent progress that lasted the first moment of eternity.

Indeed, if speculations are avoided (on which there is less than a vague agreement among the scientists who deal with the present subject), an eternal universe should be "for most of the eternity" a universe dead in every sense, certainly dead "early enough" for men. The "thermal death" that is the state of maximum entropy of the universe, or if we want, the state in which the Universe will have reached everywhere a uniform temperature could take place in  $10^{10^{120}}$  years. According to the second law of thermodynamics, processes with energy exchange or information exchange will become impossible, and at that time, the last, minimal, remaining lights will also go out. Nonetheless, even then, eternity will be only at the beginning. It is refreshing to think of a universe so young and already so dead!

However, there are those who expect a lot of other things to happen (even if there will be no place for Man as we understand it): to read a final scenario, an excellent article is the "Chronology of the distant future," in [Timeline of the far future - Wikipedia](#). Many speculations seem to propose that the big crunch will happen sooner or later, eventually followed by one or more new big bangs, with the birth of one or more new universes, but it is difficult for me to think how this is possible, if the Universe, as believed, continues its expansion, which moreover, seems to be accelerating.

But, as we saw, even  $10^{10^{120}}$  years are only the beginning of eternity. Nor do all the other successive stages indicated in the quoted article affect eternity. Let's enjoy these 120 billion years, the years of youth in the Universe!

## LEAVING THE EARTH

Let's now forget about these speculations and go back to the first billion years. At this point, the Sun could begin to misbehave (increase in brightness, evaporation of the Earth's oceans, extinction of eukaryotes, extinction of pluricellular life, etc.). This date is more or less what I would bet for the extinction – on this Earth - of human life as we know it. However, opinions vary widely: some pessimists predict that in 10,000 years Mankind will have a 95% probability of disappearing, not necessarily because of natural catastrophes, but because of some form of self-destruction. Other scholars give us 100,000,000 years to

reach the same percentage. Most think that indeed the human species will not go beyond 8 billion years, after the red-giant/white-dwarf solar phase. But this is not excluded, and there are those who predict that the lifetime of Mankind is "infinite" (see above for the fun of such existence, but probably it is just a matter of getting accustomed). In the case we survive, we should, therefore, be able to move, not so much to the extremes of the solar system, as attractive as an anti-aircraft shelter, but permanent, of the Second World War, as in the vicinity of another star. Or, otherwise, we should be able to build a huge spaceship, a new "Noah's Ark", which will be the new Earth of humanity and will take energy from various "slingshot effects" with other planets and stars, assuming it is useful or necessary to move around (if the prospects of Section 1 will be verified).

An intriguing hypothesis is that Mankind sets to work, given a suitable time (and a billion years would be largely sufficient), to colonize the whole Galaxy. The game would also work with spaceships going at 1% of the speed of light, which are almost within our reach and do not require the calculations that I do on my site for the antimatter rocket (<http://dainoequinoziale.it/sassolini/2017/10/07/viaggiois2.html>). A series of colonizing missions that would settle on habitable planets close to us, after a journey of a few thousand years, could take off from the Earth. The game could be repeated for example every century. A small crew lands on a new suitable planet, and it is sufficient because the colony is supposed to double every 25 years. In 750 years it will have doubled 30 times, reaching a population of over one billion elements (starting from two initials). Of course, this billion people will already be in a state of advanced civilization and will begin to colonize nearby stars, always with a journey of a few millennia. But if the Earth and its successive colonies colonize in turn a number of consecutive colonies (at least 2 each), some have calculated (the calculation is not difficult, once there is an agreement on the value of the various parameters) that in a hundred million years the whole galaxy, ten billion stars, albeit not all habitable, could be colonized. In reality, as regards times, the difficulty is not the number of stars that we want to colonize, and of necessary generations, but the speed with which it can be done; if our spaceships go at a speed of one hundredth of the speed of light, the galaxy is crossed in 10 million years. This is about the minimum time necessary to begin colonizing the entire Galaxy at speed 0.01 c (c is traditionally the value of the speed of light), with rockets almost available.

Of course, we also have the option of proceeding at one thousandth or less of the speed of light, with rockets almost within our reach, but at the cost of extending the years of travel. Instead, if, taken by the frenzy, we use the antimatter rockets that I mention in my site, then at the speed of light we can cross the Galaxy in 100,000 years, and travel time will no longer be the determining factor in calculating the timing of this colonization. It will be enough to have an outrageous amount of antimatter. It should be noted that, by choosing a low travel speed already within our reach, if technological progress does not stop, all the spaceships that could be launched in a few years will be reached or desperately overtaken by successive generations of spaceships: they would be useful to leave the Earth, not to go somewhere.

