Introduction

Metaphysics of Physics is the much needed and crucial voice of reason in the philosophy of science, rarely found anywhere else in the world today. We are equipped with the fundamental principles of a rational philosophy that gives us the edge, may make us misfits in the mainstream sciences but also attracts rational minds to our community.

With this show, we are fighting for a more rational world, mostly by looking through the lens of the philosophy of science. We raise awareness of issues within the philosophy of science and present alternative and rational approaches.

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Hi everyone! This is episode fifteen of the Metaphysics of Physics podcast and I am Ashna, your host and guide through the hallowed halls of the philosophy of science. Thanks for tuning in!

Today we are going to answer some Quora questions on the topic of mathematics.

As some of you will already know, this episode comes out while Dwayne and I are on our honeymoon in sunny Australia, so of course, this episode was recorded and scheduled for release well in advance. We will be sure to share some photos when we return from our adventures!

As you listen to this, we are now husband and wife philosophers. Pretty neat huh?

Anyway, back to the show! As there has been a lot of wedding related stuff going on, this will be a shorter episode as we did not have time for a lot of questions. I hope you enjoy the questions we answered in the time available.

But, without further ado, let us start with our Quora questions.

Is it possible that an alien civilization has completely different mathematics than ours? Is mathematics absolute?

First of all, what *is* mathematics?

Let us define it as the science of method whereby we establish quantitative relationships between things for the purpose of measurement.

This makes sense, right? A great deal of mathematics is dedicated to the measurement of physical attributes such as size, volume, etc.

But mathematics does not only measure physical attributes. It can also be used to quantify abstract concepts, such as probabilities. These do not directly refer to the physical attributes of entities, but nonetheless refer to some measurable aspect of reality.

If performed properly and if it is measuring the same quantities, mathematics should be objective and get equivalent results. The units of measurement may well be different, but once you account for these differences, the results should be the same.

Why? Because the facts of reality being measured are the same no matter what the units are or which alien civilization is performing the measurements. Assuming the same things are being measured.

Does that mean that the mathematical methods must be the same? Not necessarily.

As mathematics is a science of method, there may be multiple valid methods which can be used to establish quantitative relationships and arrive at valid measurements.

For instance, if you want to measure the volume of an irregular solid, you can potentially use a number of different methods in calculus to find the volume. Or, you can use something other than calculus, although the results may not be quite as accurate.

Any mathematical method is valid, as long as it gets sufficiently reliable results. And what qualifies as "sufficiently reliable" really depends on the context and how accurate the results need to be.

So, it is entirely possible that alien civilizations have some mathematical methods we do not know of, which work fine in the proper context.

So, is mathematics absolute? Well, yes. If performed properly, different methods should arrive at equivalent results based on the same facts of

reality. Even if the mathematical methods may differ in their details.

I think mathematicians have got it wrong with infinity. Infinity is infinity. One infinity cannot be larger than another infinity. What do you think?

Actually, you do kind of have a point, despite what others here and most mathematicians have thought for a long time.

Infinity is not a number. It does not have a size. It is a concept that indicates *potentiality*. The potentiality of what? To progress in a sequence.

Let us take the counting numbers. Let us say that you start listing them. Well, you obviously have to stop sometime, you cannot keep doing it forever. But, no matter how many of them you list, you never "run out" of counting numbers. There are always more of them you could have listed had you kept going.

Or, take the digits of "pi". You can keep listing those digits for a long time, but you have to stop at *some* point. But, no matter at which point you *do* stop, there are always further digits you might have listed.

This is what infinity indicates: The fact that there are certain mathematical sequences which you can progress along until a certain point. But, at no matter which point you *do* stop, there is always the *potential* to have progressed further.

It indicates that the progression along any sequence must be finite, but that no matter where you stop progressing, you do not run of terms and that if you had kept going, you could always have identified further terms.

Infinity simply indicates the potential to progress in a sequence of mathematical steps, no matter where one does actually stop. There is always the *potential* to have continued.

Alright, so if infinity indicates merely a potential, then where does size enter into it?

It doesn't. It makes no sense to discuss the "size" of a potential such as this. Either the potential exists or it does not. There are no "potentials" that are larger than other "potentials".

What then to make of the claims that some "infinite" sets are larger than others? Well, not that some infinities are larger than others.

This might surprise you: infinite sets do not have sizes! They are simply infinite. To say that they have a size implies that you can count and quantify all of their elements. But, you can't, that is what it means to be an infinite set!

So, if infinite sets have no size, then there is no basis for comparing their sizes!

What would a non-mathematical universe look like?

It would look much the same as it does now, ignoring parts of Earth (and possibly other worlds with intelligent life) that have been changed by people.

Mathematics is a science of method invented by people to help them measure things. Without it, we would lack the ability to do much science and we would know almost nothing about the world or our universe. Without it, we would know nothing about engineering and we would be unable to build most of the technology we have.

But, other than the fact that the universe would lack all of those things that people have built, it would be much the same.

It is not as though mathematics is part of the universe or as though it needs mathematics to work the way it does. Despite what many physicists believe, mathematics is not fundamental to the universe. It is just something people use to measure things in the universe.

I know that people cannot understand the "unreasonable success" of mathematics. It is not unreasonable at all, it is entirely predictable and obvious, if you understand what mathematics is: a method of quantifying relationships and performing measurements!

If you know that, then why should it be surprising that mathematics is able to … quantify and measure the universe?

[Was mathematics invented or discovered?](#)

It is a science of *method.* Methods of quantifying relationships, quite often for the purpose of performing measurements of physical things.

It is NOT the same thing as the quantities being measured. The relationships and properties being measured *are* discovered.

Mathematics, is a science of method and those methods must be invented, created. They are no more "discovered" than any other such methods are "discovered".

One does not "discover" the process of programming computers, one invents those processes. One does not "discover" the process of measuring circles. One invents processes for doing so. Unless of course, they already exist and one discovers what someone else did.

Even numbers are not "discovered". They are invented as an important conceptual method which forms a basis for mathematics.

Mathematics is a series of methods which must be invented. One should not confuse the things being measured, which are discovered, and the methods used to make those discoveries. The methods are invented by someone and then discovered by everyone else.

The point is that the originators of mathematical methods invent them, they do not "discover them".

But, in a way, this is not the primary issue. The more important issue is that you appreciate that mathematics is not "out there in the world" independent of the human mind.

The important thing to remember is that mathematics is a bunch of conceptual methods created for the purpose of measurement and do not exist "out there in nature", independent of the human mind. The things being measured exist independent of the human mind, but the conceptual methods do not. From which one can later infer that these conceptual methods are invented.

Outro

That brings us to the end of this episode. I hope you enjoyed our Quora questions on mathematics. If you would like clarifications on these

answers or want to ask us your own mathematics questions, send them in.

Next episode we will briefly cover the nature of space and time. This will not go into great depth, but will cover the basics of what these are. Not physical aspects of the universe but conceptual relationships. More on this in the next episode!

Thanks for listening!

In April we will be launching our subscription content. This will be content which can be accessed for the very small monthly fee of $2.

Remember to check out the website and subscribe if you like our podcast, sign up to our mailing list or follow us on Facebook or Twitter to get the updates!

You can also look at our Metaphysics of Physics merchandise if you wish. All profits from these go back into the show. Click here to take a look.

As always, you are welcome to send in questions about any of the things talked about in this episode or about irrational stuff in physics or the philosophy of science in general. Send them to questions@metaphysicsofphysics.com.

Please tune in for the next episode and start thinking of some questions! Until then, stay rational!