Chemical propulsion (with efficiency less than  $1.2 \cdot 10^{-8}$  so much is the mass fraction that is transformed into energy) gives us speeds of the order of hundreds of km / s, nuclear fission propulsion provides a speed with (with efficiency about  $5 \cdot 10^{-4}$  maybe around 10000 km / s, and nuclear fusion (with efficiency around  $2.3 \cdot 10^{-3}$  - double maybe - even 200000 km / s. Of course, the king of the propulsion methods would be the even more hypothetical antimatter engine, with 100% conversion efficiency of the mass into energy, and the possibility of going at speeds very close to those of light, perhaps in comfortable motion accelerated with acceleration  $g$ , which would give us the illusion of still being on Earth. The antimatter engine would also be the instrument of choice to explore the Universe, because the effect of time dilatation would allow, in the course of human life, even to go on other galaxies. However, measured from Earth, the speed of the rocket would still be at most that of light, so a star 500 light-years away would still require a back and forth journey of at least 1000 years. As for a visit to the galactic center, we could do it in 10.7 of our years to get there and 10.7 to come back, but, seen from the Earth, the travel back and forth would have lasted 100,000. Frankly, I would be afraid to be the pilot on such terms, and maybe I'd rather stay on some star on the other side of the Galaxy.

And of course, many science fiction movies that do not take into account these scientific truths can only create erroneous ideas in the minds of those who take them more seriously than they deserve. It must be apparent to the viewer that the whole series of "Star Wars" is a mountain of scientific nonsense, the Far West carried in the Universe - at a speed higher than that of light. A few decades ago a congress of science-fiction writers was held, which (I believe) unanimously admitted that the interstellar journey made sense only if a way was found to go faster than the speed of light. And since this was admitted to be impossible (who would dare to go against Einstein?), the writers who wrote this type of novels were condemned to tell scientific lies.

Now, to all intents and purposes, as we shall see, one can in a certain sense go at a speed higher than that of light, but the disruption of temporal systems relative to a few years of travel would render the action impossible to follow. In fact, in addition to going faster than the speed of light, we need to go from the Earth to the Center of the Galaxy in ten years but so that even for those who stayed on Earth only ten years have passed when we call them from the center of the Galaxy. This is, of course, impossible. Will we call them? Better that this is not an urgent communication, because the call will still take 50000 years to arrive. And it does not take much to understand how, if a spaceship went faster than the speed of light, it would be impossible to communicate with it from the Earth.

But at least, eternity would still be far away, and it means that we will have time to think about it.

NOTES.

I. The spacecraft Enterprise, star of Star-Trek, would work with antimatter engine, which does not just push the ship but modifies the curvature of the space-time surrounding it,

allowing speeds up to 140 times those of light. Recently (1994), a model of mechanism that causes a deformation of space-time was proposed by the Mexican (theoretical!) physicist Miguel Alcubierre. He claimed to have been inspired by the "Star Trek" series, but the mechanism is not content with devouring antimatter: it requires exotic matter, negative energy and so on. Do not hold your breath waiting for it to be developed.

## II. Pleasures of the trip.

The relativistic rocket's motion presents some interesting peculiarities:

- i) Signals sent from the ground to the spacecraft at the speed of light after the time  $c / g$  where  $g$  is the acceleration of gravity, chosen so that we can live on our spaceship as if we were on Earth, cannot reach the spacecraft anymore (which takes away a bit of the fun of the trip: no more conversations with friends and relatives, not even deferred, no news: no soccer world championships). In other words, behind the spaceship, a "horizon" is formed (at distance  $-c^2 / g$ ), a sort of black disk that swallows up the universe little by little.
- ii) The head of an astronaut standing or even sitting, ages more quickly than the feet of the same. The clocks placed on the ceiling are ahead of those on the floor. This is quite evident if we think that the length of the astronaut (in the hypothesis that it is disposed longitudinally in the direction of motion) in an accelerated motion passes from a reference system to a faster one and therefore - in the Terrestrial reference system, it shortens second by second, which tells us that the acceleration of the head is different from that of the feet. But is it the head that slows down or are the feet accelerating? We will have to think about stretching in the opposite direction from time to time.
- iii) Cosmic rays and radiation, in particular, the "black body" universal background radiation at 3 degrees Kelvin focus on the bow of the spacecraft and photons and particles soon reach such energies as to melt any material known today. The shielding of such a spaceship could prove to be a real, almost insurmountable problem.

## What are some of the rarely mentioned facts about the Roman Empire?

17 July 2018

(I referred to the answer to "Is the United States an empire?", of July 18, 2018.)

## What is Greek tragedy?

13 July 2018

As I see that there are requests for this answer, I report here - just slightly edited - the answer I gave on 23 June last to the question "How is a Greek tragedy structured?" It is

not exactly the same question, and I am sorry if the present answer is considered redundant.

In my answer I will consider neither the primitive, more or less known types of Tragedy, nor the later forms, made to be read rather than performed, but only the classical, developed, dramas of the Golden Age of Greek Tragedy, V century BCE (1).

## ELEMENTS OF THE TRAGEDY

Classical tragedies were based on two elements:

(I) the characters/actors (an actor could play more than one role) to a maximum of three on the scene at the time (according to the tradition Euripides introduced the second actor, Sophocles the third);

(II) the Chorus, with the accompaniment of instruments, in particular, the *aulos* (a wind instrument). The names of the sections of the choral piece suggest that a (slow) dance accompanied the singing: in fact "*strophé*" means "turning"; "*antistrophé*" means "turning in the opposite direction"; "*epode*" is the "after the song".

Interestingly enough the actors performed in Attic dialect, while the chorus sang in Doric dialect (the language of Sparta, which was hardly understandable to the Athenians). Also, the verse meter was different: iambic for the actors, lyric for the Chorus.

The actors performed wearing masks and high buskins (*cothurni*).

Tragedies were in general presented in a connected trilogy (we have only one complete trilogy in our possession, the "*Oresteia*" by Aeschylus, who is supposed to have invented the trilogy form). In a trilogy, the dramatic action was interrupted (or concluded) by the so-called "*satyr drama*," a comic interlude out of context.

We don't have comprehensive statistics on Greek tragedies, because, besides fragments, we have only 32 whole Greek tragedies extant (seven by Aeschylus and seven by Sophocles, plus eighteen from Euripides. Considering that Sophocles was the great favorite of his time, we can conclude that posterity has developed a different taste). The repertoire of the Golden Age of Greek Tragedy, the V century BCE, consisted of more than one thousand pieces.

## THE PLAY.

The opening frequently was a prologue by some actor who explained the background of the play. In Euripides, the prologues tend to be rather long. One must understand that the

Greeks already knew to a certain depth the subject of the drama, and spoilers mattered comparatively little. However, in some tragedies (Oedipus Rex) the prologue is missing.

Then the Chorus enters (parodos = way in) and sings its first piece, in general, expressing hope that all will be fine.

Then the drama begins: it is an alternation of actions involving the actors (*episodes*) and parts sung by the choir (*stàsima*). The action may be elaborated (*peripeteia*) and generally develops in an optimistic mood. The central part is the "*catastrophé*," the "turning point." As it tends to lead to a tragic ending, "catastrophe" has come to mean a disastrous event. However, it is not always so.

Then the tragedy ends, generally in a tragic way, after which the Chorus sings its last song and goes out (exodus = exit).

#### PURPOSE OF THE TRAGEDY.

Aristotle examined in detail the tragedy in his "Poetics." I think that it was all too easy to misunderstand him: he was an empiricist, who did not really intend to establish inflexible rules (such as the famous unities of time, place and action, which reappeared in the French XVIIIth century tragedy) but merely examined which tragedies had best reached their effect, and with what means.

What was the expected effect? He said that Tragedy is an enactment of a deed that is important and complete [unity of action], grandiose to a certain extent, through sublime language: it is enacted, not recited, it incites pity and fear, and through compassion, it effects purification (*catharsis*) of such emotions.

Please note the words: Sublimity, pity and fear, catharsis.

The "sad" tragedies had this development. Catharsis was a more complicated concept. By watching a tragedy, the spectators had to feel compassion, thus cleansing their soul of the feeling of pity and terror the tragedy inspired, and perhaps more private sorrows. The tragic hero has no moral guilt, but has committed or has been the victim of some "mistake."

There are, however, tragedies with more or less happy endings, mostly brought out by a disguised god, or by a "deus ex machina", that is, a divinity, whom a "*mechane*" (=machine) brought high up, such as to the roof of a temple, and, while declaring the will of the gods, solved all problems.

But the "*deus ex machina*" is only an artifice to solve a complicated situation: pity and terror, compassion, catharsis are still in force in most cases.

Out of the thirty-two extant tragedies, there are ten with a happy ending:

(I) By **Aeschylus** (2): The *Suppliants* (a half-happy ending); The *Eumenides* (the Furies, goddesses of vengeance, become Eumenides, "well-meaning" goddesses; Athena determine the acquittal of Orestes).

Possibly there existed also a "Prometheus Unbound" set free by Heracles and acquitted by Jupiter.

(II) By **Sophocles** (2): *Oedipus at Colonus*, but while he is acquitted, strife begins between his children and will end in one of the most famous tragedies of antiquity, which are still beloved today, the *Antigone*. *Philoctetes*: here we have a "deus ex machina" (Heracles) who convinces Philoctetes to join the other Greeks in the war against Troy.

(III) By **Euripides** (6): *Alcestis*; Andromache: Thetis - deus ex machina - arranges the matters; *Iphigenia in Tauris* - Athena, deus ex machina - arranges the matters; *Ion* - Athena, deus ex machina - arranges the matters; *Helen*: the miraculous intervention of the demi-gods Castor and Polydeuces prevents a murder; *Orestes*: Apollo "deus ex machina" settles the inextricable plot.

In *Iphigenia in Aulis*, on the other hand, the happy ending appears to be a late addition.

## ANALOGIES WITH OTHER THEATRICAL FORMS IN DIFFERENT CULTURES

Apparently, human beings at some time needed dramas built on the scheme of the Greek Tragedy, as I gather from observing other types of theatrical forms, elaborated in different cultures, which, perhaps unwittingly, follow a similar scheme, either in form or action or both. I mention two:

1. **The Japanese Noh drama.** The Noh has actors wearing masks and special shoes; a chorus with instruments. There is unity of action, the language is sublime (and archaic, the *Kobun* or *Bungotai*, nowadays practically incomprehensible to the non-specialised Japanese). It also has comic interludes, the *kyogen* (like the satyr drama in the Greek trilogies).

Besides, the original form of both the Greek Tragedy (if we listen to Aristotle) and the Noh drama, was a sort of harvest celebration.

The purpose of Noh, however, is not to search for purification (catharsis), but the search for beauty through novelty (*hana*), elegance and subtlety (*yugen*).

2. **Opera.** It was designed in Italy during the XVII century precisely in the attempt to recreate the Greek tragedy. As Italians were wont to do at that time, they discovered

something else than what they were looking for. We have the name and date of the first modern opera, unfortunately mostly lost: it is [Jacopo Peri's \*Dafne\*](#), produced in [Florence](#) in 1598.

3. The last examples I want to quote, include some of the best modern **movies**. What I will now call "chorus" from now on will be interludes, musical or not, which break the action into segments. I may quote the Italian film "*Una Giornata Particolare*," (A Special Day, 1977) where the chorus are sections of the radio commentary of the visit of Hitler to Rome (May 3rd, 1938), on whose background the main action develops, respecting the unities of action, space and time.

The first American film, which comes to my mind, is "*American Graffiti*," (1973), which has an ending, which is neither sad nor happy, but has unity of place and time (a night in Modesto, CA) and a chorus, here represented by the songs introduced by the mythical Wolfman Jack. The action is not unique but unified by the common purpose of the students to celebrate the last night of the summer vacations.

A second remarkable American example is a forgotten masterpiece, "*The Cure*" (1995). The choir is "felt," and we hear only its echoes: it is the choir of indifference, fear, hostility, which surrounds the "kid with AIDS." The "*peripetiai*" are the adventures to search for "the cure" in the woods surrounding their homes and down the Mississippi River. The catastrophe is when the two kids give up their search. Pity and fear are there. We also discover the "deus ex machina," pure Friendship, untainted by any sexual overtones. That was the Cure: it was always there, and neither the characters in the play nor many viewers and reviewers noticed it.

As for the catharsis ... it would be perfect if "all the world were NOT a stage and men and women NOT merely players", and we did not know what followed the last scene, after the movie, that is the brilliant but short career, the life of petty criminality, the untimely death at 25 by an overdose of one of the two extraordinary kid-actors. Too sad: there is no catharsis for that, because it happened in reality. We can only feel compassion, if not pity and terror.

## CONCLUSION

I'm quite sure that, if you think of it, most of the great dramatic movies you have liked in one way or the other have the "Aristotelian structure" of Greek Tragedy. On the other hand, I advise no modern spectator to watch an original Greek Tragedy. If you are determined to try, take it as a cultural adventure, like the exploration of a new planet. But be ready for the scarcity of oxygen.

NOTE(1) As an aid to memory, the Greeks considered the naval battle of Salamis (480) as the crucial date for Tragedy: Aeschylus, aged 45, fought at the battle; Sophocles, then 16, was selected to lead the paeon, the song of victory sung by boys in the official celebrations, which followed the battle; Euripides was born in that year .

## What is lowest temperature achieved? Can we achieve lower temperature than zero kelvin?

12 July 2018

Typically, this is a question which demands a long answer. Or rather, the answer is short, while the explanation of the answer is long. The answer: *"It is actually possible to reach temperatures below zero Kelvin, and the lowest temperature that can be reached (and is reached) is  $T = -\infty$ ."* With this, I would have given my answer and could stop here.

However, the explanation will need a dedicated essay, which you will eventually find on a page on this site, [scienze/scienze-general](#).

## Why was ancient Rome and most of ancient Europe depraved?

5 July 2018

Here we have an interesting question, which seems to imply that the rest of the world at all times has never been depraved, and ancient Europe, chiefly Rome, has been the only black spot in this admirable whiteness. The obvious answer is that Rome and Europe were depraved because apparently, the person who asked the question knows only about the depravation of Rome and ancient Europe.

Does he/she know anything about depravity in the Chinese Empire, where boiling a person alive on a slow fire was one of the death penalties, as well as slow slicing? Or the deeds of emperors, starting with Xia Jie or Zhou Xin? Or cruelty in Japan (which exploded in WWII, for example in China and other occupied Countries, not to mention the tortures inflicted on Christians in the XVII century)? Has she/he ever heard of Ashoka's Hell or about human sacrifices in India, up to the ceremony of the Sati, which was legally suppressed only recently? Does he/she know the savage tortures used by populations without a written history, for example, those practiced on the war prisoners by the North American Indians? Does he/she know how the Mexicans tried to produce rain through suitable sacrifices to god Tlaloc? Does she/he understand what such sacrifices were? And how about the festivals in honor of the god Xipe Totec?

Some were religious rituals, others were not. Do I need to mention the tortures and depravity inflicted on an even larger scale on prisoners and/or civilians by all armies without exceptions, when they could afford it? And how about Dictators and their henchmen, not so long ago? Or how about people burned alive on TV by ISIS? The depravity of ancient people pales in comparison. And yet, let there be no mistake: there is still worse secretly going on today in "civilized" Countries, proud of their higher moral standards. How about the dark side of the net, of which I know only a part of what can be

found on Quora, the part which still allows me to sleep? Does the inquisitive reader, comfortably sitting in his comfortable house, realize that maybe not far from him a boy or a girl is boiled alive on a slow fire for the enjoyment of the on-watchers?

If you believe what I say (I believe it because I have a high opinion of Quora), the answer to your question is: "Rome and ancient Europe were depraved because - at worse - they were not different from all other people at all time. Only, they had accessible written records, and most of the others did not."

It follows that the questions to be asked are others: "Why Man, as soon as he has the possibility of doing so without being punished, has always been and is now cruel and depraved? Why do the strong and the powerful prove pleasure in torturing morally and physically the weak and defenseless? Why the ink history uses to write its useless records are the tears of the innocents?"

## Why not just teach Lagrangian mechanics instead of Newtonian mechanics to begin with, as quantum field theory is more Lagrangian?

Updated 15 July 2018

It is a fact that the mathematics required for Newtonian Mechanics is, in general, more straightforward than that, which Lagrangian Mechanics requires (partial differential equations).

Still, authoritative textbooks (and I am referring here to Landau's "Mechanics") follow the advice of the person who asked the question. They skip the Newtonian Mechanics at all and start directly from the "principle of least action," which gives, in a somewhat backhanded way, a "reason" for the "equations of motion" (Newton set down the Tables of the Law, with no explanations, only definitions, and laws).

The principle of least action states (of course without proving it, like all principles) that any motion must develop in such a way as to minimize "action." We thus have one principle instead of three laws. Of course, the principle posed a philosophical problem: why should motion happen in such a way that it minimizes the "Action," a little known mechanical quantity? The Seventeenth Century mathematicians, had interminable discussions on this subject, even calling the divine will into the game.

Feynman gave an interesting answer, (see Path Integral Formulation on Wikipedia) with roots in quantum mechanics: light waves follow a given preferred path, for example, in some case, a straight line, because the waves following paths, which are far from the preferred straight-line interfere negatively canceling each other. Particles also follow a preferred path, because all of them have an associated wavelength, which depends on the inverse of the momentum, and classically of the mass. You could find your particle

anywhere, but with extremely low probability, practically only within some of its wavelengths from the “action minimizing “ path. A body like a billiard ball has an imperceptibly small probability of being found far from the path predicted by classical mechanics. That is, to me, an entirely satisfactory explanation, and I urge the reader to go directly to the source, that is Feynman, Lectures on Physics, starting with vol II, 26.2, and going on (unfortunately Feynman does not come back to the point in an orderly way) until he can.

From the principle of least action, the Euler-Lagrange equations result. Lagrange also demonstrated that one could arrive at the same equations starting from Newton’s Equation, seen through the eyes of D’Alembert principle, who transformed a dynamic problem “ $F = ma$ ” into a static problem “ $F - ma = 0$ ”. Then, Lagrange applied his “principle of virtual works” and more or less intuitive, generalized, independent, “Lagrangian coordinates, “ one per each degree of freedom of the system. Such coordinates, so to speak, include the constraint forces. For example, a particle constrained to follow a circumference needs two coordinates  $(x, y)$ , but it is evident that the rotation angle is the only degree of freedom of the system, and, therefore, it is a good candidate for a single, independent Lagrangian coordinate which, in a sense, includes the constraint.

At this point, one can transform the Newton equations into the (second form of ) Lagrange Equations. As Landau does not use Newton’s mechanics, he has to introduce a curious sentence in his otherwise rigorous book: (§5) “It is found that the interaction between the particles [of a closed system] can be described by adding to the Lagrangian [of the free particles] a certain function of the coordinates, which depends on the nature of their interaction...which we shall call  $-U$ ”. Right, but why not  $+U$  or any other function of  $U$ ? He does not say it, but in the end, the reason is that otherwise, he would not get the correct results of Newton’s equations.

Morale: there is no free lunch in classical mechanics.

Frankly, I think that Lagrange initially wanted an automatic method to produce the equations of motion: give me the kinetic energy,  $T$ , and the potential energy,  $U$  (all in generalized coordinates), subtract them, which gives you the Lagrangian, turn the mathematical crank and - pronto - you get the equations of motion. Such equations would be in general the result of much more complex reasoning in Newtonian mechanics. Moreover, occasionally they introduce some simplification when “ignorable coordinates” appear.

However, it is true that advanced quantum mechanics forgets about  $T$  and  $U$ , while still relying on some sort of minimum principle. The Lagrangian is also written for extremely complex quantum systems using symmetry arguments of various kinds. In the Millennium Problems of the Clay Institute, one of the problems, in short, is “proving the Yang-Mills existence and solving the problem of the mass gap.” For this problem, a

Lagrangian is already given, but it has little to do with what we have seen above. You can look at “Yang-Mills Theory” if you wish, on Wikipedia.

## Greek Tragedy: In *The Oresteia* by Aeschylus, why did Athena try so hard to appease the Eumenides (Furies)?

Updated 26 June 2018

I think that the tragedy of the Eumenides deals with a much more profound problem than what appears at the surface. From verse 800 to the end, verse 1045, Orestes is no longer mentioned, and a grandiose ending will conclude the drama. A much higher conflict comes to its end. It is the conflict of the ancient law (terrestrial or Chthonian), represented by the Furies (the Chorus), and allowing for personal vengeance, against the new law, represented by Athena, based on trial and legality. The old law, in this case, has brought to an impasse, and it has become clear that avenging evil with evil, the evil doubles. A new, more civil law is dawning, and Athena fights for that. However, also in the legal trial (although Athena herself selected the jury), we are at an impasse: votes for and against Orestes are even. Athena breaks the deadlock (“Mine is the right to add the final vote, And I award it to Orestes' cause” - and from now on in Athens it will be so: tie vote will mean acquittal).

The humiliated Furies ask where they can find shelter, now that the old law is despised. No other place will be better than Athens, says Athena, because it will have the most glorious destiny of all Greek cities: the Furies should stay in Athens and protect it because nowhere else they will find such veneration. The Furies accept. They will turn into benevolent divinities (Eumenides) and will take care of the city.

From the Exodus of the tragedy: “All-seeing Zeus and Fate descend ‘Ring out your chant, ring out your joy's acclaim!’”. The play was performed in Athens, and you can imagine the enthusiasm of the audience at this ending.

There might have been more direct political allusions in the drama, but I think that what I wrote is enough.

## How is a Greek tragedy structured?

See my answer to the question “What is Greek tragedy? », given on 13 July 2018.

## How is the dirac delta function linked to the unit step function?

Answer given on June 8, 2018.

If you accept the Dirac delta function as a function (which you shouldn't, but everybody does, and seems to be happy with it) the delta function is the derivative of the unit step function. Indeed its value is zero at all points, excepting the step, at which point its value is infinity, and its integral from minus infinity to infinity is 1 (as its integral is the unit step function).

## Can you beat roulettes where you can bet on a color and green at the same time?

Answer updated on 25 June 2018

My answer would be very simple. If you bet on a green only, in the long term you lose. If you bet on color only, in the long term you lose. It is very optimistic to think that combining two losing strategies you may win.

As a footnote I add that all betting systems I know of are combinations of a single losing strategy, the "en plein". Which means that all combinations I know are losing combinations. Sorry.

If you are not convinced, suppose that you bet on green and there is a person who bets on color on the other side of the table, a person totally unknown to you (it is very likely that there are one or more people who do indeed bet on color on the other side of the table, whom you do not know).

But the wheel has no eyes: it does not know anything about bets, in particular whether the bets on green and color come from the same person, from two partners, or from two persons perfectly unknown to each other.

Do you think that this totally casual fact (the existence of somebody who unknowingly completes your strategy) increases the chances of victory of one or both of you, who are completely unknown to each other? Do you really think it reasonable to hope that at the end of the day you find out that you won in a fairly consistent way, and you do not even know whom to thank?

Think of it: it happens every evening at every table, that the most complicated combinations are unwittingly and separately played by people who do not know each other - and consistently lose. The proof? If they consistently won there would be no Casinos left.

## What is the English name for bakra?

Answered on June 1<sup>st</sup>, 2018

I have the impression that you are asking for the meaning of the Arabic word BUKRA. If I am wrong, apologies.

If I am right, then I will ask you a question: Do you know the meaning of the Spanish word "mañana"? Literally it means "tomorrow," but when somebody tells you that he will do something for you "mañana," it might also mean "at an unspecified time in the future," possibly "never."

Well, a friend of mine asked an Egyptian friend what "bukra" meant. The answer was: "It is more or less like the Spanish ""mañana," but it does not convey the same sense of urgency...."

Where could I get the script of the movie 《The cure》 ? I mean read the subtitles file in a text format or PDF, I really love this movie, is it adapted from a novel?

Updated 5 July 2018

Glad to answer your question:

I found at least two scripts, the best being:

<http://www.scifiscripts.com/msol...>

I don't think the script is adapted from a novel. Robert Kuhn, as far as I know, is the writer of both the subject and the screenplay.

The reason why I am glad to answer is that I think that "The Cure" is one of the best and most underrated movies of American filmography of the last thirty years. It suffered especially because of authoritative reviewers who were looking for messages important to them, or silly details, or flaws in the first work of new movie Director (and a new screenplay writer). Above all, they (and the public itself) were probably shocked, but did not dare to tell it, because the Director dared to deal with the ultimate American taboo subject, that of death.

They did not realize that they were watching a work of art of superior quality, and their reviews rightly have paled into insignificance. But the evil is done, and the evil that bad

reviewers do lives after them. The good...is always interred with their bones (generally much earlier).

The movie is not, repeat, not, the typical industrial run-of-the-mill tear-jerker. It is something much higher, a real classical tragedy in American form. After watching it, and discovering its gems (some of them are scenes which last only a few seconds) I concluded that spoilers don't matter, which is the touchstone of a true work of art: we can read and re-read War and Peace, watch and re-watch Leonardo's Last Supper, listen and re-listen to Mozart's Don Giovanni. The ancient Greeks knew the story of Oedipus Rex before Sophocles was even born, but they went eagerly to watch his tragedy in spite of all they knew and expected. Why? Because they wanted to see how sublime words could make the spectator follow the flow of fate dragging the guiltless characters to their destiny, inspiring feelings of pity and terror, until the final catharsis. So says Aristotle, and, miraculously, all is there in "The Cure." Not only, but the fact that the leads are kids gives a new twist to the classical tragedy, trying to awaken in each of us the kid who, hopefully, is still there.

I add the explicit of a comment "made in Italy," too late:

MELPOMENE ON THE MISSISSIPPI RIVER ([MELPOMENE ON THE MISSISSIPPI RIVER](#))

THE RIVER OF DESTINY. EXODUS (THE EXIT).

We find Erik in the last scene. He still wears his best clothes, but he is among the reeds beside the current of water that we already know, which "*ends up in the Mississippi,*" like "*every drop of water that lands in the water here.*" Here, sitting with his naked legs in the water, almost religiously, he lets the small patent leather shoe go, drifting on the river of destiny.

We have two last shots of Erik's face. In the second there appears fleetingly on his face just the beginning of a radiant and thoughtful smile. And so Erik goes too because he has to accompany Dexter: the basketball shoe, which Dexter will take with himself, implies that Erik is next to him, wherever they are. I think that that place is the heaven of all the immortal characters of the history of cinema, who were preparing a party to welcome Dexter and Erik among them.

Once Erik was gone, on the bank of the river, there remained the 13-year-old Brad Renfro, born to be a superlative and promising actor. He was probably surrounded by the entire team needed to shoot the film, including the Director, Assistant Directors, technicians, machines, lights and so on. There may have been a party for the completion of the movie, and Brad did not have the time to look at the mud-brown waves of the river of fate, which was no longer Erik's fate, who was gone, but the destiny of Brad Renfro, who had been left behind, on the river bank.

Maybe, looking upstream, he had a glimpse of his unpromising infancy, abandoned by his parents, living in a camper, where his grandmother raised him. All was over now, and his innate gift for acting had propelled him to fame. Happy him, if he did not look downstream and could not see his future, with the end of his brilliant but short career, and then petty criminality, alcohol, drugs ...! *Weltschmerz*.

Brad Renfro died of an overdose at age twenty-five, in 2008. May he rest in peace, if only for the good he did, without even knowing it.

## How do you win at roulette over the long run? Does live or automated roulette offer better opportunities?

22 May 2018

You don't play roulette to win, but to have fun, like going to the movies. Thus, you must pay for the fun you have. Winning is an extra, like finding a diamond in the theatre, which is of course possible.

Fundamentally there are only two ways to win at roulette over the long run:

1. to be part of the group which owns the roulette . The method is legal.
2. to sell systems which promise to win at roulette. The method is legal. (Barnum used to say that a sucker is born at every minute).

ALL OTHER METHODS I KNOW OF (besides that of being outrageously lucky, which we can hardly call a method) ARE ILLEGAL AND MAY BE DANGEROUS.

1. ("Einstein method") to take money out of the table while the croupier looks elsewhere (you may succeed if you go to the wheel with a gorgeous blonde sitting opposite. But be careful: there are micro-cameras everywhere, and one half of the customers are detectives in disguise. The method was considered by Einstein, who studied the matter, as the only possible way of winning. It was not. Those were other times, though).
2. ("Reverse Einstein") To add money on the case of the number which was just extracted, while the croupier does not look (you will win less, but the same caveats apply as before).
3. There is also an indirect method (also illegal) which might work in the long run, but you have a little less than a 50% chance to succeed. How? You borrow 150.000 dollars from a bank. You put aside 20.000 dollars and buy a ticket for Rio. You bet all of 130.000 on the Red. Case a) You win. Then you get back the bet + 130000 = 260000. You give back 150000 to the bank, and have 110000 for you, plus the 20000 you set aside, which you will invest appropriately, making money in the long run (but not by playing the wheel). Case b) You lose. You take the first plane for Rio

and disappear. It might be fun. In the meantime, of course, you should refresh your Portuguese.

I wrote more on the Roulette, but it is in Italian. Google Translate, however, does wonders nowadays. Just go to: [La Roulette](#)

download, translate, and have fun.

You will find also the answer to your second question. It sums up to: roulettes on line are less fun to play, you will win less and, perhaps without realising it, you will lose more.

## [What is the easiest spoken language to learn?](#)

19 May 2018

I suppose you mean an official language spoken in a sovereign State. In that case, I suggest looking into the vast supply of “creole languages”. Most do not have an official status (and I would not count them in here) but some do and are fun to learn. Two examples (for English speaking people): Bis(h)lama, the official language of Vanuatu; TokPisin, the official language of Papua New Guinea.

## [Why do writers write?](#)

19 May 2018

*To give rest to their soul.*  
(Livy, ab urbe condita, IX, 17)

## [Can you write a sentence without using 'a' or 'e'?](#)

Updated 15 July 2018

These exercises are called “lipograms” (LEIPO in greek means to leave out).

I suppose you ask for a text in English. I will not give one, because, in English ,there is the novel “Gadsby”, by Ernest Vincent Wright (1939). It contains 43 chapters, 50000 words, not a single “e”. You can find it at

[Wikisource, the free online library](#)

It was not a major editorial success, only 50 copies were sold.

Thus, yes, I could write sentences omitting the letter e in English, just by copying (or adapting) any sentence from "Gadsby". I certainly would not spend time in creating "ex novo" such sentences, especially because I could never beat such a champion. But you only asked if I can write (not create) a sentence.

For example, the original incipit of chapter 1 is:

"If youth, throughout all history, had had a champion to stand up for it; to show a doubting world that a child can think; and, possibly, do it practically; you wouldn't constantly run across folks today who claim that "a child don't know anything." A child's brain starts functioning at birth; and has, amongst its many infant [convolutions](#), thousands of dormant atoms, into which God has put a mystic possibility for noticing an adult's act, and figuring out its [purport](#)."

Etcetera.

One could similarly write:

"If brontosaurus, throughout history, had had a champion to stand up for saurians; to show a doubting world that a brontosaurus can think; and, possibly, groan out and apply its thoughts practically, you wouldn't constantly run across folks today who claim that "brontosauri don't know anything...."

If I am not wrong, there are similar achievements in which other letters are omitted. In French, the champion is, I believe, Georges Perec, who wrote a 300 pages book omitting ALL vowels excepting "e" (la Disparition, 1969).

Have fun.